COURSE CURRICULUM

B.Sc. Chemistry

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

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 SubDomain
PO1	Basic Knowledge: To impart knowledge regarding basic concepts of applied chemical sciences.	Cognitive domain	Apply
PO2	Interdisciplinary approach: To explain the relationships between chemical sciences, biological sciences, physical sciences and mathematical sciences.	Cognitive domain	Apply
PO3	Practical learning: To perform procedures as per laboratory standards in the areas of Chemical Sciences and to think analytically.	Cognitive domain	Create
PO4	Effective Communication and social Interaction: To communicate effectively in terms of reading, writing, speaking and delivering the view to others.	Cognitive domain	Evaluate
PO5	Ethics: To culminate and understand the moral values for any of the subjects with respect to good practices and humanity.	Cognitive domain	Create
PO6	Environment and Sustainability: To explain the importance of ecological balance along with conservation of natural resources for human well being.	Cognitive domain	Create

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.	Cognitive domain	Remember Evaluate Create
PSO2	Students will be able to demonstrate learning skills to work as a team in a multidisciplinary environment.	Cognitive domain	Evaluate Analyse
PSO3	Students will be able to design and develop sustainable solutions to major environmental/biological problems by applying appropriate chemistry tools.	Cognitive domain	Apply Create
PSO4	Students will be able to demonstrate effective writing and oral communication skills.	Cognitive domain	Understand Analyse
PSO5	Students will have knowledge and understanding of norms and ethics in the field of chemistry.	Cognitive domain	Apply Create
PSO6	Students will be able to design, perform experiments, analyze and interpret data for investigating complex problems in chemistry and related fields.	Cognitive domain	Apply Create

Mapping of POs & PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6
PSO1	1	1	3	3	3	1
PSO2	2	2	1	3	1	3
PSO3	3	3	3	1	3	3
PSO4	2	2	3	2	3	2
PSO5	2	2	3	2	3	2
PSO6	2	2	3	2	3	2
Avg.	2	2	3	2	3	2

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

Definition of Credit:

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

Course code Definitions:

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

Structure of Undergraduate Programme:

Sr. No.	Category	Credit Breakup
1	Humanities and Social Sciences including Management courses	04
2	Basic Science courses	48
3	Professional core courses	84
4	Professional Elective courses relevant to chosen specialization/branch	48
6	Project work, seminar and internship in industry or elsewhere	10
7	Mandatory Courses [Environmental Sciences, Induction Programme,Indian Constitution, Essence of Indian Knowledge Tradition]	12
8	Skill Enhancement Compulsory/Elective Courses	20
	Total	**226**

Category-wise Courses:

Humanities & Social Sciences Courses

(i) Number of Humanities & Social Science Courses: 2
(ii) Credits: 4

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	AECC101	Fundamentals of English	I	2	0	0	2	2	0	0	2
2.	AECC201	Communication Skills in English	II	2	0	0	2	2	0	0	2
		Total		4	0	0	**4**	4	0	0	**4**

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

Basic Science Course- Discipline Specific Generic Electives

(i) Number of Basic Science Course: 108
(ii) Credits: 18

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	BSPY115	Physics - I	I	3	4	0	7	3	2	0	5
2.	BSMA115	Mathematics – I	I	3	4	0	7	3	2	0	
3.	BSPY215	Physics – II	II	3	4	0	7	3	2	0	5
4.	BSMA215	Mathematics – II	II	4	0	1	5	4	0	1	5
5.	BSPY307	Physics – III	III	4	4	0	8	4	2	0	6
6.	BSMA307	Mathematics – III	III	5	0	1	6	5	0	1	
7.	BSBO307	Biotechnology – I	III	4	4	0	8	4	2	0	
8.	BSPY407	Physics – IV	IV	4	4	0	8	4	2	0	6
9.	BSMA407	Mathematics – IV	IV	4	4	0	8	4	2	0	
10.	BSBO407	Biotechnology – II	IV	4	4	0	8	4	2	0	
11.	BSCM503	Industrial Chemistry	V	4	4	0	8	4	2	0	6
12.	BSCM504	Green Chemistry	V	4	4	0	8	4	2	0	
13.	BSCM505	Polymer Chemistry	V	4	4	0	8	4	2	0	6
14.	BSCM506	Novel Inorganic Chemistry	V	4	4	0	8	4	2	0	
15.	BSCM603	Drug and Dyes	VI	4	4	0	8	4	2	0	6
16.	BSCM604	Application of Computers	VI	4	4	0	8	4	2	0	
17.	BSCM605	Analytical Chemistry	VI	4	4	0	8	4	2	0	6
18.	BSCM606	Instrumental Chemistry	VI	4	4	0	8	4	2	0	
		Total		74	64	2	140	74	32	2	**48**

