COURSE CURRICULUM

B.Sc. Microbiology

Batch: 2025-2026
Academic Year: 2025-2026
Updated on: May, 2025

GSFC University
School of Science, Vigyan Bhavan, P. O. Fertilizernagar, Vadodara - 391750, Gujarat, India

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
PO1	Basic Knowledge: To impart knowledge regarding basic concepts of applied chemical sciences.	Remembering and Understanding	Explain, Describe, Discuss, Recall, Locate
PO2	Interdisciplinary approach: To explain the relationships between chemical sciences, biological sciences, physical sciences and mathematical sciences.	Application and Analysing	Apply, Practice, Interpret, Select, Correlate
PO3	Practical learning: To perform procedures as per laboratory standards in the areas of Chemical Sciences and to think analytically.	Analysing	Compare, Classify, Select, Investigate
PO4	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
PO5	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
PO6	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
PSO1	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
PSO2	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
PSO3	Students will be able to design and develop sustainable solutions to major environmental/biological problems by applying appropriate chemistry tools.	Analysing	Compare,Classify, Select, nvestigate
PSO4	Students will be able to demonstrate effective writing and oral communication skills.	Understanding	Explain, Describe, outline, Predict, Summarize
PSO5	Students will have knowledge and understanding of norms and ethics in the field of chemistry.	Evaluating	Judge, Assess, Estimate, Predict, Argue
PSO6	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
PSO1	3	3	2	3	3	2
PSO2	2	3	2	3	3	2
PSO3	2	2	3	2	2	2
PSO4	3	2	3	3	2	2
PSO5	2	3	3	2	3	2
PSO6	3	2	3	2	2	3
Avg.	2.5	2.5	2.7	2.5	2.5	2.2

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

No.	Programme Educational Objectives (PSOs)	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
PEO1	Graduates will establish themselves in microbiology and allied sectors by competing effectively at national and international levels.	Cognitive	Application / Analysis
PEO2	Graduates will pursue higher studies and engage in lifelong learning to continuously upgrade their scientific and professional competencies.	Cognitive	Evaluation / Synthesis (Creating)
PEO3	Graduates will demonstrate effective communication, leadership qualities, and professional ethics while functioning efficiently in multidisciplinary and multicultural teams.	Affective	Valuing / Organization
PEO4	Graduates will exhibit a sense of social responsibility and contribute towards sustainable development and environmental conservation.	Affective	Valuing / Characterization
PEO5	Graduates will apply innovative thinking, research aptitude, and entrepreneurial skills to address real-world challenges in microbiology.	Cognitive & Psychomotor	Synthesis (Creating) / Precision

Mapping of POs & PEOs:

	PO1	PO2	PO3	PO4	PO5
PEO1	3	3	2	1	1
PEO2	3	2	1	1	1
PEO3	2	1	1	3	3
PEO4	1	1	1	1	3
PEO5	2	3	3	1	1

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, , 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 -**Major (Core)**	78
2	Professional Elective courses relevant to chosen specialization/branch - **Minor Stream**	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	**134**

Table: Minimum Credit Requirement

S.No.	Broad Category of Course	**Minimum Credit Requirement**
		4-year UG
1	**Major (Core) (50% of total credit)** BSMO111 Cell Biology BSMO112 Biomolecules BSMO211 Molecular Biology BSMO212 Metabolism BSMO311 Microbial Genetics BSMO312 Introduction to Microbiology and Microbial Diversity BSMO313 Bacteriology BSMO411 Industrial Microbiology BSMO412Recombinant DNA Technology BSMO413 Microbial Physiology BSMO511 Bioanalytical Tools BSMO512 Medical Microbiology BSMO611 Immunology BSMO612 Bioinformatics & Drug Discovery, Design and Development BSMO613 Food and Dairy Microbiology	**65**
2	**Minor Elective Course** BSCM 116 Basics of Chemistry – I BSMA116 Mathematics – I BSCM 216 Basics of Chemistry – II BSPY216 Physics – I BSCM 316 Chemistry – I/ BSPY316 Physics – II BSMA316 Mathematics – II BSCM 415 Chemistry – II BSPY415 Biophysics/ BSMA415 Biostatistics BSMO513 Agriculture Microbiology/ BSMO514 Microbial Biotechnology BSMO515 Virology BSMO613 Environmental Microbiology/ BSMO614 Advances in Microbiology	**36**
3	**Ability Enhancement Courses (AEC)** AECC101 Fundamentals of English AECC201 Communication Skills in English AECC301 Entrepreneurship Development AECC401 Environmental Science AECC501 Disaster Risk Management AECC601 Indian Constitution	**12**

4	**Skill Enhancement Courses (SEC) (from major & Minor)** SECC104 Internship SECC204 Internship SECC304 Internship SECC404 Internship SECC504 Internship	**10**
5	**Value Added Course (VAC)** VACC101 Foundation Course VACC201 Tinkering and Mentoring VACC202 Vedic Mathematics	**06**
	Total	**129**

Category-wise Courses:

Humanities & Social Sciences Courses

1. Number of Humanities & Social Science Courses: 5
2. Credits: 10

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
		Total									**10**

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: 11
ii. Credits: 36

Sr. No.	CourseCode	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	BSCM116	Basics of Chemistry – I	I	2	2	0	4	2	1	0	3
2.	BSMA116	Mathematics – I	I	2	0	1	3	2	0	1	3
3.	BSCM216	Basics of Chemistry – II	II	2	2	0	4	2	1	0	3
4.	BSPY216	Physics – I	II	2	2	0	4	2	1	0	3
5.	BSCM316	Chemistry – I	III	2	2	0	4	2	1	0	3
6.	BSPY316	Physics – II	III	2	2	0	4	2	1	0	3
	BSMA316	Mathematics – II	III	2	0	1	3	2	0	1	

7.	BSCM415	Chemistry – II	IV	2	2	0	4	2	1	0	3
8.	BSPY415	Biophysics	IV	2	2	0	4	2	1	0	3
	BSMA415	Biostatistics	IV	2	0	1	3	2	0	1	
9.	BSMO513	Agriculture Microbiology	V	3	2	0	5	3	1	0	4
	BSMO514	Microbial Biotechnology	V	3	2	0	5	3	1	0	
10.	BSMO515	Virology	V	3	2	0	5	3	1	0	4
11.	BSMO613	Environmental Microbiology	VI	3	2	0	5	3	1	0	4
	BSMO614	Advances in Microbiology	VI	3	2	0	5	3	1	0	
		Total		35	24	3	62	35	12	3	36

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Professional Core Courses

i. Number of Professional Core Courses: 15
ii. Credits: 60

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	Biomolecules	I	3	2	0	5	3	1	0	4
3.	BSBO211	Molecular Biology	II	3	2	0	5	3	1	0	4
4.	BSBO212	Metabolism	II	3	2	0	5	3	1	0	4
5.	BSMO311	Microbial Genetics	III	3	2	0	5	3	1	0	4
6.	BSMO312	Introduction to Microbiology and Microbial Diversity	III	3	2	0	5	3	1	0	4
7.	BSMO313	Bacteriology	III	3	2	0	5	3	1	0	4
8.	BSMO411	Industrial Microbiology	IV	3	2	0	5	3	1	0	4

9.	BSMO412	Recombinant DNA Technology	IV	3	2	0	5	3	1	0	4
10.	BSMO413	Microbial Physiology	IV	3	2	0	5	3	1	0	4
11.	BSMO511	Bioanalytical Tools	V	3	4	0	7	3	2	0	5
12.	BSMO512	Medical Microbiology	V	3	4	0	7	3	2	0	5
13.	BSMO611	Immunology	VI	3	4	0	7	3	2	0	5
14.	BSMO612	Bioinformatics & Drug Discovery, Design and Development	VI	3	4	0	7	3	2	0	5
15	BSMO613	Food and Dairy Microbiology	VI	3	4	0	7	3	2	0	5
		Total		42	36		78	42	18	0	60

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Project Work, Seminar and Internship In Industry Or Elsewhere

i. Number of Project Work, Seminar And Internship In Industry Or Elsewhere: 5
ii. 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
		Total					**10**				**10**

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Value Added Courses

i. Number of Courses-3
ii. Credits- 6

Sr. No.	CourseCode	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	VACC101	Foundation Course	I	0	2	0	2	0	2	0	2
2.	VACC201	Tinkering and Mentoring	II	0	2	0	2	0	2	0	2
3.	VACC202	Vedic Mathematics	III	2	0	0	2	2	0	0	2
		Total					**06**				**06**

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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.) Microbiology Program is an Honours Degree which is designed for Eight Semesters (Four 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 Microbiology is designed to full fill recent demands of industrial career. The B.Sc. (Hons.) Mcirobiology 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.

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.	BSMO111	Cell Biology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSMO112	Biomolecules	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
3.	BSCM116	Basics of Chemistry – I	2	2	0	4	2	1	0	3	20	40	40	100	50	150
4.	BSMA116	Mathematics – I	2	0	1	3	2	0	1	3	20	45	75	150	0	150
	C. Ability Enhancement Courses															
5.	AECC101	Fundamentals of English	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	D. Skill Enhancement Courses															
6.	SECC101	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	F. Value Added Courses															
7.	VACC101	Foundation Course	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**2**	**00**	**00**	**00**	**50**	**00**	**50**
	Total									**20**						**600**

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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.	BSMO211	Molecular Biology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSMO212	Metabolism	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
3.	BSCM216	Basics of Chemistry - II	2	2	0	4	2	1	0	3	20	45	75	150	0	150
4.	BSPY216	Physics - I	2	2	0	4	2	1	0	3	20	45	75	150	0	150
	C. Ability Enhancement Courses															
5.	AECC201	Communication Skills in English	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	D. Skill Enhancement Courses															
6.	SECC201	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	E. Value Added Courses															
7.	VACC201	Tinkering and Mentoring	0	2	0	0	0	2	0	2	00	00	00	50	00	50
8.	VACC202	Vedic Mathematics	2	0	0	2	2	0	0	2	00	00	00	100	00	100
	Total									**22**						**700**

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

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. Major Courses															
1.	BSMO311	Microbial Genetics	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSMO312	Introduction To Microbiology And Microbial Diversity	3	2	0	5	3	1	0	4	20	40	40	100	50	150
3	BSMO313	Bacteriology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
3.	BSCM316	Chemistry – I	2	2	0	4	2	1	0	3	20	40	40	100	50	75
4.	BSMA316	Mathematcs - II	2	0	1	3	2	0	1	3	20	45	75	150	0	75
5.	BSPY316	Physics - II	2	2	0	4	2	1	0	3	20	40	40	100	50	
	C. Ability Enhancement Courses															
6.	AECC301	Entrepreneurship Development	2	0	0	2	2	0	0	2	20	40	40	100	00	50
	D. Skill Enhancement Courses															
7.	SECC301	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	Total									**22**						**700**

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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. Major Courses															
1.	BSMO411	Industrial Microbiology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSMO412	Recombinant DNA Technology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
3	BSMO413	Microbial Physiology & Metabolism	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
4.	BSCM415	Chemistry – II	2	2	0	4	2	1	0	3	20	40	40	100	50	75
5.	BSMA415	Biostatistics	2	0	1	3	2	0	1	3	20	45	75	150	0	75
6.	BSPY415	Biophyscics	2	2	0	4	2	1	0	3	20	40	40	100	50	
	C. Ability Enhancement Courses															
7.	AECC401	Environmental Science	2	0	0	2	2	0	0	2	20	40	40	100	00	50
	D. Skill Enhancement Courses															
8.	SECC301	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	Total									**22**						**700**

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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															
2	SECC504	Internship	0	2	0	2	0	0	0	2	0	0	0	0	50	50
	C. Core Course															
3	BSMO511	Bioanalytical Tools	3	4	0	7	3	2	0	5	20	40	40	100	50	150
4	BSMO512	Medical Microbiology	3	4	0	7	3	2	0	5	20	40	40	100	50	150
	D. Minor Electives (Any One)															
5	BSMO513	Agriculture Microbiology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	BSMO514	Microbial Biotechnology	3	2	0	5	3	1	0	4	20	40	40	100	50	
	E. Minor Compulsory															
6	BSMO515	Virology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
		Total								**22**						**750**

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	BSMO611	Immunology	3	4	0	7	3	2	0	5	20	40	40	100	50	150
3	BSMO612	Bioinformatics & Drug Discovery, Design and Development	3	4	0	7	3	2	0	5	20	40	40	100	50	150
4	BSMO613	Food and Dairy Microbiology	3	4	0	7	3	2	0	5	20	40	40	100	50	150
	C. Minor Electives (Any One)															
5	BSMO614	Environmental Microbiology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	BSMO615	Advances in Microbiology	3	2	0	5	3	1	0	4	20	40	40	100	50	
		Total								**21**						**700**

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Semester – I							
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Marks**
A. Major							
1	BSMO111	Cell Biology	3	0	1	4	150
2	BSMO112	Biomolecules	3	0	1	4	150
B. Minor							
3	BSCM116	Basics of Chemistry – I	2	0	1	3	75
4	BSMA116	Mathematics – I	2	1	0	3	75
C. Ability Enhancement Course							
5	AECC101	Fundamentals of English	2	0	0	2	50
D. Skill Enhancement Course							
6	SECC104	Internship	0	0	2	2	50
E. Value Added Course							
7	VACC101	Foundation Course	0	0	2	2	50
					Total	**20**	**600**

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.	BSMO111	Cell Biology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSMO112	Biomolecules	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
3.	BSCM116	Basics of Chemistry – I	2	2	0	4	2	1	0	3	20	40	40	100	50	150
4.	BSMA116	Mathematics – I	2	0	1	3	2	0	1	3	20	45	75	150	0	150
	C. Ability Enhancement Courses															
5.	AECC101	Fundamentals of English	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	D. Skill Enhancement Courses															

6.	SECC101	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	F. Value Added Courses															
7.	VACC101	Foundation Course	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**2**	**00**	**00**	**00**	**50**	**00**	**50**
	Total									**20**						**600**

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COURSE CODE BSMO111	COURSE NAME Cell Biology	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisites	School Level Understanding of Biology and a keen interest in learning.
Course Category	Professional Core Courses
Course focus	Employability
Rationale	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.
Course Revision/ Approval Date:	07/11/2023
Course Objectives (As per Blooms' Taxonomy)	**To enable the student to:** 1. Gain the basic knowledge and understanding of basic concept and structure of cells and cell organelles. 2. Understand the molecular structure and function of major organelles. 3. Understand and analyze the role of endo membranous cell organelles 4. Learn and understand cell division and cell cycle. Understand and apply the basic tools in cell biology.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Basic concept of cell and structure of organelles 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
Unit 2: Molecular structure and function of major organelles Nucleus - Nuclear envelope, nuclear pore complex and nuclear lamina. Chromatin – Molecular organization. Chloroplast, Mitochondria, Lysosomes, Peroxisomes, Vacuoles.	20%	9
Unit 3: The Endomembrane system 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 adhesion in cell cycle regulation	20%	9

Unit 4: Cell division and cell cycle	20%	9

Mitosis and Meiosis. Eukaryotic cell cycle. Cell cycle control in prokaryotes and eukaryotes.		
Unit 5: Basic tools in cell biology 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 airoven, 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.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Understand the structure, composition and function	Remember, Understanding	Describe

ofcell organelles.		
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.	**Reference books:** 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.	**Journal & Periodicals:** 1. Journal of Cell Biology 2. Trends in Cell Biology 3. Cell Biology International 4. Science
3.	**Other Electronic resources :** NPTEL

Evaluation Scheme	**Total Marks = 150**	
Theory: Mid semester 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
	Research Paper Review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	35 marks
	Viva	10 marks
	Journal	05 marks

	Total	**50 Marks**

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

COURSE CODE BSMO112	COURSE NAME Biomolecules	SEMESTER- I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisite	School Level Understanding of Biological molecules and a keen interest in learning.
Course Category	Core Professional
Course Focus	Employability
Rationale	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.
Course Revision/ Approval date	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	**To enable the student:** **1.** To understand the structure, function, and properties of carbohydrates and analyze its significance in biological processes. 2. To remember the structure, functions and classification of lipids. 3. To understand and remember physical and chemical properties of nucleic acids and analyse its significance. 4. To understand and analyse the structure and function of amino acids. 5. To understand the nomenclature of enzymes and its significance.

Course Content	Weightage	Contact Hours
Unit 1: Carbohydrates Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides, Glycoprotein's and their biological functions.	20%	9
Unit 2: Lipids Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.	20%	9
Unit 3: Nucleic acids 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
Unit 4: Amino acids A historical prospective. Amino acids & Proteins: Structure & Function.	20%	9

Structure and properties of Amino acids, Types of proteins and their classification. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.		
Unit 5: Enzymes 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, transluscent, acrolein, Hubbles test for saturated/unsaturated lipids, saponification, Burchard test for cholesterol	2%	2
6. Qualitative test for lipids: solubility, transluscent, 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 their structural organization, and explain denaturation processes.	Remember, Analyse	Define Describe
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.	**Reference Books** 1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman andCo. 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.	**Journals & Periodicals:** 1. JBC 2. Current Science
3.	**Other Electronic resources:** 1. NPTL

Evaluation Scheme	**Total Marks = 150**
Theory: Mid semester 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 Research Paper Review: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 35 marks Viva: 10 marks Journal: 05 marks **Total: 50 Marks**

Mapping of PSOs & Cos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
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

COURSE CODE BSCM116	COURSE NAME Basics of Chemistry – I	SEMESTER- I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	2	0	4	2	1	0	3

Course Pre-requisites	Basic understanding of high school chemistry.
Course Category	Generic Elective
Course Focus	Skill Development
Rationale	This course aims to provide a comprehensive understanding of fundamental chemical principles, including atomic structure, bonding, solution chemistry, resonance, and chemical kinetics, essential for advanced studies in chemistry and related fields.
Course Revision/ Approval date	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1: **Understand** the principles of atomic structure and electronic configurations. 2: **Apply** knowledge of chemical bonding theories to explain bond formation. 3: **Analyze** various factors affecting solubility and solute-solvent interactions in solutions. 4: **Evaluate** the concept of resonance and its application in inorganic and organic compounds. 5: **Interpret** kinetic data to determine reaction rates and mechanisms.

Course Content	Weightage	Contact hours
Unit 1: Atomic Structure Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.	20%	6
Unit 2: Chemical Bonding Types of bonds and factors affecting the bond formation, various theories, bond parameters, types of bonds in biomolecule, Hydrophilic and hydrophobic interactions.	20%	6
Unit 3: Solutions & Solvents Solutions: Solutions, types of solutions, solvation energy, lattice energy, Equivalent & molecular mass, mole concept, solubility & factors affecting solubility, Expression for concentration of	20%	6

solutions, polarity of solvents, Importance of dielectric constant of solvents, Solvents other than water, classification of solvents Dilution factor, serial dilution, Solute– solvent interactions in solutions.		
Unit 4: Resonance Concept of resonance and resonating structures in various inorganic and organic compounds.	15%	4
Unit 5: Chemical kinetics Rate of reaction, differential rate law expressions, Order & molecularity, rate constant, integrated equations (1st, 2nd & 3rd order), nth life of a reaction, Arrhenius equations, temperature dependence of rate constant, energy profile diagrams. Reaction intermediates, Different theories on reaction rate	25%	8

List Of Practicals	Weightage	Contact hours
Polar and Non-Polar Molecules Identification	**10%**	**2**
Preparation of Solutions and Concentration Measurement	**10%**	**2**
Determination of Solubility	**10%**	**2**
Serial Dilution and Calculation of Dilution Factor	**10%**	**2**
Determination of Equivalent and Molecular Mass	**15%**	**2**
To determine the normality and strength of x N $H_2C_2O_4$ by titrating it against 0.2 N NaOH solution	**20%**	**2**
To determine the normality and strength of x N FAS by titrating it against 0.5 N $KMnO_4$ solution	**20%**	**2**

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

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain

After successful completion of the above course, students will be able to:		
CO1: Identify the rules for filling electrons in various orbitals and describe the electronic configurations of atoms, including the stability of half-filled and completely filled orbitals.	Identify and Describe	Knowledge and Comprehension
CO2: Explain various types of chemical bonds and illustrate factors affecting bond formation, including hydrophilic and hydrophobic interactions in biomolecules.	Explain and Illustrate	Comprehension and Application
CO3: Analyze the factors affecting solubility and solve problems related to solute-solvent interactions, including the calculation of solvation energy and concentration expressions for solutions.	Analyze and Solve	Analysis and Application
CO4: Demonstrate basic knowledge of matrices and determinants and apply it to find the inverse of a matrix.	Evaluate and Discuss	Evaluation and Comprehension
CO5: Calculate reaction rates, rate constants, and interpret kinetic data to determine reaction mechanisms, including the application of Arrhenius equations and understanding energy profile diagrams.	Calculate and Interpret	Application and Analysis

Learning Resources	
1	**Reference Books:** 1. A Textbook of Inorganic Chemistry by J.D. Lee. 2. Principles of Physical Chemistry by B.R. Puri, L.R. Sharma, and M.S. Pathania. 3. Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr. 4. Chemical Kinetics and Dynamics by Jeffrey I. Steinfeld, Joseph S. Francisco, and William L. Hase 5. Principles of Inorganic Chemistry by Puri Sharma Kalia
2	**Journals & Periodicals:** 1. Chemistry Today
3	**Other Electronic Resources:** http://www.chemguide.co.uk/

Evaluation Scheme	**Total Marks**	
Theory: Mid semester 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
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & Cos

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

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

COURSE CODE	COURSE NAME	SEMESTER
BSMA116	**Mathematics-I**	**I**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	1	3	2	0	1	3

Course Pre-requisites	Knowledge of basic precalculus concepts
Course Category	Discipline Specific Generic Elective
Course focus	Skill development
Rationale	
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1: **Demonstrate** knowledge of basic precalculus concepts and skills. 2: **Evaluate** limits, recognize continuity and use the properties of continuous functions. 3: **Find** derivatives of algebraic and trigonometric functions using the definition or basic rules of differentiation. 4: **Find** rates of change, solve related rate problems, Find extreme values in optimization problems. 5: **Apply** 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 (Theory)	Weightage	Contact hours
Unit 1: Introduction to matrices, Elementary operations on matrices and types of matrices, Symmetric and skew- symmetric matrices,. Rank of a matrix. Row Reduced Echelon form of a matrix and matrix inversion using it.	**20%**	**6**
Unit 2: Determinant of 2 x 2 and 3 x 3 matrices. Inverse of a square matrix Homogeneous and Non-homogeneous linear equations. Application of matrices in solving a system of simultaneous linear equations.	**20%**	**6**
Unit 3: Trigonometry and its identities, inverse trigonometric functions, Concept of a limit and Continuity. Derivative of elementary functions	**20%**	**6**
Unit 4: Rules of differentiation (without proof), Chain rule (without proof), differentiation of implicit functions, Applications of Derivatives: maxima and minima of function.	**20%**	**6**
Unit 5: Standard integration formulae, Integration by the method of substitution, Integration by parts, definite integration, Applications of Integrations: Area of a region.	**20%**	**6**

List Of Practical Tutorial	Weightage	Contact hours
Unit 1: Problem solving on Trigonometry.	**20%**	**3**

Unit 2: Problem solving on differentiation	**20%**	**3**
Unit 3: Problem solving on Integration.	**20%**	**3**
Unit 4: Problem solving on Matrices and Determinants.	**20%**	**3**
Unit 5: Problem solving on solving system of linear equations.	**20%**	**3**

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

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Understand and Apply** Concepts of linear algebra to find rank and inverse of a matrix.	**Understand and Apply**	Describe, Demonstrate & Examine, Find, Evaluate
CO2: **Apply** Concepts of linear algebra to solve system of linear equation.	**Evaluate**	Demonstrate & Examine, Find
CO3: **Understand and Apply** the knowledge of basic trigonometry and precalculus concepts and skills.	**Remember, Understand and Apply**	Define, Classify, Describe, Demonstrate & Examine
CO4: **Evaluate** derivatives of algebraic and trigonometric functions to find maxima-minima of function of one variable.	**Evaluate**	Demonstrate & Examine, Find, Evaluate
CO5: **Evaluate** integration of algebraic and trigonometric functions and use it find Area of the region.	**Evaluate**	Demonstrate & Examine, Find, Evaluate

Learning Resources	
1.	Reference Books: 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
2.	Journals & Periodicals:
3.	Other Electronic Resources: GeoGebra Toolbox : https://www.geogebra.org/

Evaluation Scheme	**Total Marks**
Theory: Mid semester 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
		Total	**40 Marks**
Practical Marks		Attendance	05 marks
		Practical Exam	20 marks
		Viva	10 marks
		Journal	10 marks
		Discipline	05 marks
		Total	**50 Marks**
Project/ Industrial Internship Marks		Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
		Practical understanding of the subject on the Project/Industrial.	30 marks
		Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
		Attendance	10 marks
		Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	1	2	0	1	0	1	1	2	0
CO2	2	2	0	0	1	1	2	2	0
CO3	2	2	0	0	1	1	2	2	0
CO4	2	2	1	0	1	1	2	2	1
CO5	3	3	2	1	0	3	3	3	2

Mapping of POs & COs

	PO1	PO2	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	0	1	1	0	2	2	0
CO2	1	2	1	1	0	0	1	2	1
CO3	1	2	1	1	0	0	1	2	1
CO4	1	2	1	2	0	0	1	2	1
CO5	1	1	3	2	0	0	1	1	3

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

COURSE CODE AECC101	COURSE NAME Fundamentals of English	SEMESTER- I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

Course Pre-requisites	Student should have cleared 12th Science
Course Category	Mandatory Course
Course focus	Skills Development
Rationale	It enables humanity to experience the benefits of chemistry when we apply it in the exploitation of materials and energy.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. Emphasize the development of listening and reading skills among learners 2. Equip them with writing skills needed for academic as well as workplace context 3. Enable learners of science develop their basic communication skills in English 4. Strengthen the fundamentals in English Language. 5. Build up the confidence to communicate with the world.

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

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

Instructional Methodand Pedagogy:
Classroom Lecture, Case Studies, Quizzes, Presentations, Role Play, Expert Lecture (Consultant)

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1:To emphasize the developmentof 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

Learning Resources	
1.	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
3.	**Journal & Periodicals** 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
4.	**Other Electronic Resources** 1. Wordsworth - Language software 2. Jam board

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

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	BSMO211	Biomolecules	3	0	1	4	150
2	BSMO212	Metabolism	3	0	1	4	150
B. Minor							
3	BSCM216	Basics of Chemistry – II	2	0	1	3	75
4.	BSPY216	Physics – I	2	0	1	3	75
C. Ability Enhancement Course							
5	AECC201	Communication Skills in English	2	0	0	2	50
D. Skill Enhancement Course							
6	SECC201	Internship	0	0	2	2	50
E. Value Added Course							
7	VACC201	Tinkering and Mentoring	0	0	2	2	50
8	VACC202	Vedic Mathematics	2	0	0	2	100
					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.	BSMO211	Molecular Biology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSMO212	Metabolism	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
3.	BSCM216	Basics of Chemistry - II	2	2	0	4	2	1	0	3	20	45	75	150	0	150
4.	BSPY216	Physics - I	2	2	0	4	2	1	0	3	20	45	75	150	0	150
	C. Ability Enhancement Courses															
5.	AECC201	Communication Skills in English	2	0	0	2	2	0	0	2	20	40	40	100	00	100

	D. Skill Enhancement Courses															
6.	SECC201	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	E. Value Added Courses															
7.	VACC201	Tinkering and Mentoring	0	2	0	0	0	2	0	2	00	00	00	50	00	50
8.	VACC202	Vedic Mathematics	2	0	0	2	2	0	0	2	00	00	00	100	00	100
	Total									**22**						**700**

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

COURSE CODE BSMO211	COURSE NAME Molecular Biology	SEMESTER- II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	5	4	3	1	0	4

Course Pre-requisite	School Level Understanding of Biology and a keen interest in learning.
Course Category	Core Professional
Course Focus	Employability
Rationale	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.
Course Revision/ Approval date	07/11/2023
Course Objectives (As per Blooms' Taxonomy)	**To enable the student to:** 1. Understand the historic perspective, types and structure of genetic material. 2. Gain knowledge about DNA replication mechanism in both prokaryotes and eukaryotes 3. Comprehend the process of transcription in prokaryotes and eukaryotes 4. Familiarize with post-transcriptional processing. 5. Develop an understanding of translation in both prokaryotes and eukaryotes.

Course Content	Weightage	Contact hours
Unit 1: Structures and types of Genetic Material 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
Unit 2: Replication of DNA 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

Unit 3: Transcription in Prokaryotes and Eukaryotes 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
Unit 4: Post-Transcriptional Processing Concept of introns and exons, RNA splicing, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA.	20%	9
Unit 5: Translation (Prokaryotes and Eukaryotes) 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 Safetyin 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 Labdemonstrations: DNA Isolation, Purification and quantitation	2%	2
8: Virtual Labdemonstrations: 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
After successful completion of the above course, students will be able to: 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 anddifferentiate betweenthem.	Remember, Understanding, Analyze	Explain, Compare
CO3: Understand and compare the mechanisms of DNA transcription in both prokaryotes and eukaryotes and differentiate betweenthem.	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 betweenthem	Remember, Understanding, Analyze	Describe, Compare

Learning Resources	
1.	**Reference books** 1. Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian Lewis, et al. 2. Principles of Molecular Biology by Burton E. Tropp 3. Essential Cell Biology by Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson. 4. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach. V Edition. ASMPress 5. Molecular Biology by David P. Clark and Nanette J. Pazdernik
2.	**Journal & Periodicals** 1. Journal of Molecular Biology 2. Nucleic Acid Research 3. Molecular Biology Reports 4. Current Science
3.	**Other Electronic resources:** NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester 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
Research Paper Review	10 marks
Total	**40 Marks**

Practical Marks

Attendance	05 marks
Practical Exam	35 marks
Viva	10 marks
Journal	05 marks
Total	**50 Marks**

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 BSMO212	COURSE NAME Metabolism	SEMESTER- II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total hours	Lecture	Practical	Tutorial	Total Credit
3	2	0	5	3	1	0	4

Course Pre-requisite	School Level Understanding of Biological molecules pathways and a keen interest in learning.
Course Category	Core Professional
Course Focus	Employability
Rationale	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.
Course Revision/ Approval date	09/11/2023
Course Objectives (As per Blooms' Taxonomy)	**To enable the student :** 1. To remember, understand and analyze the knowledge of carbohydrate metabolism. 2. To apply the knowledge of carbohydrate metabolism to explain cellular respiration process. 3. To remember, understand and apply the lipid metabolism. 4. To remember, understand and apply the amino acid metabolism. 5. To remember, understand and apply the nucleic acids metabolism.

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

acid synthesis		
Unit 5: Nucleotide metabolism Metabolic specializations in Microorganisms. *De novo* 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.	**Reference Books** 1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman andCo. 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.	**Journals & Periodicals:** 1. JBC 2. Current Science
3.	**Other Electronic resources:** 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 ß-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

<table>
<tr><th>Evaluation Scheme</th><th>Total Marks = 150</th></tr>
<tr><td>Theory: Mid semester Marks</td><td>20 marks</td></tr>
<tr><td>Theory: End Semester Marks</td><td>40 marks</td></tr>
<tr><td>Theory: Continuous Evaluation Component Marks</td><td>
<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>
</td></tr>
<tr><td>Practical Marks</td><td>
<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>
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		Total	**50 Marks**

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 BSCM216	COURSE NAME Basics of Chemistry - II	SEMESTER- II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total hours	Lecture	Practical	Tutorial	Total Credit
2	2	0	4	2	1	0	3

Course Pre-requisites	Basic knowledge of general chemistry.
Course Category	Generic Elective
Course Focus	Skill Development
Rationale	This course aims to provide a comprehensive understanding of fundamental and advanced concepts in electrochemistry, organic chemistry, coordination chemistry, stereochemistry, and organic reaction mechanisms, preparing students for further studies or careers in chemistry-related fields.
Course Revision/ Approval date	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Knowledge**: Describe the principles and applications of electrochemistry, organic reactions, coordination compounds stereochemistry, and organic reaction mechanisms. 2. **Comprehension**: Interpret electrode potentials, Nernst equation, reaction mechanisms, and stereochemical representations. 3. **Application**: Apply knowledge to solve problems related to electrochemical cells, organic reactions, coordination complexes, and stereochemical configurations. 4. **Analysis**: Analyze and evaluate redox reactions, reaction mechanisms, and properties of coordination compounds. 5. **Synthesis**: Design experiments and propose mechanisms for organic reactions, and predict properties and applications of coordination compounds.

Course Content	Weightage	Contact hours
Unit 1: Electrochemistry Electrochemistry: Electrode potential, related problems, Nernst equation & its applications, emf of the cell, related problems, Redox reactions in cells, free energy change & standard EMF of the cell.	20%	6
Unit 2: Organic Chemistry Nomenclature, Introduction to functional groups, chemical & physical properties, Oxidation, reduction, elimination, addition and substitution reactions, reaction intermediates, Heterocyclic	20%	6

compounds, Configuration & projection formula, Optical & geometrical isomerism, Tautomerism, Enantiomerism & its applications. Aromatic compounds.		
Unit 3: Coordination Chemistry Introduction to co-ordinations compounds, Crystal field theory, Color & magnetic properties of complexes, Chelation & applications, biologically relevant coordination compounds	20%	6
Unit 4: Stereochemistry Conformations with respect to ethane, butane and cyclohexane Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms).	20%	6
Unit 5: Mechanism of Organic Reactions Bond fission, Electrophilic and nucleophilic reagents, Types of organic reactions, Stability and reactivity of carbon ions, stability and reactivity of free radicals	20%	6

List Of Practicals	**Weightage**	**Contact hours**
Measurement of electrode potential using standard hydrogen electrode (SHE).		
Identification of functional groups using chemical tests (e.g., bromine water test for alkenes).		
Tollens' test for aldehydes, etc., on known organic compounds.		
Perform simple distillation, liquid-liquid extraction, and thin-layer chromatography (TLC) experiments.		
Redox titrations applications with two examples.		

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

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**

After successful completion of the above course, students will be able to:		
CO1: Recall and define fundamental concepts in electrochemistry, organic chemistry, coordination chemistry, stereochemistry, and organic reaction mechanisms.	Remember	Knowledge
CO2: Demonstrate understanding by explaining the principles underlying electrochemical processes, organic reactions, stereochemical configurations, and coordination chemistry phenomena.	Demonstrate	Define, Classify, Describe,
CO3: Solve problems involving electrode potentials, Nernst equation, redox reactions, organic reaction mechanisms, and coordination compound properties.	Analyze and Solve	Analysis and Application
CO4: Analyze and interpret data from electrochemica experiments, organic reaction mechanisms, stereochemica relationships, and coordination compound properties to draw conclusions and solve complex problems.	Analyze	Analysis and Application
CO5: Synthesize information to propose mechanisms for organic reactions, design experiments related to electrochemistry and coordination chemistry, and develop strategies to solve practical challenges in these fields.	Synthesis	Application and Analysis

Learning Resources	
1	**Reference Books:** 5. A Textbook of Inorganic Chemistry by J.D. Lee. 6. Principles of Physical Chemistry by B.R. Puri, L.R. Sharma, and M.S. Pathania. 7. Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr. 8. Chemical Kinetics and Dynamics by Jeffrey I. Steinfeld, Joseph S. Francisco, and William L. Hase 5. Principles of Inorganic Chemistry by Puri Sharma Kalia
2	**Journals & Periodicals:** 2. Chemistry Today
3	**Other Electronic Resources:** http://www.chemguide.co.uk/

Evaluation Scheme	**Total Marks**		
Theory: Mid semester 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
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & Cos

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

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

COURSE CODE BSPY216	COURSE NAME Physics – I	SEMESTER- II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	2	0	4	2	1	0	3

Course Pre-requisites	Understanding of basic physics up to school level (10+2 level).
Course Category	Minor (Compulsory)
Course focus	Skill development
Rationale	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.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1: To **understand** & **remember** the basic laws of optical concepts and **apply** these concepts to **understand** the working of different optical instruments. 2: To **understand** & **remember** the basic quantities governing in the regime of electricity and electronics and **analyse** respective phenomena in allied areas. 3: To get the knowledge of electromagnetism and their **applications.** 4: To **understand** the fundamental building blocks of matter and **remember** their behaviour to under different conditions. 5: **Understand** the basics of advanced instrumentation.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Applied optics 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%**	**6**
Unit 2: Fundamentals of electricity and electronics 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%**	**6**

Unit 3: Magnetostatics Magnetic force, magnetic field and magnetization, Hysteresis. EM Waves, Emission and absorption spectrum, Application of EM Waves.	**20%**	**6**
Unit 4: Properties of matter Introduction and application of nano-materials, composite materials, Ecofriendly materials.	**20%**	**6**
Unit 5: Instrumentation Physics Fundamental of optical microscopy, scanning electron microscopy. transmission electron microscopy, X-ray diffractometer, Raman effect and its applications	**20%**	**6**

List Of Practical	Weightage	Contact hours
Based on theory contents		

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: **Describe** & **demonstrate** the fundamental concepts related to optics and working principles of various optical instruments.	Remember & Understand	Define, Classify, Describe, Demonstrate
CO2: **Define** & **classify** different electric and electronic materials and **demonstrate & analyse** the working of different electronic systems.	Understand, Remember, Analyse & Apply	Define, Classify, Describe, Demonstrate & Examine
CO3: **Define** the fundamental notions related to electrostatics & magnetostatics and, **explain** the basics of EM waves, their **classification** and respective applications.	Understand, Remember, Assess & Apply	Define, Classify, Describe & Demonstrate
CO4: **Classify** the materials based on their properties and **analyse** their behaviour under different conditions.	Understand, Analyse	Classify, Describe, Demonstrate & Examine
CO5: **Describe** the fundamental notions and working principles related to the advanced instrumentation techniques and **analyse** their applications in allied areas.	Understand & Analyse	Describe & Demonstrate

Learning Resources	
1.	Reference Books: 1. Jearl Walker, David Halliday, Robert Resnick, **Fundamentals of Physics**, Wiley, 2011. 2. D. C. Tayal, **Electricity and Magnetism,** Himalaya Publishing House, 1988. 3. F. A. Jenkins and H. E White, Fundamentals of Optics, McGraw-Hill Publishing, 4th edition, 2001. 4. Ch Sateesh Kumar, M. Muralidhar Singh, Ram Krishna, Advanced Materials Characterization, 1st 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: **Feynman Lectures in Physics: https://www.feynmanLectures.caltech.edu/**

Evaluation Scheme	Total Marks
Theory: Mid semester 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**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks Discipline: 05 marks **Total: 50 Marks**

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

COURSE CODE AECC201	COURSE NAME Communication Skills in English	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	0	0	2	2	0	0	2

Course Pre-requisites	Student should have cleared First Semester of Bachelor of Science
Course Category	Mandatory Course
Course focus	Communicational Skills
Rationale	It enables humanity to experience the benefits of chemistry when we apply it in the exploitation of materials and energy.
Course Revision/ Approval Date:	14/03/2023
Course Objectives **(As per Blooms' Taxonomy)**	1. To enable learners, develop their basic communication skills in English. 2. To equip them with writing skills needed for academic as well as workplace context. 3. To prepare students for professional communication at world level. 4. To develop corporate communicational attitude. 5. To strengthen digital communication using technological modules and expertise.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Communicative Skills Basics of Communication, Verbal & Non-verbal, Communication, Barriers to Effective Communication, Strategies of Effective Communication	**20%**	**6**
Unit 2: Grammar & Vocabulary: Types of sentences, Synonyms, Antonyms, Tenses - Past, Present & Future, Homophones, Modals, Verb forms, Phrasal Verbs, Error correction, commonly misused words, technical Terms	**15%**	**5**
Unit 4: Writing Skills & Speaking Skills: 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**
Unit 3: Listening & Reading Skills: 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)		
Unit 4: Writing Skills & Speaking Skills: 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**
Unit 5: ICT/ Digital/ E-Skills: Computer Assisted Language Learning (CALL), Mobile Assisted Language Learning (MALL), Emails, Blogs, Digital/ E-Portfolio, Filling Online Application Forms	**20%**	**6**

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). *Maya Angelou: A Critical Companion*. Westport, : Greenwood Press. ISBN 978-0-313-303225. 6. Booher, Diana. (2004),*Booher's Rules of Business Grammar*, OUPUr, Penny (2002), *Grammar Practice Activities*, OUP

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

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

COURSE CODE	COURSE NAME	SEMESTER
VACC201	Vedic Mathematics	II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	0	0	2	2	0	0	2

Course Pre-requisites	None
Course Category	Value Added Elective
Course focus	Skill development
Rationale	The present course will give the idea about different concepts of Vedic Mathematics like Arithmetic, Algebra, Geometry and Trigonometry.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1: **Understand** Concepts of Vedic Mathematics to promote joyful learning of mathematics,. 2: **Learn** Vedic Mathematics to enhance computation skills. 3:.**Develop** logical and analytical thinking 4: **Apply** Vedic mathematics to solve problems of Algebra, geometry and Trigonometry. 5: **Understand** the rich heritage of mathematical temper of Ancient India

Course Content (Theory)	Weightage	Contact hours
Unit 1: History of Vedic Maths and its Features, Vedic Maths formulae: Sutras and Upsutras Addition in Vedic Maths: Without carrying, Dot Method 77, Subtraction in Vedic Maths: Nikhilam Navatashcaramam Dashatah (All from 9 last from 10) , Fraction -Addition and Subtraction	20%	6
Unit 2: "Miracle Multiplication and Excellent Division, Multiplication in Vedic Maths: Base Method (any two numbers up to three digits, Multiplication by Urdhva Tiryak Sutra, Miracle multiplication: Any three-digit number by series of l's and 9's, Division by Urdhva Tiryak Sutra (Vinculum method)"	20%	6
Unit 3: Lightening Squares and Rapid Cubes, Squares of any two-digit numbers: Base method, Square of numbers ending in 5: Ekadhikena Purvena Sutra, Easy square roots: Dwandwa Yoga (duplex) Sutra, Square root of 2: Baudhayana Shulbasutra, Cubing: Yavadunam Sutra	20%	6
Unit 4: Enlighten Algebra and Geometry, Factoring Quadratic equation: Anurupyena, Adyamadyenantyamanty Sutra, Concept of Baudhayana (Pythagoras) Theorem,	20%	6
Unit 5: Circling a square: Baudhayana Shulbasutra, Concept of pi: Baudhayana Shulbasutra, Concept angle (8) 0o, 300, 450, 600 and 900: Baudhayana number	20%	6

Instructional Method and Pedagogy: Chalk & board, group discussions, assignments, , Online materials, Practice examples

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:		
CO1: **Apply** techniques of Vedic Mathematics to solve the problems of Addition and subtraction.	Remember, Understand, Apply	Explain, Use, Solve,
CO2: **Understand and Apply** techniques of Vedic Mathematics to solve the problems of Multiplication and Division.	Remember, Understand, Apply	, Identify, Use, Solve
CO3: **Apply** techniques of Vedic Mathematics to find squares, cubes, square roots and Cube roots.	Understand, Apply	Describe, Identify, Solve, Use, Find
CO4: **Understand and Apply** techniques of Vedic Mathematics to solve quadratic equation.	Remember, Apply	Describe, Use, Solve
CO5: **Understand** the rich heritage of mathematical temper of Ancient Indi.	Understand	classify, Explain, Identify, Use, solve.

Learning Resources	
1.	**Reference Books:** 1. A Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, Wiley Eastern Limited, New Delhi 2. Enjoy Vedic Mathematics, S M Chauthaiwale, R Kollaru, The Art of Living, Bangalore 3. Magical World of Mathematics, VG Unkalkar, Vandana Publishers, Banglore. **Text Books:** 1. The Essential of Vedic Mathematics, Rajesh Kumar Thakur, Rupa Publications, New Delhi, 2019 2. Vedic Mathematic by Bharati Krishna Tirthaji, Motilal Banarasidas, New Delhi, 2015. 3. Vedic Mathematics made easy, Dhaval Bhatiya, Jaico Publishing, New Delhi, 2011
2.	Journals & Periodicals:
3.	Other Electronic Resources:

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	5
MCQs	10
Open Book Assignment	15
Article Review / Presentations / Practice Assignments	10
Total	**40**

VACC 201	Tinkering & Mentoring	L	T	P	C
		0	0	2	1
Total Credits: 1	**Total Hours in semester : 30**	**Total Marks: 100**			
1	**Course Pre-requisites: NA**				
2	**Course Category: Value Added Compulsory Course (VACC)**				
3	**Course Revision/ Approval date**				
4	**Course Objectives**				

4.1 To provide hands-on experience in problem-solving and prototyping through group-based tinkering projects.

4.2 To develop entrepreneurial, creative, and critical thinking skills among students.

4.3 To enhance students' understanding of industry standards, intellectual property rights, and ethical practices.

4.4 To foster collaboration, teamwork, and communication skills through multidisciplinary group projects.

4.5 To expose students to real-world case studies, expert insights, and best practices in innovation and sustainability

Course Content	Weightage	Contact hours	Pedagogy
Unit 1 Introduction to Entrepreneurship: Understanding the concept, need, myths, and types of entrepreneurship. Importance of entrepreneurship in innovation and problem-solving.	10%	3	Expert talks, brainstorming sessions, and case studies.
Unit 2 Idea Generation and Feasibility Study: Stages of POC, TRL, MRL, , developing Minimum Viable Products (MVP), assessing product-market fit, and pricing strategies.	20%	4	Interactive mentoring sessions, group brainstorming, and discussions.
Unit 3 Values, Ethics, and Standards: Importance of values in professional and personal growth. Sustainable solutions, eco-friendly systems, and understanding of BIS standards and their role in innovation and industry.	10%	3	Expert talks and group discussion
Unit 4: Tinkering and Prototyping: Hands-on project work in groups to develop solutions for identified problems. Projects will include:	50%	20	Practical tinkering sessions, Faculty

Physical Prototypes for engineering and science students. Conceptual Modules (e.g., software, programs) for IT students. Business Cases or Models for management students. Students will work closely with faculty mentors to brainstorm, design, and create functional prototypes or models.			Mentoring

Learning Resources	
1.	Textbook: N/A – The course relies on expert experiential learning and practical activities.
2.	Reference books 1. "The Lean Startup" by Eric Ries 2. "Zero to One" by Peter Thiel 3. "Intellectual Property Rights: Unleashing the Knowledge Economy" by Prabuddha Ganguli
3.	Journal Articles from Harvard Business Review and MIT Sloan Management Review.
4.	Periodicals Business Standard, Economic Times, and Forbes articles on entrepreneurship and innovation.
5.	Other Electronic resources TED talks, and online courses on prototyping and entrepreneurship.

Sr No	Evaluation Component	Marks
1	**Internal**	**50**
A	Attendance	10
B	Progress Report Presentation - Problem identification, Ideation & Initial Design	15
C	Progress Report Presentation - Progress Review and Prototype Development	15
D	Expert Session Takeaway Report	10
2	**External**	**50**
A	Final Project Presentation and Demonstration	30
B	Viva-Voce	20

Course Outcomes	1. Students will understand entrepreneurial concepts, including business plans, feasibility studies, and product-market fit.
	2. Students will gain insights into intellectual property rights, ethical practices, and sustainability in innovation.
	3. Students will work effectively in teams, demonstrating collaboration, communication, and leadership skills.
	4. Students will connect theoretical knowledge with practical applications through expert talks and hands-on tinkering activities
Additional Information to enhance learning	**Expert Talks**: Delivered by professionals and industry leaders on topics such as entrepreneurship, IPR, and sustainability. **Hands-On Tinkering Projects:** Guided by faculty mentors, with resources provided by GUIITAR.

Semester – III							
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Marks**
A. Major							
1	BSMO311	Microbial Genetics	3	0	1	4	150
2	BSMO312	Introduction To Microbiology And Microbial Diversity	3	0	1	4	150
3	BSMO313	Bacteriology	3	0	1	4	150
B. i. Minor (Compulsory)							
4	BSCM316	Chemistry - I	2	0	1	3	75
C. ii. Minor (Elective)							
5	BSMA316	Mathematics - II	2	1	0	3	75
6	BSPY316	Physics - II	2	0	1	3	
D. Ability Enhancement Course							
7	AECC301	Entrepreneurship Development	2	0	0	2	50
E. Skill Enhancement Course							
8	SECC301	Internship	0	0	2	2	50
					Total	**22**	**700**

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. Major Courses															
1.	BSMO311	Microbial Genetics	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSMO312	Introduction To Microbiology And Microbial Diversity	3	2	0	5	3	1	0	4	20	40	40	100	50	150
3	BSMO313	Bacteriology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
3.	BSCM316	Chemistry – I	2	2	0	4	2	1	0	3	20	40	40	100	50	75
4.	BSMA316	Mathematcs - II	2	0	1	3	2	0	1	3	20	45	75	150	0	75
5.	BSPY316	Physics - II	2	2	0	4	2	1	0	3	20	40	40	100	50	
	C. Ability Enhancement Courses															
6.	AECC301	Entrepreneurship Development	2	0	0	2	2	0	0	2	20	40	40	100	00	50
	D. Skill Enhancement Courses															
7.	SECC301	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	Total									**22**						**700**

COURSE CODE BSMO311 .	COURSE NAME MICROBIAL GENETICS	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisites	Fundamental knowledge of concepts related to genes, genomes and chromosomes.
Course Category	Professional Core Course
Course focus	Employability
Rationale	To have an overview of genome organisation of bacteria. The subject also explains mechanisms of genetic exchange in bacteria and transposable elements present in prokaryotes.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	1. **Remember** Understanding microbial genes, genomes, and gene expression. 2. **Analyze and Differentiate** Types of plasmids 3. **Understand** Microbial replication, transcription and translation. 4. **Illustrate and Discuss** Phage Genetics 5. **Evaluate and Apply** Knowledge of Transposable Elements

Course Content (Theory)	Weightage	Contact hours
Unit 1: Genome Organization E. coli, Saccharomyces, Tetrahymena Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations. Reversion and suppression: True revertant; Intra- and inter-genic suppression; Ames test; Mutator Genes	**20%**	**6**
Unit 2: Plasmids Types of plasmids – F plasmid, R Plasmids, colicin genic plasmids, Ti plasmids, linear plasmids, yeast- 2 µ plasmid, Plasmid replication and partitioning, Host range, plasmidincompatibility, plasmid amplification, Regulation of copy number, curing of plasmids.	**20%**	**6**
Unit 3: Mechanisms of Genetic Exchange No. of Transformation - Discovery, mechanism of natural competence. Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping. Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers.	**20%**	**6**

Unit 4: Phage Genetics Features of T4 genetics, Genetic basis of lytic versus lysogenic switch of phage lambda	**20%**	**6**
Unit 5: Transposable elements Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon. Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds) Uses of transposons and transposition.	**20%**	**6**

List Of Practical	Weightage	Contact hours
1: Study the effect of chemical (HNO2) and physical (UV) mutagens on bacterial cells	**10%**	**4**
2: Study survival curve of bacteria after exposure to ultraviolet (UV) light	**10%**	**4**
3. Isolation of chromosomal DNA from E. Coli	**10%**	**4**
4. Agarose gel electrophoresis of genomic DNA and purity by spectrophotometry	**10%**	**4**
5. Isolation of Plasmid DNA from E. coli.	**10%**	**4**
6. Study different conformations of plasmid DNA through Agarose gel electrophoresis.	**10%**	**4**
7. Demonstration of Bacterial Conjugation	**10%**	**2**
8. Demonstration of Bacterial Transformation	**10%**	**2**
9. Demonstration of Bacterial Transduction	**10%**	**4**
10. Demonstration of AMES test	**10%**	**4**

Instructional Methodand Pedagogy: (Max. 100 words)

PPT, Demonstration, Video, Case study

Course Outcomes: After successful completion of the above course, students will be able:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	To understanding Genome Structure and Mutation Mechanisms	Remember, understand	Explain, Describe, Discuss, Recall,
CO2	To gain knowledge of Plasmid Types and Functionslearn the processes behind mutations and other genetic changes	knowledge	Apply, Practice, Interpret, Select, Correlate
CO3	To understand and apply the mechanisms of Genetic Exchange and Mapping Techniques	Understand, apply, Analyses and Evaluation	Compare, Classify, Select, Investigate
CO4	To learn genetic Basis of Phage Lifecycle Decisions	Remember, understand	Construct, Develop, Produce
CO5	To gain insights into prokaryotic and eukaryotic transposable elements	Understand	Explain, Describe

Learning Resources	
1.	**Reference books:** 1. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings. 2. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India. 3. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings. 4. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press. Maloy SR, Cronan JE and Friefelder D (2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers.
2.	Journals & Periodicals 1. Microbial Genomics 2. Genes 3. Genomics 4. The Scientist
3.	Other Electronic resources: https://www.the-cientist.com/tag/microbiology,genetics-genomics

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

Marks		MCQs	10 marks	
		Open Book Assignment	15 marks	
		Research Paper Review	10 marks	
		Total	**40 Marks**	
Practical Marks				
		Attendance	05 marks	
		Practical Exam	30 marks	
		Viva	10 marks	
		Journal	05 marks	
		Total	**50 Marks**	

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSMO312 .	COURSE NAME INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	2	0	5	3	1	0	4

Course Pre-requisites	Fundamental knowledge of concepts related to microbiology
Course Category	Major
Course focus	Employability
Rationale	To have an overview and understanding of microbiology and microbial diversity. The subject also explains the life cycle and industrial importance of microorganisms.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	1. **Remember** the History of Microbiology 2. **Analyze** different types of microorganisms 3. **Understand** about algae and their life cycle 4. **Apply** the importance of fungi. 5. **Explain** the characteristics of protozoa

Course Content (Theory)	Weightage	Contact hours
Unit 1: History of Development of Microbiology Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Noteworthy Contributions of Scientists. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Development of the field of soil microbiology and important contributions. Establishment of fields of medical microbiology and immunology through notable contributions.	**20%**	**6**
Unit 2 Diversity of Microbial World **A. Systems of classification:** Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms **B. General characteristics of different groups:** Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.	**20%**	**6**

Unit 3 Algae History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Applications of algae in agriculture, industry, environment and food.	**20%**	**6**
Unit 4: Fungi Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic importance of fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration and mycotoxins.	**20%**	**6**
Unit 5: Protozoa General characteristics with special reference to Amoeba, Paramecium, Plasmodium, Leishmania and Giardia An overview of Scope of Microbiology	**20%**	**6**

List Of Practical	**Weightage**	**Contact hours**
1: Preparation of various media, sterilization and testing for sterility	**10%**	**2**
2: Study of Air microflora	**10%**	**4**
3: Preparation of Winogredsky's column and study of different groups	**12%**	**4**
4. Study of Spirogyra and Chlamydomonas, Volvox using temporary Mounts	**12%**	**4**
5. Growth on Sabouraud's agar / PDA and wet mount of fungus	**10%**	**4**
6. Study of Rhizopus, Penicillium, Aspergillus using temporary mounts	**12%**	**4**
7. Study of the following protozoans using permanent mounts/photographs: Amoeba, Entamoeba, Paramecium and Plasmodium	**36%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives: **After successful completion of the above course, students will be able to:**	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
CO1 Describe Key Historical Developments in Microbiology	Remember	Explain, Describe, Discuss, Recall, Locate

CO2	Classify and Differentiate Microorganisms	Apply	Apply, Practice, Interpret, Select, Correlate
CO3	Analyze and Explain the Characteristics and Applications of Algae	Analyses and Evaluation	Compare, Classify, Select, Investigate
CO4	Evaluate the Importance and Characteristics of Fungi	Evaluate	Construct, Develop, Produce
CO5	Describe and Interpret the General Characteristics of Protozoa	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	**Reference Books:** 1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. 2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company. 3. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
2.	Journals & Periodicals 1. Microbiological Research 2. FEMS Microbiology Ecology 3. Journal of Microbiology 4. Microbiology Today
3.	Other Electronic resources: https://microbiologysociety.org/

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
		Research Paper Review	10 marks
		Total	**40 Marks**
Practical Marks			
		Attendance	05 marks
		Practical Exam	30 marks
		Viva	10 marks
		Journal	05 marks
		Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSMO313 .	COURSE NAME BACTERIOLOGY	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisites	Fundamental concepts of microbiology.
Course Category	Major
Course focus	Employability
Rationale	To have an overview of bacterial systematics and classification. The subject also explains the culture methods and techniques used in microbiology for better understanding of bacterial morphology.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	1. **Remember** To recognize, identify and differentiate the internal and external structures of bacterial cells. 2. **Apply** To gain understanding of cultivation, preservation and control of bacteria. 3. **Analyses** To develop basic skills necessary to work with bacterial strains. 4. **Create** To know general techniques for isolation of pure cultures of bacteria. 5. **Understand** To identify categories of bacteria and analyze their classification and diversity.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Cell organization Cell size, shape and arrangement, glycocalyx, capsule, flagella, endo flagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Archaebacterial cell wall and eubacterial cell wall, Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS), spheroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation.	**20%**	**6**
Unit 2: Growth, nutrition and Reproduction in Bacteria Nutritional requirements in bacteria and nutritional categories; Culture media and its types. Physical methods of microbial control. Chemical methods of microbial control. disinfectants, types and mode of action. Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate	**20%**	**6**

Unit 3: Bacteriological techniques & Microscopy Cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing nonculturable bacteria. Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope	**20%**	**6**
Unit 4: Bacterial Systematics Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences. Differences between eubacteria and archaebacterial	**20%**	**6**
Unit 5: Important archaeal and eubacterial groups Archaebacteria: General characteristics, Classification and phylogenetic overview. Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups: Gram Negative: Non proteobacteria: General characteristics and classification with suitable examples. Gram Positive: Low G+ C (Firmicutes): General characteristics with suitable examples High G+C (Actinobacteria): General characteristics with suitable examples. Cyanobacteria: An Introduction."	**20%**	**6**

List Of Practical	**Weightage**	**Contact hours**
1: Study of Bacterial structure and morphology: Simple staining, Gram staining, Acid-fast staining (Demo), motility by hanging drop method	**20%**	**8**
2: Special staining: Capsule, endospore, metachromatic granule, flagella, Cell wa	**20%**	**8**
3. Measurement of cell size by micrometry method	**10%**	**4**
4. Pure culture study and biochemical characterization of bacteria (E. coli, S. aureus, Bacillus, Streptococci)	**10%**	**4**
5. Isolation and enumeration technique: Serial dilution, Standard Plate Count, Colony Forming Unit	**10%**	**4**
6. Preservation by Slant and Glycerol stock	**10%**	**4**
7. Isolation of anaerobic bacteria	**10%**	**4**
8. Preparation of various media (solid, semi solid, broth, synthetic, complex, defined, enriched media, differential and selective, and enrichment media)	**20%**	**8**
9. Isolation of Actinomycetes from soil (slide culture technique)	**10%**	**4**

Instructional Methodand Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Describe characteristics of bacterial cells, cell organelles, cell wall composition and various appendages like capsules, flagella or pili.	Remember	Explain, Describe, Discuss, Recall, Locate
CO2	Describe the nutritional requirements of bacteria for growth.	Apply	Apply, Practice, Interpret, Select, Correlate
CO3	Understand & apply microscopy techniques for identification of bacteria.	Analyses and Evaluation	Compare, Classify, Select, Investigate
CO4	Remember & Understand bacterial systematics	Remember & understand	Construct, Develop, Produce
CO5	Develop knowledge and understanding of the bacteria which grow under extreme environments.	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	**Reference books:** 1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. 2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall 3. Madigan MT, and Martinko JM. (2014). Brock Biology of Microorganisms. 14th edition. Parker J. Prentice Hall International, Inc. 4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht 5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan. 6. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education. 7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education. 8. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
2.	Journals & Periodicals 1. Journal of Bacteriology 2. Microbiological Research 3. World Journal of Microbiology and Biotechnology 4. Microbiology Today
3.	Other Electronic resources: https://microbiologysociety.org/why-microbiology-matters/what-is-microbiology/bacteria.html

Evaluation Scheme	Total Marks
Theory: Mid semester 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
Research Paper Review	10 marks
Total	**40 Marks**

Practical Marks

Attendance	05 marks
Practical Exam	30 marks
Viva	10 marks
Journal	05 marks
Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM316	COURSE NAME CHEMISTRY-I	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	2	0	4	2	1	0	3

Course Pre-requisites	Basic knowledge of physical and organic chemistry.
Course Category	Generic Elective
Course focus	Employability
Rationale	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 halogentaed hydrocarbons, phenols, ethers, epoxides, reactions of Carbonyl Compounds.
Course Revision/ Approval Date:	07/03/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1. To impart the knowledge of thermodynamics. Concept of chemical equilibrium and ionic equilibria. 2. To understand basic organic chemistry reactions. 3. Detailed explanation of preparation and reactions of alkyl and aryl halides. 4. Preparation of alcohols and phenols and the reactions involving them. 5. Knowledge of preparation of ethers and different types of reactions.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Chemical Energetics Review of thermodynamics and the Laws of Thermodynamics (1st, 2nd & 3rd). 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. Kirchhoff's equation.	**20%**	**6**

Unit 2: Chemical Equilibrium Free energy change in a chemical reaction. Law of chemical equilibrium. Distinction between G and Go, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases	**20%**	**6**
Unit 3: 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.	**20%**	**6**
Unit 4: Alcohols and Phenols (Up to 5 Carbons) **Alcohols:** Preparation: Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3). **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	**20%**	**6**
Unit 5: Ethers, Aldehydes and ketones (aliphatic and aromatic) Cleavage of ethers with HI. Aldehydes and ketones (Formaldehyde, acetaldehyde acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles Reactions – Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction MeerweinPondorff Verley reduction.	**20%**	**6**

Instructional Methodand Pedagogy:

PPT, Demonstration, Video, Casestudy

List Of Practical	Weightage	Contact hours
Based on Unit 1 – 5		

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

		Research Paper Review	10 marks	
		Total	**40 Marks**	
Practical Marks				
		Attendance	05 marks	
		Practical Exam	20 marks	
		Viva	10 marks	
		Journal	10 marks	
		Discipline	05 marks	
		Total	**50 Marks**	

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

COURSE CODE BSMA316	COURSE NAME MATHEMATICS-III	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	2	0	4	2	1	0	3

Course Pre-requisites	Basic knowledge of algebra and calculus. Basic knowledge of derivatives and integration.
Course Category	Discipline Specific elective course
Course focus	Skill development
Rationale	This course involves solving the system of linear equations, approximation of root of non-linear equation. Students also learn interpolation methods for equi-distant and non equi-distant data. Also they develop the skill to find numerical integration and differentiation and techniques to solve IVP.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	1: **Solve:** Make the students familiarise with the ways of solving complicated mathematical problems numerically 2:**Understand:** To help them become familiar with MATLAB and other convenient numerical software such as Microsoft Excel and with simple Programming 3: **Recognize, Find:** Obtain numerical solutions to non-algebraic equations and system of linear equations. 4: **Understand:** Describe and understand of the several errors and approximation in numerical methods 5: **Understand, Find:** Understanding of several available Solution techniques for differential Equations in One Variable. Study of Curve Fitting and Interpolation. **Blooms' Taxonomy word** should be highlighted

Course Content (Theory)	Weightage	Contact hours
Unit 1: **Solution of Algebraic and Transcendental Equations:** Bisection, False position, Newton Raphson Method, Secant Method. Solution using Matlab	**20%**	**6**
Unit 2: **Solution of system of Linear Equations:** LU decomposition method, Gauss Jacobi Method, Gauss Seidel method. Solution using Matlab	**20%**	**6**
Unit 3: **Interpolation:** Newton's forward and backward interpolation, Newton's divided difference interpolating polynomials, Lagrange Interpolating polynomials. Solution using Matlab.	**20%**	**6**
Unit 4: **Numerical Integration:** Trapezoidal rule, Simpson's one third and 3/8th rule. Solution using Matlab **Curve Fittings:** General Linear Least Squares, Fitting of quadratic and exponential curves. Solution using Matlab.	**20%**	**6**
Unit 5:	**20%**	**6**

Numerical methods for Solution of ordinary differential equation: Euler's method, Modified Euler's Method, Runge Kutta forth ordered method, Solution using Matlab.		

List Of Practical	Weightage	Contact hours
1: Introduction to MATLAB, Matrix algebra, functions	**7%**	**2**
2: Loops: For, if else , while Programme for Bisection Method	**7%**	**2**
3: Programme for Regula-falsi and Secant Method	**7%**	**2**
4: Programme for Newton-Raphson's Method	**7%**	**2**
5: Programme for Difference Table	**7%**	**2**
6. Programme for Newtons's Forward and Beckward Interpolation	**8%**	**2**
7. Programme for Newtonds Divided Difference Interpolation Method	**7%**	**2**
8. Programme for Lagrange's Method	**7%**	**2**
9. Use of Curve fitting Toolbox	**7%**	**2**
10. Programme for Numerical integrations (Trapezoidel and simpson's rules)	**8%**	**2**
11. Solving system of linear equations	**7%**	**2**
12. Plotting 2D and 3D graphs	**7%**	**2**
13. Programme for Euler's Method	**7%**	**2**
14. Practive test and Revision	**7%**	**4**

Instructional Method and Pedagogy: (Max. 100 words) Chalk-board, Presentation, Use of Mathlab, Excel and Geogebra. Group Discussion, Case Study, Quizziz application.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: **Apply, solve:** Apply numerical methods to find out solution of non-algebraic equations using different methods	**Apply**	Describe, Find
CO2: **Apply, solve:** Apply numerical methods to find numerical solution of system of linear equations.	**Understand, Remember**	Demonstrate & Examine, Find
CO3: **Demonstrate, find:** Apply various interpolation methods and finite difference concepts	**Understand, Remember**	Demonstrate & Examine, Find
CO4: **Demonstrate:** Work out numerical integration and Cure Fitting whenever and wherever routine methods are not applicable	**Evaluate**	Examine, Find
CO5: **Solve:** Work numerically on the ordinary differential equations using different methods through the theory of finite differences.	**Understand, Remember, Apply & Analyse**	Define, Classify, Describe, Demonstrate & Examine

Learning Resources

1.	Reference Books: 1 **S.** S. Sastry, .**Introductory methods of** Numerical **Analysis, 5th Edition, Prentice-Hall India, 2012** **2. G. Shankar Rao, Numerical Analysis, New Age International Pvt. Ltd., 2006** **3. P.C. Biswal, Numerical Analysis, Prentice-Hall India, 2008**
2.	Journals & Periodicals: Mathematics Open
3.	Other Electronic Resources: **MATLAB, Microsoft Excel, Geogebra Toolbox**

Evaluation Scheme	**Total Marks**
Theory: Mid semester 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 **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks Discipline: 05 marks **Total: 50 Marks**

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

COURSE CODE BSPY317	COURSE NAME PHYSICS-II	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	2	0	4	2	1	0	3

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

Course Content (Theory)	Weightage	Contact hours
Unit 1: Vector Analysis 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	**12%**	**6**
Unit 2: **Electrostatics** 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	**23%**	**14**
Unit 3: Magnetostatics Biot-Savart's law and its applications - straight conductor, circular coil,	**23%**	**14**

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. Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in the magnetic field.		
Unit 4: : Laws of Thermodynamics 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 & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero	**22%**	**14**
Unit 5: Thermodynamic Potentials 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.	**20%**	**12**

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

Instructional Methodand Pedagogy: (Max. 100 words)
PPT, Demonstration, Video,Case study

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

Learning Resources	
1.	Reference Books: 1. C. Chattopadhyay, R. Rakshit, **Electricity and Magnetism** (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), Societyof Physics Students.
3.	Other Electronic Resources: **Feynman Lectures in Physics: https://www.feynmanLectures.caltech.edu/**

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

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

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 AECC301	COURSE NAME ENTREPRENEURSHIP DEVELOPMENT	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

Course Pre-requisites	Knowledge and skills of entrepreneurship.
Course Category	Ability Enhancement Compulsory Course
Course focus	Entrepreneurship
Rationale	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.
Course Revision/ Approval Date:	14/03/2020
Course Objectives (As per Blooms' Taxonomy)	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 entrepreneurialventures 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 andviable Businesses.

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

Unit 2: Creativity and Entrepreneurship 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**
Unit 3: Feasibility Study (Non-financial Aspects) Market feasibility, Technical feasibility, operational feasibility, Legal feasibility, Human Resource Feasibility, Supply Feasibility.	**20%**	**6**
Unit 4:Feasibility Study (financial Aspects) 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 & AngelInvesting	**20%**	**6**
Unit 5: Detailed Project Report & Business Plan 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**
After successful completion of the above course, students will beable to:		
CO1 Students will develop skills for evaluating, articulating, refining, and pitching a new product or service offering.	Evaluate	Define,Classify and describe
CO2 Identify the elements of success of entrepreneurial ventures	Apply and Understand	Define,Classify, Describe,Demostrate and Examine
CO3 Analyze Feasibility of the project (Financial and Non-Financial) and interpret business plan	Analyse	Define,Classify, Describe,Demostrate and Examine
CO4 Demonstrate and present successful work, collaboration and division of tasks in a multidisciplinary and multicultural team.	Create and Understand	Define,Classify, Describe,Demostrate and Examine
CO5: Demonstrate understanding and application of the tools necessary to create sustainable and viable Businesses	Create and Understand	Define,Describe and Demostrate

Learning Resources	
1.	**Textbook:** 1. Fundamentals of Entrepreneurship. 2. Managing Entrepreneurship.
2.	**Reference books** 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 -https://www.jemi.edu.pl/
5.	Other Electronic resources:https://innovation-entrepreneurship.springeropen.com/

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

School of Science

Semester – IV							
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Marks**
A. Major							
1	BSMO411	Industrial Microbiology	3	0	1	4	150
2	BSMO412	Recombinant DNA Technology	3	0	1	4	150
3	BSMO413	Microbial Physiology & Metabolism	3	0	1	4	150
B. i. Minor (Compulsory)							
4	BSCM417	Chemistry – II	2	0	1	3	75
B. ii. Minor (Elective)							
5	BSMA415	Biostatistics	2	1	0	3	75
6	BSPY415	Biophysics	2	0	1	3	
C. Ability Enhancement Course							
8	AECC401	Environmental Science	2	0	0	2	50
D. Skill Enhancement Course							
9	SECC401	Internship	0	0	2	2	50
					Total	**22**	**700**

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. Major Courses															
1.	BSMO411	Industrial Microbiology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSMO412	Recombinant DNA Technology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
3	BSMO413	Microbial Physiology & Metabolism	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
4.	BSCM415	Chemistry – II	2	2	0	4	2	1	0	3	20	40	40	100	50	75
5.	BSMA415	Biostatistics	2	0	1	3	2	0	1	3	20	45	75	150	0	75
6.	BSPY415	Biophyscics	2	2	0	4	2	1	0	3	20	40	40	100	50	
	C. Ability Enhancement Courses															
7.	AECC401	Environmental Science	2	0	0	2	2	0	0	2	20	40	40	100	00	50

	D. Skill Enhancement Courses															
8.	SECC301	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	Total									**22**						**700**

COURSE CODE BSMO411 .	COURSE NAME INDUSTRIAL MICROBIOLOGY	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	2	0	5	3	1	0	4

Course Pre-requisites	Fundamental knowledge of industrial use of microorganisms.
Course Category	Major
Course focus	Employability
Rationale	To have an overview and understanding of industrially important microorganisms. The subject also explains the different types of fermentation processes, bioreactors and production of microbial products.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	1. **Remember** the Basics of Industrial Microbiology and Fermentation Processes 2. **Understand** Types of Bioreactors and Fermentation Parameter Measurements Analyses To study microbial classification. 3. **Analyze** Techniques in Upstream and Downstream Processing 4. **Evaluate** Microbial Production of Industrial Products 5. **Apply** Methods for Enzyme Immobilization

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to industrial microbiology and Fermentation Process Brief history and developments in industrial microbiology. Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations.	**20%**	**6**
Unit 2: Types of bioreactors and measurement of fermentation parameters Components of a typical bioreactor. Types of bioreactors: Laboratory, pilot-scale and production fermenters, continuously stirred tank reactor, air-lift fermenter. Measurement and control of fermentation parameters: pH, temperature, dissolved oxygen, foaming and aeration.	**20%**	**6**
Unit 3: Upstream and Downstream processing **Upstream processing :** Sources of industrially important microbes and their isolation, preservation and maintenance methods. Crude and synthetic media: Molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract, soybean meal, peptone and tryptone. **Downstream processing:** Cell disruption by physical, chemical and biological methods. Membrane filtration and ultrafiltration, centrifugation, solvent-solvent extraction, precipitation, lyophilization and spray drying.	**20%**	**6**
Unit 4: Microbial production of industrial products Microorganisms, fermentation and recovery strategies: citric acid, ethanol, glutamic acid, Vitamin B12. wine, beer, antibiotics (penicillin, streptomycin). Enzymes: amylase, protease, lipase, glucose isomerase and glucose oxidase.	**20%**	**6**

Unit 5: Enzyme immobilization Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).	**20%**	**6**

List Of Practical	Weightage	Contact hours
1. Screening and Isolation of industrially important microorganism from natural resource (enzyme/ antibiotic/organic acid producer)	**10%**	**4**
2. Calculation of thermal death point (TDP) of a microbial sample.	**10%**	**4**
3. Study parts of bioreactor and its design	**10%**	**4**
4. Measure the dissolve oxygen in the fermentation broth	**10%**	**4**
5. Preparation of Inoculum (cell count of yeast cell using haemocytometer)	**10%**	**4**
6. Preparation of fermentation media	**10%**	**4**
7. Product recovery and Purification	**10%**	**4**
8. Antibiotic Assay (Well and Disk method)	**10%**	**4**
9. Enzyme Immobilization	**10%**	**4**
10. Production and Analysis of Ethanol	**10%**	**4**
11. Production and Analysis of amylase	**10%**	**4**

Instructional Method and Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Explain the Fundamentals of Industrial Microbiology and Fermentation Processes	Remember	Knowledge and Comprehension
CO2	Analyze and Classify Different Types of Bioreactors	Analyze	Apply, Practice, Interpret, Select, Correlate
CO3	Evaluate Upstream and Downstream Processing Techniques	Analyses and Evaluation	Compare, Classify, Select, Investigate
CO4	Develop Strategies for Microbial Production of Industrial Products	Create	Construct, Develop, Produce
CO5	Apply Techniques for Enzyme Immobilization and Evaluate Their Industrial Applications	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources

1.	**Reference Books:** 1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. 2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company. 3. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science
2.	Journals & Periodicals 1. Current Science 2. Advances in Industrial Microbilogy
3.	Other Electronic resources: NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester 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**
Practical Marks	Attendance: 05 marks Practical Exam: 30 marks Viva: 10 marks Journal: 05 marks **Total: 50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSMO412 .	COURSE NAME RECOMBINANT DNA TECHNOLOGY	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	2	0	5	3	1	0	4

Course Pre-requisites	Fundamental knowledge of genes, genomes and genetic engineering.
Course Category	Professional Core Course
Course focus	Employability
Rationale	This course equips students with essential knowledge and practical skills in molecular tools, PCR, genetic engineering, protein engineering, and plant genetic engineering, preparing them for applications in biotechnology and research.
Course Revision/ Approval Date:	07/03/2024
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember& Understand** Molecular Tools and Applications 2. **Apply** Principles of PCRand Genetic Mapping 3. **Analyses** Genetic Engineering Techniques and Therapeutic Applications 4. **Create** Modelorganisms in recombinant DNA technology 5. **Create** Genetic Engineering Strategies in Plants

Course Content (Theory)	Weightage	Contact hours
Unit 1: Molecular tools and applications Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication.	**20%**	**6**
Unit 2: Polymersae chain reaction 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 ofrecombinants, reverse transcription.	**20%**	**6**

Unit 3: Genetic Engineering and Therapeutic Applications 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 engineeringblood proteins, human hormones, immune modulators and vaccines (one example each).	**20%**	**6**
Unit 4: Advanced Techniques in Protein Engineering 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%**	**6**
Unit 5: 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%**	**6**

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 Methodand 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:		
CO1 Understand the Principles and Applications of Molecular Tools in Genetic Engineering	Understand and Analyse	Explain, Describe, Discuss, Recall,
CO2 Apply PCRTechniques and Genetic Analysis Methods	Apply and create	Apply, Practice, Interpret, Select, Correlate
CO3 Evaluate Genetic Engineering Applications and Therapeutic Uses	evaluate	Compare, Classify, Select, Investigate
CO4 Analyze Advanced Techniques in Protein Engineering	Analyze	Construct, Develop, Produce
CO5 Apply Genetic Engineering Principles to Plant Biotechnology	Create	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	**Reference books:** 1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K. 2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA. 3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington. 4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K. 5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
2.	**Journals & Periodicals** 6. Current Science in RDNA technology 7. Advances in R-DNATechnology
3.	Other Electronic resources: NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester 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**
Practical Marks	Attendance: 05 marks Practical Exam: 30 marks Viva: 10 marks Journal: 05 marks **Total: 50 Marks**

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 BSMO413 .	COURSE NAME MICROBIAL PHYSIOLOGY & METABOLISM	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisites	Fundamental concepts of microbial growth, nutrition and biochemistry.
Course Category	Professional Core Course
Course focus	Employability
Rationale	To have an overview of microbial growth and physiological processes. The subject also explains the nutrient uptake and transport mechanism in microorganisms.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	1. **Remember** To learn about the major features of growth and metabolism of microorganisms, and microbial relationships. 2. **Apply** To study determination of growth curve environmental influence on the microbial growth. 3. **Analyses** To study the biology and evolution of microorganisms and their interactions with the environment. 4. **Create** To learn about and primary and secondary metabolism. 5. **Understand** To explore about energy source for microorganisms and relationship between metabolism and energy source.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Microbial Growth and Effect of Environment on Microbial Growth. Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve. Microbial growth in response to environmental conditions (Temperature, pH, solute and water activity, Oxygen and pressure). Microbial growth in response to nutrition and energy sources.	**20%**	**6**
Unit 2: Nutrient uptake and Transport Passive and facilitated diffusion. Primary and secondary active transport, concept of uniport, symport and antiport. Group translocation, Iron uptake.	**20%**	**6**

Unit 3: Chemoheterotrophic Metabolism- Aerobic Respiration. Concept of aerobic respiration, Concept of anaerobic respiration and fermentation. Sugar degradation pathways. Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors. Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/Nitrite and nitrate/ammonia respiration; fermentative nitrate reduction). Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways	**25%**	**8**
Unit 4: Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. Oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria.	**20%**	**6**
Unit 5: Nitrogen Metabolism - an overview Introduction to biological nitrogen fixation Ammonia assimilation Assimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification.	**20%**	**6**

List Of Practical	Weightage	Contact hours
1. Study and plot the growth curve of E. coli by turbidometry and standard plate count methods.	**10%**	**4**
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.	**10%**	**4**
3. Diauxic growth curve of E. Coli (Lac Operon)	**10%**	**4**
4. Effect of desiccation/drying on the growth of bacteria	**10%**	**4**
5. Effect of temperature on growth of E. coli and S. aureus	**10%**	**4**
6. Effect of pH on growth of E. coli and S. aureus	**10%**	**4**
7. Effect of Temperature, pH, concentration of salt (NaCl) and Sugar (glucose) on growth of E. coli and S. aureus (Turbidimetry)	**10%**	**4**
8. Effect of carbon and nitrogen sources on growth of E. coli.	**10%**	**4**
9. Effect of salt on growth of E. coli.	**10%**	**4**
10. Single Enzyme test: (Catalase test, Coagulase test, Oxidase test, Indole test, ONPG (O-nitrophenyl-beta-D-galactopyranoside), Urease	**10%**	**4**
11. Metabolic Pathway: Carbohydrate fermentation/ Oxidation- fermentation test (Oxidative fermentative -medium -CDC test, -Carbohydrate fermentation on TSI -MR/VP test	**10%**	**4**

12. Decarboxylase/Di hydrolase test Deaminase reaction test (Phenylalanine agar) Lysine decarboxylase test Citrate Utilization (Simmons citrate agar) Nitrate reduction test Gelatin liquification test		

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
CO1	Describing the growth characteristics of the microorganisms capable of growing under unusual environmental condition of temperature, oxygen, and solute and water activity	Remember	Explain, Describe, Discuss, Recall, Locate
CO2	Describing the growth characteristics of the microorganisms capable of growing under unusual environmental condition of temperature, oxygen, and solute and water activity	Apply	Apply, Practice, Interpret, Select, Correlate
CO3	Differentiating concepts of aerobic and anaerobic respiration and how these are manifested in the form of different metabolic pathways in microorganisms	Analyses and Evaluation	Compare, Classify, Select, Investigate
CO4	Differentiating concepts of aerobic and anaerobic respiration and how these are manifested in the form of different metabolic pathways in microorganisms	Create	Construct, Develop, Produce
CO5	Describing the growth characteristics of the microorganisms which require different nutrient for growth and the associated mechanisms of energy generation for their survival like autotrophs, heterotrophs, chemolithoautotrophs etc	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	**Reference books:** 1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag 2. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press. 3. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
2.	**Journals & Periodicals** 1. Current Science 2. Advances in Microbiology
3.	Other Electronic resources: NPTEL

<table>
<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
<tr><td>Theory: Mid semester Marks</td><td>20 marks</td></tr>
<tr><td>Theory: End Semester Marks</td><td>40 marks</td></tr>
<tr><td>Theory: Continuous Evaluation Component Marks</td><td>
<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>Total</td><td>40 Marks</td></tr>
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<tr><td>Practical Marks</td><td>
<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>Total</td><td>50 Marks</td></tr>
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Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM415	COURSE NAME CHEMISTRY II	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	2	0	4	2	1	00	3

Course Pre-requisites	Basic knowledge of physical and organic chemistry
Course Category	Generic elective
Course focus	Employability
Rationale	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.
Course Revision/ Approval Date:	14/03/2023
Course Objectives **(As per Blooms' Taxonomy)**	1. To impart the knowledge of solution state and the laws governing thereof. 2. To equip the students with the indepth knowledge ofPhase equilibria and their industrial relevance 3. To make the students skilled in operating electroanalytical devices, like, pH meter, potentiometer and conductometery by imparting fundamental knowledge of electrochemistry 4. To impart knowledge pertaining to carboxylic acids, Amines and diazonium Salts. 5. To equip the students with knowledge ofamino acids, peptides and proteins and the properties and conversions thereof.

Course Content (Theory)	Weightage %	Contact hours
Unit 1: Solutions Thermodynamics of ideal solutions Ideal solutions and Raoult's law, deviations from Raoult's law – nonideal solutions. Vapour pressure-composition and temperature composition 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**	**6**

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 and two component systems	**20**	**6**
Unit 3: Conductance & Conductivity Introduction, Equivalent and molar conductivity and thei 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.	**20**	**6**
Unit 4: Carboxylic acids and their derivatives (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions Hell – Volhard - Zelinsky Reaction. Acid chlorides, Anhydrides Esters and Amides from acids and their interconversion Reactions: Comparative study of nucleophilicity of acy 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 tes Hinsberg test, with HNO_2, Schotten – Baumann Reaction Electrophilic substitution (case aniline): nitration, bromination sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.	**20**	**12**
Unit 5: Amino Acids, Peptides and Proteins	**20**	**12**

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Isoelectric point and Electrophoresis. Reactions of Amino acids: ester of –COOH group, acetylation of –NH2 group, complexation with Cu2+ ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by N-terminal and C–terminal. Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, ascending and descending in monosaccharides. Structure of disacharrides and polysacharrides.		

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) ofa 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, $(NH_4)_2Ni(SO_4)_2.6H_2O$	**15**	**4**
6. To prepare hexakis thiourea plumbus (II) nitrate hexahydate	**15**	**4**
7. To prepare tetraamine copper sulphate	**10**	**4**

Instructional Methodand Pedagogy:

Classroom lecture, discussion, question and answer method, Casestudies, quizes, presentations, role play, expert lecture(Consultant)

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

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

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

Evaluation Scheme	**Total Marks**
Theory: Mid semester 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**
Practical Marks	Attendance: 05 marks Practical Exam: 30 marks Viva: 10 marks Journal: 05 marks **Total: 50 Marks**

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

COURSE CODE BSMA415	COURSE NAME BIOSTATISTICS	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	1	3	2	0	1	3

Course Pre-requisites	Students should have basic knowledge of Calculus & Algebra.
Course Category	Core course
Course focus	Skill development
Rationale	Biostatistics is the application of statistical methods to biological, health, and medical data. It involves collecting, analysing, and interpreting data to draw meaningful conclusions in fields like epidemiology, genetics, and public health. Biostatisticians design experiments, develop models, and utilize advanced statistical techniques to uncover patterns, trends, and relationships within biological systems. They play a crucial role in medical research, clinical trials, and public health interventions by providing insights into disease prevention, treatment effectiveness, and healthcare policies.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Remember:** Use discrete and continuous probability distributions, including requirements, mean and variance, and making decisions. 2. **Apply:** Use Poisson, exponential distributions to solve statistical problems. 3. **Understand, Apply:** Identify the type of statistical situation to which different distributions can be applied. 4. **Understand:** Define and distinguish between population parameters and sample statistics. 5. **Understand, Apply:** Explain what is meant by statistical inference..

Course Content (Theory)	Weightage	Contact hours
Unit 1: Concept of sampling, Introduction to Probability, basic results and theorems of Probability.	**20%**	**6**
Unit 2: Concept of random variable, Probability distribution of random variable, Expectation and variance.	**20%**	**6**
Unit 3: Study of Binomial, Poisson and Normal Distribution, Application of this distribution in Bio –Sciences.	**20%**	**6**
Unit 4: Basic principles of statistical inference, Point estimation, Internal estimation, Statistical Hypothesis framing.	**20%**	**6**
Unit 5: Test of Significance, p- value, t – test, F – test, chi – square test, ANOVA etc.	**20%**	**6**

List Of Practical	Weightage	Contact hours

1: Tutorials Based on Basic Probability.	**20%**	**3**
2: Tutorials Based on Probability distribution and random variables.	**20%**	**3**
3: Tutorials based on Binomial, Poisson and Normal Distribution.	**20%**	**3**
4: Tutorials based on Hypothesis testing.	**20%**	**3**
5: Tutorials based on Tests of Significance	**20%**	**3**

Instructional Method and Pedagogy: (Max. 100 words) Chalk-board, PPT, Computer Based learning, Use of M.S. Excel and Geogebra Toolbox.

Course outcome:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Understand :** Define and distinguish between populations and samples CO2: **Apply:** Compute a sample and polulation mean, sample variance, and sample standard deviation CO3: **Remember, Understand:** Know the practical issues arising in sampling studies. CO4: **Apply, Analyse:** Appropriately interpret results of analysis of variance tests. CO5: **Analyse:** Analyse statistical data using MS-Excel.		

Learning Resources	
1.	Reference Books: 1. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc. 2. Fundamentals of Mathematical Statistics by S C Gupta & V K Kapoor, Sultan Chand & Sons, New Delhi 2009. 3. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA 4. Glaser AN (2001) High Yield TM Biostatistics. Lippincott Williams and Wilkins, USA.
2.	Journals & Periodicals: **Style:** name of the journal, volume (issue number), range of pages, and year.
3.	Other Electronic Resources: Geometry and Algebra: Geogebra.org/Calculator MATLAB : Mathworks.com/ **https://www.tutorialspoint.com/matlab/matlab_syntax.htm**

Evaluation Scheme	Total Marks
Theory: Mid semester 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
Total	**40 Marks**

Practical Marks

Attendance	05 marks
Practical Exam	20 marks
Viva	10 marks
Journal	10 marks
Discipline	05 marks
Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE	COURSE NAME	SEMESTER
BSPY415	Biophysics	IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

Course Pre-requisites	Understanding of basic sciences up to school level (10+2 level).
Course Category	Mandatory courses
Course focus	Employability
Rationale	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.
Course Revision/ Approval Date:	14/03/2020
Course Objectives (As per Blooms' Taxonomy)	Course Objectives: Students will be able to: 1: To provide introductory knowledge of Biophysics to the students 2: To familiarize students with relevant applications required for study of biological systems 3: To enable the students to address any elementary thermodynamic problems in biological systems 4: To familiarize the student with chemical thermodynamics of biological systems 5: To familiarize students with modern developments in the area of biomaterials

Course Content (Theory)	Weightage	Contact hours
Unit 1: Building Blocks & Structure of Living State: 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.	**20%**	**6**
Unit 2: Heat Transfer in biomaterials: Heat TransferMechanism, The Heat equation, Joule heating of tissue. Living State Thermodynamics: Thermodynamic equilibrium.	**20%**	**6**
Unit 3: Thermodynamics: 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.	**20%**	**6**

Unit 4: Thermodynamics: Open systems and chemical thermodynamics: Enthalpy, Helmholtz Free energy, Gibbs Free Energy and chemical potential.	**20%**	**6**
Unit 5: Thermodynamics: Activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Haemoglobin.s	**20%**	**6**

List Of Practical	Weightage	Contact Hours
Based on theory		

Instructional Method and Pedagogy: (Max. 100 words)
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: CO1:Students will have sufficient knowledge of Biophysics for undergraduate studies	Understand	Describe
CO2: Students will be familiar with concepts that help them prepare for modern courses like Bioinstrumentation.	Understand and Create	Describe
CO3: Students will be able to understand and appreciate the interdisciplinary nature of the modern researches	Evaluate and Analyse	Describe and Explain
CO4: Students will be able to prepare working models on Biophysical systems	Remember, Apply and Create	Describeand classify
CO5: Students will be able to continue learning through various e-resources	Understand and Apply	Classify and Explain

Learning Resources	
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 (https://onlinecourses.nptel.ac.in/noc20_ph02/preview)

Evaluation Scheme	**Total Marks**
Theory: Mid semester 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
Research Paper Review	10 marks
Total	**40 Marks**

Practical Marks	

Attendance	05 marks
Practical Exam	30 marks
Viva	10 marks
Journal	05 marks
Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

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

COURSE CODE AECC401	COURSE NAME ENVIRONMENTAL SCIENCE	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

Course Pre-requisites	10 +2 (With Arts/Science/Commerce)
Course Category	Ability Enhancement Compulsory Course.
Course focus	Employability
Rationale	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.
Course Revision/ Approval Date:	07/03/2024
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Remember:** To acquire an awareness of and sensitivity to the total environment and its allied problems. 2. **Understand:** Tomake educatedjudgments about environmental issues. 3. **Apply:** Develop skills and a commitment to act independently and collectively to environmental sustainability 4. **Analyse:** Students can able to debate environmental science with use of appropriate scientific information 5. **Create:** Engaging with students of all disciplines to think critically, ethically, and creatively when evaluating environmental issues.

Course Content (Theory)	Weightage	Contact hours
Unit 1: 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
Unit 2: Unit 2: Ecological pyramids of various ecosystems Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic ecosystem, Estuarine Ecosystem.	20%	6
Unit 3: 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

Unit 4: 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
Unit 5: 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 Methodand Pedagogy:

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

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Subdomain
After successful completion of the above course, students will be able to:		
CO1: Skills for identifying environmental problems: Evaluate information frompopular electronic and print media	Understand & remember	Define, Classify & Describe
CO2: 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
CO3: 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
CO4: 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
CO5: 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.	Reference/Text Books: 1. Fundamentals of Ecology by EP Odum Cengage 2. Big Questions in Ecology & Evolution by TN Sherratt & DMWilkinson, Oxford. 3. Ecology: Experimental Analysis of Distribution & Abudance by CJ Krebs,Pearson Education, London 4. Concept of Ecology by EJ Kormondy, Pearson Education, London 5. Conservation Biology: Voices from the Tropics. Bys Sodhi, N.S., Gibson, L. & Raven, P.H. (eds) John Wiley & Sons 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 7. Fundamental concepts in Environmental studies by DD Mishra, S. Chand Publishing, India 8. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by PS Verma and VK Agarwal, S. Chand Publication, India 9. Fundamentals of Ecology by PD Sharma, Rastogi Publications
2.	Journals & Periodicals: 1. Environmental Pollutants and Bioavailability 2. Clean Air Journal 3. Emerging Contaminants 4. Environment: Science and Policy for Sustainable Development 5. Annual Review of Environment and Resources 6. Renewable Energy 7. Renewable & Sustainable Energy Reviews
3.	Other Electronic Resources: 1. Green.tv—supported by UNEP—broadband TV channelfor films about environmental issues. 2. Climate Change TV—funded by companies, governments andorganisations, andproduced by the magazine Responding to Climate Change—the world's first web channel specific to climate change videos. 3. Terra:The Nature of Our World video podcast produced in conjunction with the Master of Fine Arts program in Science & Natural History Filmmaking at Montana State University, Filmmakers for Conservation, and PBS—weeklyvideo show about science andnatural history.

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	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

Semester – V							
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Marks**
A. Ability Enhancement Compulsory Course							
1	AECC501	Disaster Risk Management	2	0	0	2	100
B. Skill Enhancement Courses							
2	SECC504	Internship	0	0	2	2	50
C. Core Course							
3	BSMO511	Bioanalytical Tools	3	0	2	5	150
4	BSMO512	Medical Microbiology	3	0	2	5	150
D. Minor Electives (Any one)							
5	BSMO513	Agriculture Microbiology	3	0	1	4	150
	BSMO514	Microbial Biotechnology	3	0	1	4	
E. Minor Compulsory							
6	BSMO515	Virology	3	0	1	4	150
					Total	22	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	2	0	0	0	0	50	50
	C. Core Course															
3	BSMO511	Bioanalytical Tools	3	4	0	7	3	2	0	5	20	40	40	100	50	150
4	BSMO512	Medical Microbiology	3	4	0	7	3	2	0	5	20	40	40	100	50	150
	D. Minor Electives (Any One)															
5	BSMO513	Agriculture Microbiology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	BSMO514	Microbial Biotechnology	3	2	0	5	3	1	0	4	20	40	40	100	50	
	E. Minor Compulsory															
6	BSMO515	Virology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
		Total								**22**						**750**

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

COURSE CODE BSEN501	COURSE NAME DISASTER RISK MANAGEMENT	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

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

Course Content (Theory)	Weightage	Contact hours
Unit 1: 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, Biological Disasters, Technological Disasters, and Man-made Disasters.	**20%**	**06**

Unit 2: Disaster Management Cycle and Framework- 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.	**20%**	**06**
Unit 3: Disaster Profile of India – Mega Disasters of India, 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), Disaster Management Act in relation to COVID 19 Pandemic.	**20%**	**06**
Unit 4: 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).	**20%**	**06**
Unit 5: 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%**	**06**

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 Objectives:		**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
CO1	On completion of this course, students should be able to Possess awareness to mitigate the effects of disaster.	Understand, Remember& apply	Explain, Describe, Discuss
CO2	On completion of this course, students should be able to Know local disaster management policies, regulations and authorities.	Apply	Apply, Practice, Interpret, Select, Correlate
CO3	On completion of this course, students should be able to Understand role of science in mitigating disasters.	Understand and Remember	Apply and Practice
CO4	On completion of this course, students should be able to understand the role of science in mitigating disasters.	Apply	Construct, Develop, Produce

CO5	On completion of this course, students should be able to contribute to safe society by the study of various disasters.	Understand, Remember& apply	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1	**Reference Books:** 1. Alexander, D., Natural Disasters, Kluwer Academic London. 2. Asthana, N. C., Asthana P., Disaster Management, Aavishkar Publishers. 3. Carter, N., Disaster Management: A Disaster Manager's Handbook, Asian Development Bank. 4. Collins, A.E., Disaster and Development, Routledge. 5. Coppola, D.P., Introduction to International Disaster Management, 2nd Edition, Elsevier Science. 6. Goyal, S.L., Encyclopedia of Disaster Management (Vols. 1-3), Deep & Deeep, New Delhi 7. Gupta, A.K., Nair, S.S., Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi. 8. Ibrahimbegovic, A., Zlatar, M., Damage Assessment and Reconstruction after War or Natural Disaster, Springer. 9. Menshikov, V.A., Perminov, A.N., Urlichich, Y.M., Global Aerospace Monitoring and Disaster 10. Modh, S., Introduction to Disaster Management, Macmillian Publishers India 11. Srivastava, H.N., Gupta, G.D., Management of Natural Disasters in Developing Countries, Daya Publishers, NIDM AND NIDMA publications
2	Journal: • GSDMJ, disaster management act
3	Other Electronic resources: GIDM and NIDM.

Evaluation Scheme	**Total Marks**
Theory: Mid semester 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 and CO for Agriculture Microbiology:

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

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

Mapping of PO and CO for Disaster Risk Management

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

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

COURSE CODE BSMO511	COURSE NAME BIOANALYTICAL TOOLS	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	4	0	7	3	2	0	5

Course Pre-requisites	Students should have basic knowledge about biological analytical tools for deep understanding of theory and practical.
Course Category	Core Professional
Course focus	Employability
Rationale	To understand the principle of various biophysical techniques.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	1. Remember: To gain knowledge on the various Microscopic techniques for observation of biomolecules. 2. Apply: To understand the principle of various biophysical techniques. 3. Analyses: To understand the instrumentation and application of various cell fractionation techniques. 4. Apply: To learn various biophysical techniques for purification of the biomolecules. 5. Understand: To learn various biophysical techniques for characterization of the biomolecules.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Microscopy: Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM).	**20%**	**8**
Unit 2: Photometry Techniques: Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red).	**20%**	**8**
Unit 3: Cell fractionation techniques: Centrifugation, isolation of sub- cellular organelles and particles.	**20%**	**8**

Unit 4: Chromatography Techniques: 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.	**20%**	**11**
Unit 5: Protein Purification Techniques: Introduction to electrophoresis. Polyacrylamide gel (Native and SDS-PAGE). Zymography, pulse field gel electrophoresis, isoelectric focusing.	**20%**	**10**

List of Practical

List of Practical	**Weightage**	**Contact hours**
1. Paper and TLC of amino acids and plant pigments.	**20%**	**8**
2. Demonstration of Fluorescence microscope	**10%**	**4**
3. Preparation of protoplasts/spheroplast from leaves/ Bacteria	**20%**	**4**
4. SDS PAGE of Protein	**20%**	**8**
5. Working of HPLC, GC (Demo)	**10%**	**6**
6. Verify Beer's Lambert's law using $KMNO_4$	**10%**	**4**
7. Separation of serum and blood cells	**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.

Course Objectives:		**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
CO1	Assimilate the principles and applications of microscopic techniques.	Understand, Remember	Explain, Describe, Discuss
CO2	Characterize certain functionalities of biomolecules by using spectroscopic techniques.	Apply	Practice, Interpret, Select, Correlate
CO3	Employ the knowledge for the separation of proteins/peptides by selecting appropriate separation techniques.	Apply	Apply and Practice

CO4	Assimilate the principles and applications of chromatography in research and related experiments.	Create	Construct, Develop
CO5	Plan experiments for separations and Characterization of biomolecules	Apply, Understand & Remember	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1.Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India. 2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India. 3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York. 4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon. 5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India. 6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London. 7. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India. 8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD. 9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
2.	Journals & Periodicals 1. Journal of Food Science 2. Current opinion on Food Sciences.
5	Other Electronic resources: 1. NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester 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 Marks	**40 Marks**	
Practical Marks	Attendance	05 marks	
	Practical Exam	30 marks	
	Viva	10 marks	
	Journal	05 marks	
	Total	**50 Marks**	

Mapping of PSOs and COs

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

Mapping of POs and COs

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

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

COURSE CODE	COURSE NAME: MEDICAL MICROBIOLOGY	SEMESTER
BSMO512		**V**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	4	0	7	3	2	0	5

Course Pre-requisites	Students should have basic knowledge Medical Microbiology
Course Category	Core Professional.
Course focus	Employability
Rationale	To have an overview about the Medical Microbiology
Course Revision/ Approval Date:	14/03/2020
Course Objectives (As per Blooms' Taxonomy)	1. **Remember** To study normal microflora of human body. 2. **Apply** To study host pathogen interactions. 3. **Analyses** To study bacterial, viral, fungal, protozoan diseases. 4. **Create** To study about anti-microbial agents/drugs. 5. **Understand** To study about the mode of action of drugs.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Normal microflora of the human body and host pathogen interaction; Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Opportunistic infections, Nosocomial infections. Sample collection, transport and diagnosis Collection, transport and culturing of clinical samples.	20%	**9**
Unit 2: Bacterial diseases List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control respiratory diseases: *Streptococcus pyogenes*, *Mycobacterium tuberculosis* Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Helicobacter pylori* Others: *Staphylococcus aureus*, *Bacillus anthracis*, Clostridium tetani, Treponema pallidum	20%	**9**

Unit 3: Viral diseases - Detail with Symptoms, mode of transmission, prophylaxis and control: Polio, Herpes, Dengue, AIDS, with brief description of swine flu, Chikungunya, Japanese Encephalitis Protozoan Diseases List of diseases of various organ systems and their causative agents.	20%	**9**
Unit 4: :Fungal diseases Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis .	20%	**9**
Unit 5: Antimicrobial agents: General characteristics and mode of action. Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis. Antifungal agents: Mechanism of action of Amphotericin B. Antiviral agents: Mechanism of action of Amantadine; Antibiotic resistance- MRSA,NDM-1.	20%	**9**

List Of Practical	Weightage	Contact hours
1: Identify bacteria (any three of *E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus* sp) using laboratory strains	20%	3
2: Study the composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS	20%	3
3: Study of bacterial flora of skin by swab method, Perform antibacterial sensitivity by Kirby-Bauer method, Determination of minimal inhibitory concentration (MIC) of an antibiotic.	20%	3
4: Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, AIDS (candidiasis), dermatomycoses (ring worms)	20%	3
5: Study of various stages of malarial parasite in RBCs using permanent mounts.	20%	3

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:		
CO1 To study normal microflora of human body.	Apply	Explain, Describe, Discuss, Recall, Locate
CO2 To study host pathogen interactions.	Understand	Apply, Practice, Interpret, Select, Correlate
CO3 To study bacterial, viral, fungal, protozoan diseases.	Remember	Compare, Classify, Select, Investigate
CO4 To study about anti-microbial agents/drugs.	Create	Construct, Develop, Produce
CO5 To study about the mode of action of drugs	Analyses and Evaluation	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication 2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication 3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier 4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education 5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International. 6. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. 7. Pelzer MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company. 8. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
2.	Journals & Periodicals 1) Journal of Clinical Microbiology 2) Microbiology

3.	Other Electronic resources: https://www.microbiologyresearch.org/content/journal/jmm

Evaluation Scheme	Total Marks
Theory: Midsemester Mark	20 marks
Theory: End Semester Mark	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**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks Discipline: 05 marks **Total: 50 Marks**

Mapping of PSOs & COs

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

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

COURSE CODE	COURSE NAME	SEMESTER
BSMO513	**AGRICULTURE MICROBIOLOGY**	**V**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisites	Basic knowledge of Biological Sciences
Course Category	Minor elective
Course focus	Employability
Rationale	Agricultural Microbiology lies in the growing need for advanced scientific knowledge to address key challenges in agriculture, such as food security, environmental sustainability, and the efficient use of natural resources. Agricultural microbiology plays a pivotal role in improving agricultural productivity, enhancing soil health, and combating plant diseases, while maintaining ecological balance.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	1. To emphasize principles involved in role of microbes present in soil. 2. To understand the role of microbes. Biogeochemical cycle and Biofertilizers. 3. To impart the knowledge of PGPR and biocontrol agents. 4. To understand the Environmental and Industrial Microbiology Interface. 5. To understand the molecular plant microbe interactions.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Microbiology of Soil: Soil as a habitat for microorganisms, Soil microbial biomass and diversity, Microbial interactions in soil: symbiotic, associative, endophytic, pathogenic, Rhizosphere and phyllosphere microflora, Role of microbes in soil health and fertility	**20%**	**09**

Unit 2: Microbial Role in Nutrient Cycling: Microbial decomposition of organic matter, Biogeochemical cycles: Nitrogen, Phosphorus, Sulphur, Carbon. Biofertilizers: Types, production, and application (Rhizobium, Azospirillum, Azotobacter, PSB, Mycorrhizae)	**20%**	**09**
Unit 3: Microorganisms in Plant Health: Plant pathogenic microorganisms: symptoms and disease types, Beneficial microbes in disease suppression, Plant growth-promoting rhizobacteria (PGPR): Mechanisms and applications, Biocontrol agents and microbial pesticides	**20%**	**09**
Unit 4: Environmental and Industrial Microbiology: Microbial role in composting and waste management, Bioremediation and biodegradation, Fermentation technology in agriculture, Microbial products: Biofuels, organic acids, antibiotics	**20%**	**09**
Unit 5: Molecular plant microbe-interactions: Cell signalling, Quorum sensing, and Biofilm formation. Invasion of plant tissue: Resistance mechanisms against attack by plant pathogens. Molecular detection of pathogens. Integrated pest management-concepts and components; host plant resistance-biological control of insect pests; Mushroom cultivation and vermicomposting.	**20%**	**09**

List of Practical

Sr.No	List of Practical	Weightage	Contact hours/week
1	Isolation of soil microorganisms (bacteria, fungi, actinomycetes)	20%	4
2	Observe the rhizosphere and phyllosphere microbes.	10%	4
3	Perform Phosphate solubilization test.	10%	4
4	Isolation of Blue Green Algae	20%	4
5	Extraction and Isolation and Culturing of Mycorrhizal Spores from Rhizospheric Soil (Demonstration)	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.

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	On completion of this course, students should be able to emphasize principles involved in role of microbes present in Soil.	Understand, Remember& apply	Explain, Describe, Discuss
CO2	On completion of this course, students should be able to understand the role of microbes and Biogeochemical cycle along with microbes as biofertilizers.	Analyse	Apply, Practice, Interpret, Select, Correlate
CO3	On completion of this course, students should be able to impart the knowledge of PGPR and biocontrol agents.	Understand and Remember	Apply and Practice

CO4	On completion of this course, students should be able to understand the various Environmental and Industrial Microbiology Interface concepts such as Bioremediation and Biodegradation.	Apply	Construct, Develop, Produce
CO5	On completion of this course, students should be able to understand the molecular plant microbe interactions.	Understand, Remember& apply	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1	Textbook: • Kaushik, B. D. (2007). Principles of agricultural microbiology. Kalyani Publishers. • Sharma, H. D. (2013). Agricultural microbiology. Rastogi Publications.
2	Reference Books: • Paul, E. A. (2014). Soil microbiology, ecology, and biochemistry (4th ed.). Academic Press. https://doi.org/10.1016/B978-0-12-415955-6.00001-7 • Glick, B. R. (2014). Plant growth-promoting rhizobacteria: Applications and perspectives. Springer. https://doi.org/10.1007/978-3-319-10929-4 • Caruso, G., & Lo, F. (Eds.). (2021). Advances in plant and agricultural microbiology. Elsevier. https://doi.org/10.1016/B978-0-12-819965-2.00001-7 • Martínez-Romero, E., & Arguelles-Arias, A. (2016). Microbial diversity in the agriculture ecosystem. Springer. https://doi.org/10.1007/978-3-319-32060-7 • Singh, D. P., & Gupta, V. K. (Eds.). (2019). *Microorganisms in sustainable agriculture and biotechnology*. Springer. https://doi.org/10.1007/978-3-319-92643-0 • Widmer, F., & Mohn, W. W. (2017). Microbial ecology of the rhizosphere (1st ed.). Springer. https://doi.org/10.1007/978-3-319-45579-5
3	Journal: • FEMS Microbiology Ecology • Applied and Environmental Microbiology
4	Periodicals: • Soil Biology and Biochemistry • Biological Control
5	Other Electronic resources: Agricultural Research Service (ARS) – USDA, National Agricultural Library (NAL) – USDA, Science Direct, PubMed.

Evaluation Scheme	Total Marks
Theory: Mid semester 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 and CO for Agriculture Microbiology:

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

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

Mapping of PO and CO for Agriculture Microbiology

PO	PO1	PO2	PO3	PO4	PO5	PO6
CO						
CO1	1	2	2	1	-	2
CO2	2	2	3	-	-	1

CO3	3	2	1	2	-	2
CO4	1	2	1	-	2	-
CO5	3	3	-	3	3	3

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

COURSE CODE BSMO514	COURSE NAME MICROBIAL BIOTECHNOLOGY	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisites	Students should have basic knowledge of microbiology and microbial technology.
Course Category	Minor
Course focus	Employability
Rationale	This course explores microbial applications in biotechnology, drug resistance, biotransformation, biofuels, and bioremediation, equipping students with skills in sustainable microbial technologies for addressing industrial challenges.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	1. **Remember** To introduce students to the developments/advances made in the field of microbial biotechnology. 2. **Apply** To know the usage of microbes and their products in therapeutics. 3. **Analyses** To understand the applications of microbes in Biotransformation. 4. **Create**To demonstrate the recovery of microbial products and an overview of Intellectual Property Rights. 5. **Understand** To get insights in using microbes for Bioenergy and bioremediations.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Microbial Biotechnology- Applications and Scope In human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial application: Bacteria and yeast.	**20%**	**9**

Unit 2: Recombinant microbial production processes in pharmaceuticalindustries Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors. Therapeutics and Host pathogen interactions	**20%**	**9**
Unit 3: RNAi & Applications of Microbes in Biotransformation RNAi and its applications in silencing genes, drug resistance; Microbial based transformation of steroids and sterols Bio- catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.	**20%**	**9**
Unit 4: Microbial Products' Recovery & Intellectual Property Rights Microbial product purification: filtration, ion exchange & affinity chromatography techniques Immobilization methods and their application: Whole cell immobilization; Patents, Copyrights, Trademarks.	**20%**	**9**
Unit 5: Microbial Biofuel and Bioremediation Technologies Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents	**20%**	**9**

List Of Practical	Weightage	Contact hours
1. Production of biofertilizer (N_2 fixer, phosphate solubilizer, siderophore production)	30%	10
2. Study enzyme immobilization by sodium alginate method	10%	4
3. Isolation of xylanase or lipase producing bacteria	10%	4
4. Pigment production from fungi or bacteria	20%	4
5. Biodiesel production	20%	8

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	Blooms' Taxonomy Sub

		Domain	Domain
CO1	**Remember** To introduce students to the developments/advances made in the field of microbial biotechnology.	Remember	Explain, Describe, Discuss, Recall, Locate
CO2	**Apply** To know the usage of microbes and their products in therapeutics.	Apply	Apply, Practice, Interpret, Select, Correlate
CO3	**Analyses** To understand the applications of microbes in Biotransformation.	Analyses and Evaluation	Compare, Classify, Select, Investigate
CO4	**Create** To demonstrate the recovery of microbial products and an overview of Intellectual Property Rights.	Create	Construct, Develop, Produce
CO5	**Understand** To get insights in using microbes for Bioenergy and bioremediations.	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications, 2. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc. 3. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press. 4. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press. 5. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press 6. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press 7. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science
2.	Journals & Periodicals 1) Enzyme and Microbial Technology 2) Applied Biochemistry and Biotechnology 3) Microbial biotechnology 4) Applied microbiology and biotechnology 5) Current Science

3.	Other Electronic resources: 1.Science Daily – Microbiology News 2.https://www.sciencenews.org/topic/microbes 3.https://www.labroots.com/trending/microbiology 4.Google books:Microbial biotechnology: https://www.google.co.in/books/edition/Microbial_Biotechnology_Basic_Research_a/q_LvDwAAQBAJ?hl=en&gbpv=1&dq=microbial+biotechnology&printsec=frontcover.

Evaluation Scheme	Total Marks
Theory: Mid semester 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**
Practical Marks	Attendance: 05 marks Practical Exam: 30 marks Viva: 10 marks Journal: 05 marks **Total: 50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	1
CO2	3	3	3	1	3	1

CO3	3	3	2	1	1	3
CO4	3	3	2	1	1	3
CO5	3	2	2	1	1	1

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

COURSE CODE	COURSE NAME	SEMESTER
BSMO515	**VIROLOGY**	**V**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisites	Basic knowledge of Virology
Course Category	Compulsory elective
Course focus	Employability
Rationale	The scientific discipline focused on viruses and virus-like agents—has numerous compelling rationales, spanning public health, medicine, biotechnology, and ecology.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	1. Understand the Fundamental Properties of Viruses 2. Explore Virus-Host Interactions 3. Epidemiology and Public Health Impact of Viral Diseases. 4. Principles of Antiviral Therapy and Vaccinology 5. To understand Applied Virology.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Properties of Viruses: Baltimore classification, Genetic Material, Protein Coat, Lytic and Lysogenic Cycles and it's regulation.	**20%**	**09**
Unit 2: Virus-Host Interactions: Entry of viruses in pathogens, Genome replication and gene expression.	**20%**	**09**
Unit 3: Epidemiology of Viral Diseases: Key Epidemiological Measures, Outbreaks, Epidemics, and Pandemics, Surveillance and Control.	**20%**	**09**
Unit 4: Antiviral Therapy and Vaccinology: Antiviral drugs and targets, Mechanism of action.	**20%**	**09**
Unit 5: Applied Virology: Viral Vector-Based Gene Therapy,Oncolytic Virotherapy and Cancer Vaccines, CAR-T Cell Therapy and Viral Tools, B Cell and T Cell Receptor Therapies in Virology, Antiviral Drug Discovery and Resistance, Virology in Diagnostics and Vaccine Platforms	**20%**	**09**

List Of Practical	Weightage	Contact Hours
1: Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique.	**100%**	**30**

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 Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Understand the Fundamental Properties of Viruses	Understand, Remember and apply	Explain, Describe, Discuss
CO2	Explore Virus-Host Interactions	Analyse and apply	Apply, Practice, Interpret, Select, Correlate
CO3	Epidemiology and Public Health Impact of Viral Diseases.	Understand and Remember	Apply and Practice
CO4	Principles of Antiviral Therapy and Vaccinology	Analyse	Construct, Develop, Produce
CO5	To understand Applied Virology.	Understand, Remember and apply	Explain, Describe, outline, Predict, Summarize

	Learning Resources
1	**Textbook:** 1. Principles of Virology, 5th Edition *Authors*: Jane Flint, Vincent R. Racaniello, Glenn F. Rall, Theodora Hatziioannou, Anna Marie Skalka. 2. Textbook of Medical Virology, 2nd Edition *Author*: Baijayantimala Mishra
2	**Reference Books:** 1. Fields Virology (7th Edition, 2020) Editors: David M. Knipe, Peter M. Howley 2. Medical Virology by David O. White and Frank J. Fenner (4th Edition) 3. Clinical Virology (4th Edition) Editors: Douglas D. Richman, Richard J. Whitley, Frederick G. Hayden

	3	**Journal:** 1. Journal of Virology. Publisher: American Society for Microbiology (ASM) 2. Virology. Publisher: Elsevier
	4	**Periodicals:** Emerging Infectious Diseases (EID) Publisher: Centers for Disease Control and Prevention (CDC)
	5	National Institute of Allergy and Infectious Diseases (NIAID) USA Centers for Disease Control and Prevention (CDC) - Viral Special Pathogens Branch USA

Evaluation Scheme	Total Marks
Theory: Mid semester 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 and CO for Agriculture Microbiology:

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

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

Mapping of PO and CO for Agriculture Microbiology

PO	PO1	PO2	PO3	PO4	PO5
CO					

CO1	1	2	2	2	3
CO2	1	1	2	2	3
CO3	1	1	1	2	3
CO4	1	1	1	1	2
CO5	2	2	2	2	1

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

Semester – VI							
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Marks**
A. Ability Enhancement Compulsory Course							
1	AECC601	Indian Constitution	2	0	0	2	100
B. Core Course							
2	BSMO611	Immunology	3	0	2	5	150
3	BSMO612	Bioinformatics & Drug Discovery, Design And Development	3	0	2	5	150
4	BSMO613	Food and Dairy Microbiology	3	0	2	5	150
C. Minor Electives (Any One)							
5	BSMO614	Environmental Microbiology	3	0	1	4	150
	BSMO615	Medical Biotechnology	3	0	1	4	
					Total	21	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	BSMO611	Immunology	3	4	0	7	3	2	0	5	20	40	40	100	50	150
3	BSMO612	Bioinformatics & Drug Discovery, Design and Development	3	4	0	7	3	2	0	5	20	40	40	100	50	150
4	BSMO613	Food and Dairy Microbiology	3	4	0	7	3	2	0	5	20	40	40	100	50	150
	C. Minor Electives (Any One)															
5	BSMO614	Environmental Microbiology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	BSMO615	Advances in Microbiology	3	2	0	5	3	1	0	4	20	40	40	100	50	
		Total								**21**						**700**

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

COURSE CODE AECC601	COURSE NAME INDIAN CONSTITUTION	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

Course Pre-requisites	10 +2 (With Arts/Science/Commerce)
Course Category	Ability Enhancement Compulsory Course.
Course focus	Skill development
Rationale	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.
Course Revision/ Approval Date:	14/03/2020
Course Objectives (Asper Blooms' Taxonomy)	To enable the student: **1.** To understand Indian Constitution. **2.** To know the frameworkof Indian Constitution. **3.** To aware role of government of the union. **4.** To aware role of the state government. **5.** To understandadministration organization.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Constitution – Strategies and Principles 1. Meaning and important of constitution 2. Making of Indian constitution – sources 3. Salient Features of Indian constitution.	**20%**	**6**
Unit 2: Fundamental Rights and Directive Principles 1. Fundamental Rights 2. Fundamental Duties 3. Directive Principles	**20%**	**6**

Unit 3: Government of the Union 1. President of India – Election and powers 2. Prime Minister and council of ministers 3. Lok Sabha – composition and Powers	**20%**	**6**
4. Rajya Sabha – Composition and Powers.		
Unit 4: Government of the States & The Judiciary 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**
Unit 5: Administrative Organization and Constitution 1. Federalism in India – features 2. Local Government – Panchyats and Powers andfunctions 73rd and 74th Amendments 3. Election Commission – Organization and functions 4. Citizen Oriented Measure – RTIand PIL – Provisions and Significance.	**20%**	**6**

Instructional Methodand 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 successfulcompletion of the above course, students will be able to:		
CO1: Analyse importance of Indian constitution	Understand	Define, Classify & Describe
CO2: Analyse importance of Indian constitution	Apply	Define, Classify, Describe, Demonstrate & Examine
CO3: Know powers of state and union government.	Analyses and Evaluation	Define, Classify, Describe & Demonstrate

CO4: Understand administration of Indian Constitution	Apply & analyse	Define, Classify, Describe, Demonstrate & Examine
CO5: Understand administration of Indian Constitution.	Remember & apply	Define, Describe & Demonstrate

Learning Resources	
1.	**Reference/Text Books:** 1. Indian's Constitution by M.V. Pylee, New Delhi S. Chand Publication 2. The Constitutional Law of India by J.N. Panday Allahabad CentralLaw Agency 3. Constitution of India by National Portalof India 4. https://www.india.giv.in/sites/upload-files/coi_part_full.pdf.
2.	**Journals & Periodicals:** 1. Constitution of India 2. National Portalof India.
3.	**Other Electronic Resources:** 1. https://legislative.gov.in/constitution-of-india

Evaluation Scheme	**Total Marks**
Theory: Midsemester Marks	20 marks
Theory: End Semester Mark	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	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	COURSE NAME	SEMESTER
BSMO611	**IMMUNOLOGY**	**VI**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	4	0	7	3	2	0	5

Course Pre-requisites	A strong foundation in biology, biochemistry, and microbiology is necessary to fully grasp immunological concepts.
Course Category	Core
Course focus	Employability
Rationale	To have anoverview of Immune response and it's components. The subject also explains the regulation of immunoglobulin gene, major histocompatibility complexes, vaccines and vaccine development and immunodiagnostics.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	1. Remember Outline, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity. 2. Apply Elucidate the genetic basis for immunological diversity and the generation of adaptive immune responses. 3. Analyses Outline key events and cellular players in antigen presentation, and how the nature of the antigen will shape resulting effectors responses. 4. Create Understand and explain the basis of allergic diseases and immunodeficiencies related diseases 5. Understand Applied Immunology

Course Content (Theory)	**Weightage**	**Contact hours**
Unit 1: 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 Tcell, helper T-cell, suppressor T-cells) and B Cells.	**20%**	**09**
Unit 2: 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.	**20%**	**09**
Unit 3: Vaccines & Vaccination Theory: Adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization.	**20%**	**09**
Unit 4: Immunodiagnostics: Enzyme-Linked Immunosorbent Assay (ELISA), Western Blot, Immunofluorescence (IF), Radioimmunoassay (RIA). Flow Cytometry	**20%**	**09**
Unit 5: Applied Immunology: Emerging Technologies in Applied Immunology , Immunodiagnostic Applications in Infectious and Autoimmune Diseases, Monoclonal Antibody Technology and Therapeutics	**20%**	**09**

Sr.No	List of Practicals	Weightage	Contact hours
1.	Single radial ImmunoAssay	10 %	6
2.	Double immunodiffusion test using specific antibody and antigen.	10 %	6
3.	Dot ELISA	10 %	6
4.	Sandwich ELISA	10 %	6
5.	Total Serum Protein and Immunoglobulin Estimation	10 %	6
6.	Lymphocyte Isolation and Viability Testing	10 %	6
7.	Delayed-Type Hypersensitivity (DTH) Skin Test (Discussion or Demo).	10 %	6
8.	Demonstration of Rt PCR	10 %	6
9.	Blood Cell Identification (Peripheral Blood Smear)	10 %	6
10.	Differential White Blood Cell (WBC) Count	10 %	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 Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Outline, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity.	Remember	Explain, Describe, Discuss, Recall, Locate
CO2	Elucidate the genetic basis for immunological diversity and the generation of adaptive immune responses.	Apply	Apply, Practice, Interpret, Select, Correlate
CO3	Outline key events and cellular players in antigen presentation, and how the nature of the antigen will shape resulting effector responses.	Analyses and Evaluation	Compare, Classify, Select, Investigate
CO4	Understand and explain the basis of allergic diseases and immunodeficiencies related diseases.	Create	Construct, Develop, Produce
CO5	Understand the principles governing vaccination and the mechanisms of protection against disease.	Understand	Explain, Describe, outline, Predict, Summarize

	Learning Resources
1	**Textbook:** 1. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley- Blackwell Scientific Publication, Oxford. 2. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.

	2	**Reference Books:** 1. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York. 2. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg. 3. Richard CandGeiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication. 4. Textbook: 1. Goldsby RA,Kindt TJ,Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. FreemanandCompany, New York
	3	**Journal:** 1. Journalof Immunology 2. Molecular Immunology 3. Nature Review immunology 4. The Scientist
	4	**Periodicals:** Emerging Infectious Diseases (EID) Publisher: Centers for Disease Control and Prevention (CDC)
	5	National Institute of Allergy and Infectious Diseases (NIAID) USA Centers for Disease Control and Prevention (CDC) - Viral Special Pathogens Branch USA

Evaluation Scheme	**Total Marks**
Theory: Mid semester 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 and CO for Agriculture Microbiology:

PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO					
CO1	2	1	0	1	1
CO2	1	1	2	0	0
CO3	1	0	2	2	2
CO4	2	0	2	2	2
CO5	1	2	0	2	1

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

Mapping of PO and CO for Agriculture Microbiology

PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**

CO					
CO1	3	2	0	2	2
CO2	2	1	1	2	0
CO3	2	0	0	2	1
CO4	2	1	2	3	2
CO5	2	1	0	1	0

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

COURSE CODE	COURSE NAME	SEMESTER
BSMO612	**BIOINFORMATICS AND INTRODUCTION TO DRUG DISCOVERY, DESIGN AND DEVELOPMENT**	**VI**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	4	0	7	3	2	0	5

Course Pre-requisites	Students should have basic knowledge about fundamental theories and practices of bioinformatics and it will also provide an overview of the computational drug development process.
Course Category	Core Professional.
Course focus	Students should acquire foundational knowledge of bioinformatics theories and practices, which are essential for understanding the drug development process. This knowledge enhances their employability in pharmaceutical and biotechnology industries, where bioinformatics plays a crucial role in identifying drug targets and optimizing therapeutic strategies
Rationale	Provide an overview of the foundational theories and practices in bioinformatics, along with a comprehensive summary of the drug development process, emphasizing the scientific methodologies
Course Revision/ Approval Date:	09/05/2025
Course Objectives (As per Blooms' Taxonomy)	To Remember Recall fundamental concepts of molecular biology—including DNA, RNA, and protein structures—and understand bioinformatics databases and tools such as NCBI, BLAST,and GenBank. To Understand and Explain the role of bioinformatics in analyzing biological data and its importance in modern research. To Analyze Analyze Interpret biological datasets to identify patterns and relationships.Evaluate the results of bioinformatics tools to draw meaningful conclusions. To Apply Utilize bioinformatics software to perform sequence analysis and data visualization. To Create Develop simple bioinformatics pipelines to address specific biological questions

Course Content (Theory)	**Weightage**	**Contact hours**
Unit 1: Introduction to Bioinformatics**,** 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,	20%	9

FASTA, GENBANK, Nucleic acid sequence databases- GENBANK, EMBL, DDBJ		
Unit 2: 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	20%	9
Unit 3: Genome databases. Sequence alignment: Pairwise alignment techniques Global alignment, Local alignment, pairwise alignment techniques- continued, Significance of alignment- Z-score, P-score, E-value	20%	9
Unit 4:Multiple sequence alignment techniques- continued- profile, Hidden Markov Model, BLAST analysis, E-value, Different types of BLAST, PSI BLAST, PHI-BLAS	20%	9
Unit 5: 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%	9

List Of Practical	Weightage	Contact hours
1: Introduction to NCBI database	10%	6
2. Retrieval of nucleotide and protein sequences from databases like GENBANK, UNIPROT	10%	6
3. Retrieval of protein sequences from databases like Uniprot	10%	6
4. Genome databases	10%	6
5. Understanding Protein Structural Databases	10%	6
6. Understanding Proetin Structural Databases : PDB	10%	6
5.Sequence alignment- Pairwise (BLAST and types of BLAST)	10%	6
7. Multiple Sequence Alignment with ClustalW	10%	6
8.Use of visualizing software like PYMOL, CHIMERA	10%	6
8. Homology Modelling	10%	6
9.Visualizing Proteins with Chimer	10%	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:		
CO1 Basic Computer skills.	Apply	Explain, Describe, Discuss, Recall, Locate
CO2 Acquire knowledge about various biological databases and how to retrieve and use data from these databases.	Understand	Apply, Practice, Interpret, Select, Correlate
CO3 Understand the concepts involved in sequence alignment and phylogeny Analysis.	Remember	Compare, Classify, Select, Investigate
CO4 Be able to describe the process of drug discovery and development	Create	Construct, Develop, Produce
CO5 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.	Reference books: 1. Mount DW Cold. 2001. Bioinformatics: Sequence andGenome Analysis. Spring. 2. AttwoodTK & Parry-Smith DJ. 2003. Introduction to Bioinformatics. Pearson Education. 3. Rastogi SC, Mendiratta N & Rastogi P. 2004. Bioinformatics: Concepts, Skillsand Applications. CBS 4. Introduction to Bioinformatics. 2014- Arthur M Lesk Oxford University Press Drug Discovery and Development; Technology in Transition. HP Rang. Elsevier Ltd 1 st edition2006.

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

Evaluation Scheme	**Total Marks**
Theory: Midsemester Marks	20 marks
Theory: End Semester Mark	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**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks Discipline: 05 marks **Total: 50 Marks**

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

COURSE CODE	COURSE NAME	SEMESTER
BSMO613	**FOOD AND DAIRY MICROBIOLOGY**	**VI**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	4	0	7	3	2	0	5

Course Pre-requisites	Students should have basic knowledge of food and dairy microbiology.
Course Category	Discipline specific elective
Course focus	Employability
Rationale	To have an overview of basic food and dairy microbiology.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	1. Remember: Developed a clear understanding of multifarious roles of microorganisms in food preparation and the spoilage of food. 2. Apply: The methods introduced for the preservation of food materials. 3. Analyses: The role of microorganisms in dairy products and the role of probiotics. 4. Understand: Food intoxication and infections occur by the pathogenic microorganisms present in food. 5. Design: The methods for sterility testing of food materials and understand the governmental guidelines for food quality assurance.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Food as a substrate of Microorganisms: Intrinsic and extrinsic factors affecting the growth of growth and survival of microbes in foods, natural flora and source of contamination of food in general. Microbial spoilage of various foods; spoilage of vegetables, meat, and fruits.	**20%**	**9**

Unit 2: Preservation of Food: Principle of food preservation. Physical method of food preservation: Temperature (Pasteurization), irradiation, microwave processing, and aseptic packaging. Chemical methods of food preservation: salt, sugar, organic acids, SO_2, nitrites and nitrates, ethylene oxides, antibiotics and bacteriocins.	**20%**	**9**
Unit 3: Fermented Dairy products and Probiotics: Dairy starter cultures, fermented dairy products: yogurt, kumiss, kefir, cheese, sauerkraut, soy sauce. Probiotics: health benefits, types of microorganisms used as probiotics food available in market.	**20%**	**9**
Unit 4: Food Borne Diseases: Food intoxication: *Staphylococcus aureus*, *Clostridium botulinum*, Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*, *E. coli*, *Salmonellosis*, *Shigellosis*, *Yersinia enterocolitica*, *Listeria monocytogenes*, and *Camphylobacter jejuni.*	**20%**	**9**
Unit 5: Food Quality Assurance HACCP, indices of food sanitary quality and sanitizers cultural and rapid detection method of food borne pathogens.	**20%**	**9**

List of Practical

List Of Practical		
1. MBRT of milk samples and their standard plate count. **2.** Alkaline phosphatase test to check the efficiency of pasteurization	**20%**	**8**
3. Isolation of any food borne bacteria from food products	**20%**	**4**
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.	**20%**	**8**
5. Isolation of spoilage microorganisms from bread.	**20%**	**5**
6. Preparation of Yogurt/Dahi.	**20%**	**5**

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 Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Developed a clear understanding of multifarious roles of microorganisms in food preparation and the spoilage of food.	Understand, Remember	Explain, Describe, Discuss
CO2	The methods introduced for the preservation of food materials.	Apply	Practice, Interpret, Select, Correlate
CO3	The role of microorganisms in dairy products and the role of probiotics.	Understand and Analyses	Apply and Practice
CO4	Food intoxication and infections occur by the pathogenic microorganisms present in food.	Understand	Explain, Describe, Discuss
CO5	The methods for sterility testing of food materials and understand the governmental guidelines for food quality assurance.	Apply, Understand & Remember	Explain, Describe, outline, Predict, Summarize

Learning Resources

1.	Reference books: 1.Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India. 2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India. 3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York. 4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon. 5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India. 6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London. 7. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India. 8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD. 9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
2.	Journals & Periodicals 1. Journal of Food Science 2. Current opinion on Food Sciences.
5	Other Electronic resources: 1. NPTEL

Evaluation Scheme	Total Marks	
Theory: Mid semester 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 Marks	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	30 marks
	Viva	10 marks
	Journal	05 marks
	Total	**50 Marks**

Mapping of PSOs and COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6

CO1	2	1	2	1	1	1
CO2	2	1	2	1	1	0
CO3	2	2	3	1	1	2
CO4	2	2	3	1	1	1
CO5	2	1	2	1	1	1

Mapping of POs and COs

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

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

COURSE CODE BSMO614	COURSE NAME ENVIRONMENTAL MICROBIOLOGY	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**TotalCredit**
3	2	0	5	3	1	0	4

Course Pre-requisites	Students should have basic knowledge about environmental science and students of all disciplines can think critically, ethically, and creatively when evaluating environmental issues
Course Category	Discipline Specific Course.
Course focus	Employability
Rationale	To have an overview of the environmental science and students of all disciplines can think critically, ethically, and creatively when evaluating environmental issues.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	**Remember** To remember aspects of environmental microbiology and its scope **Apply** To understand various modes of biotic interaction of microbes **Analyses** To analyze phases of various biogeochemical cycles. **Create** To get insights i n t o role of microbes in pollution control **Understand** To get acquainted with applied aspects of environmental microbiology

Course Content (Theory)	Weightage	Contact hours
Unit 1: Microorganisms and their Habitats: Structure and function of ecosystems Terrestrial Environment: Soil profile and soil microflora Aquatic Environment Microflora of fresh water and marine habitats Atmosphere: Aero microflora and dispersal of microbes Animal Environment: Microbes in/on human body (Microbiomes) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels	20%	09
Unit 2: Microbial Interactions Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation Microbe-Plant interaction: Symbiotic and non-symbiotic interactions Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria	20%	09

Unit 3: Biogeochemical Cycling Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction Phosphorus cycle: Phosphate immobilization and solubilisation Sulphur cycle: Microbes involved in sulphur cycle Other elemental cycles: Iron and manganese.	20%	09

Unit 4: Waste Management Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal(composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment	20%	09
Unit 5: Microbial Bioremediation and Water Potability: Principles and degradation of common pesticides, hydrocarbons (oil spills). Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for fecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.	20%	09

List Of Practical	Weightage	Contact hours
1. Analysis of soil - pH, moisture content, water holding capacity	20%	6
2. Determination of Chlorine in Water	20%	6
3. Isolation of Rhizobium from root nodules	20%	6
4. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.	20%	6
5. Find Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD) of the water sample	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 Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Student will be able to demonstrate microbial diversity	Apply	Explain, Describe, Discuss, Recall, Locate
CO2	The students will be updated interaction of microbes with other Organisms	Remember	Apply, Practice, Interpret, Select, Correlate
CO3	The students will be updated with generalconcepts role of microbes in biogeochemical cycling	Analyses	Compare, Classify, Select, Investigate
CO4	The students gain knowledge on solid waste management, its sources, treatment, process etc.	Create	Construct, Develop, Produce

CO5	Students will be acquainted with the knowledge of water potability, process and treatments.	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. I.L. Pepper and C.P. Gerba (2004) Environmental Microbiology A Laboratory Manual, Elsevier/Academic Press 2. Christon J. Hurst (eds.) (2016) The Mechanistic Benefits of Microbial Symbionts, Springer International Publishing 3. Hurst, Christon J.; Crawford, Ronald L.; Garland, Jay L.; Lipson, David A.; Mills, Aaron L.; Stetzenbach, Linda D. (Eds.) (2007) Manual of Environmental Microbiology, American Society for Microbiology 4. Myung-Bo Kim eds. (2008) Progress in Environmental Microbiology, Nova Biomedical Books New York 5. Moo-Young, M., Anderson, W. A., & Chakrabarty, A. M. (Eds.). (2013). Environmental biotechnology: principles and applications. Springer Science & Business Media. 6. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K. 7. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London. 8. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England. 9. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi. 10. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education
2	Journals & Periodicals 1. Applied and Environmental Microbiology 2. Critical Reviews in Microbiology 3. Nature Reviews Microbiology 4. Nature Microbiology 5. Microbiology 6. BMC Microbiology 7. Trends in Microbiology 8. Gavrilescu, Maria. "Environmental biotechnology: achievements, opportunities and challenges." Dynamic biochemistry, process biotechnology and molecular biology 4.1 (2010): 1-36. 9. Verstraete, Willy, and Eva Top. "Holistic environmental biotechnology." Microbial control of pollution. (1992): 1- 17. 10. Grommen, Roeland, and Willy Verstraete. "Environmental biotechnology: the ongoing quest."Journal of Biotechnology 98.1 (2002): 113-123. 11. Michalak, Izabela. "The application of seaweeds in environmental biotechnology." Advances in Botanical Research. Vol. 95. Academic Press, 2020. 85-111. 12. Kalogerakis, Nicolas, et al. "The role of environmental biotechnology in exploring, exploiting, monitoring, preserving, protecting and decontaminating the marine environment." New biotechnology 32.1 (2015): 157-167.

3	Other Electronic resources 1. https://sfam.org.uk/ 2. https://www.isme-microbes.org/ 3. https://www.asmscience.org/VisualLibrary 4. https://microbe.net/resources/microbiology-web-resources/ 5. https://www.epa.gov/ 6. https://microbiologyonline.org/teachers/resources

Evaluation Scheme	Total Marks
Theory: Mid semester 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**
Practical Marks	Attendance: 05 marks Practical Exam: 30 marks Viva: 10 marks Journal: 05 marks **Total: 50 Marks**

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

COURSE CODE	COURSE NAME	SEMESTER
BSMO615	**ADVANCES IN MICROBIOLOGY**	**VI**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	1	0	4

Course Pre-requisites	Basic understanding of microbiology, molecular biology, and genetics.
Course Category	Minor
Course focus	Employability
Rationale	With the increasing use of genomic tools and microbial biotechnologies in research and industry, this course offers essential knowledge on microbial genome evolution, host-microbe interactions, and applications of synthetic biology. Understanding these molecular mechanisms is crucial for advancing in fields such as bioengineering, medical microbiology, and environmental microbiology.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	1. **Understand** the salient features and evolutionary mechanisms of microbial genomes 2. **Analyze** the development and applications of metagenomics to understand microbial diversity, meta transcriptomics, metaproteomics, and metabolomics. 3. **Evaluate** the molecular basis of host-microbe interactions 4. **Examine** the formation, types, and significance of biofilms in various environments and healthcare settings, emphasizing their role in microbial virulence and antimicrobial resistance. 5. **Apply** systems and synthetic biology principles, focusing on quorum sensing, virulence regulation, virus synthesis, and gene editing implications for microbes.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Evolution of Microbial Genomes Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Horizontal gene transfer (HGT), Evolution of bacterial virulence – Genomic islands, Pathogenicity islands (PAI) and their characteristics.	20%	9

Unit 2: Metagenomics Brief history and development of metagenomics, understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using metagenomics. Basic knowledge of viral metagenome, meta transcriptomics, metaproteomic and metabolomics.	20%	9
Unit 3: Molecular Basis of Host-Microbe Interactions Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens.	20%	9
Unit 4: Molecular Basis of Host-Microbe Interactions Biofilms: types of microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance.	15%	6
Unit 5: Systems and Synthetic Biology Networking in biological systems, Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors, Basics of synthesis of virus (having recent outbreaks) in laboratory, Future implications of synthetic biology with respect to bacteria and viruses. Gene editing concept with suitable example.	20%	12

List Of Practical	Weightage	Contact hours
1) Extraction of metagenomic DNA from soil.	**20%**	**6**
2) Understand the impediments in extracting metagenomic DNA from soil.	**15%**	**4**
3) PCR amplification of metagenomic DNA using universal 16s ribosomal gene primers.	**20%**	**6**
4) Case study to understand how the virus genome (recent outbreaks) was synthesized in the laboratory.	**20%**	**6**
5) Case study to understand how networking of metabolic pathways in bacteria takes place	**10%**	**2**
6) Isolation of biofilms	**15%**	**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 Outcomess:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**

CO1	**Understand** the essential features and evolutionary mechanisms of microbial genomes, including core and flexible genome pools, pangenome concepts, and horizontal gene transfer.	Understand	Explain, Describe, Discuss, Recall, Locate
CO2	**Analyze** the development of metagenomics, recognizing its applications in assessing bacterial diversity and identifying biotechnologically relevant genes, along with insights into viral metagenomics and related fields.	Analyze	Apply, Practice, Interpret, Select, Correlate
CO3	**Evaluate** the molecular mechanisms underlying host-microbe interactions, including epiphytic fitness, hypersensitive responses in plants, and type three secretion systems in pathogens.	Analyses	Compare, Classify, Select, Investigate
CO4	**Examine** the formation, types, and significance of biofilms, emphasizing their roles in environmental contexts, healthcare settings, and their contributions to microbial virulence and antimicrobial resistance.	Examine	Construct, Develop, Produce
CO5	**Apply** principles of systems and synthetic biology, including quorum sensing and coordinated regulation of virulence factors, as well as the synthesis of viruses in laboratory environments and the implications of gene editing technologies for bacteria and viruses.	Apply	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press 2. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press. 3. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press 4. Sangdun C. Introduction to Systems Biology, 2007, Humana Press 5. Klipp E, Liebermeister W. Systems Biology – A Textbook, 2009, Wiley – VCH Verlag 6. Caetano-Anolles G. Evolutionary Genomics and Systems Biology, 2010, John Wiley and Sons 7. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition,Pearson-Bejamin Cummings 8. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011) Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press, 9. Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International 10. Voit EO (2012) A First Course in Systems Biology, 1st edition, Garland Science
2.	Journals & Periodicals 1) International Journal of Microbiology 2) Journal of Advances in Microbiology

5	Other Electronic resources: . NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester 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**

Practical Marks

Attendance	05 marks
Practical Exam	30 marks
Viva	10 marks
Journal	05 marks
Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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