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

Professional Core Courses

(i) Number of Professional Core Courses: 14
(ii) Credits: 84

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	BSCM111	Inorganic Chemistry – I	I	3	4	0	7	3	2	0	5
2.	BSCM112	Physical Chemistry - I	I	3	4	0	7	3	2	0	5
3.	BSCM211	Organic Chemistry – I	II	3	4	0	7	3	2	0	5
4.	BSCM212	Physical Chemistry – II	II	3	4	0	7	3	2	0	5
5.	BSCM301	Inorganic Chemistry– II	III	4	4	0	8	4	2	0	6
6.	BSCM302	Organic Chemistry – II	III	4	4	0	8	4	2	0	6
7.	BSCM303	Physical Chemistry – III	III	4	4	0	8	4	2	0	6
8.	BSCM401	Inorganic Chemistry – III	IV	4	4	0	8	4	2	0	6
9.	BSCM402	Organic Chemistry – III	IV	4	4	0	8	4	2	0	6
10.	BSCM403	Physical Chemistry – IV	IV	4	4	0	8	4	2	0	6
11.	BSCM501	Inorganic Chemistry – IV	V	4	4	0	8	4	2	0	6
12.	BSCM502	Organic Chemistry – V	V	4	4	0	8	4	2	0	6
13.	BSCM601	Organic Chemistry – IV	VI	4	4	0	8	4	2	0	6
14.	BSCM602	Physical Chemistry – V	VI	4	4	0	8	4	2	0	6
		Total		**56**	**56**		**112**	**56**	**28**		**84**

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Professional Elective Courses-

(i) Number of Professional Elective Course: 108
(ii) Credits: 18

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	BSPY115	Physics - I	I	3	4	0	7	3	2	0	5
2.	BSMA115	Mathematics – I	I	3	4	0	7	3	2	0	
3.	BSPY215	Physics – II	II	3	4	0	7	3	2	0	5
4.	BSMA215	Mathematics – II	II	4	0	1	6	4	0	1	
5.	BSPY307	Physics – III	III	4	4	0	8	4	2	0	6
6.	BSMA307	Mathematics – III	III	5	0	1	6	5	0	1	
7.	BSBO307	Biotechnology – I	III	4	4	0	8	4	2	0	
8.	BSPY407	Physics – IV	IV	4	4	0	8	4	2	0	6
9.	BSMA407	Mathematics – IV	IV	4	4	0	8	4	2	0	
10.	BSBO407	Biotechnology – II	IV	4	4	0	8	4	2	0	
11.	BSCM503	Industrial Chemistry	V	4	4	0	8	4	2	0	6
12.	BSCM504	Green Chemistry	V	4	4	0	8	4	2	0	
13.	BSCM505	Polymer Chemistry	V	4	4	0	8	4	2	0	6
14.	BSCM506	Novel Inorganic Chemistry	V	4	4	0	8	4	2	0	
15.	BSCM603	Drug and Dyes	VI	4	4	0	8	4	2	0	6
16.	BSCM604	Application of Computers	VI	4	4	0	8	4	2	0	
17.	BSCM605	Analytical Chemistry	VI	4	4	0	8	4	2	0	6
18.	BSCM606	Instrumental Chemistry	VI	4	4	0	8	4	2	0	
		Total		74	64	2	140	74	32	2	**48**

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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.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	SECC101	Industrial Internship	I	0	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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Ability Enhancement Courses

(i) Number of Ability Enhancement Courses: 6
(ii) Credits: 12

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	AECC101	Fundamentals of English	I	2	0	0	2	2	0	0	2
2.	AECC201	Communication Skills in English	II	2	0	0	2	2	0	0	2
3.	AECC301	Entrepreneurship Development	III	2	0	0	2	2	0	0	2
4.	AECC401	Environmental Studies	IV	2	0	0	2	2	0	0	2
5.	AECC501	Disaster Risk Management	V	2	0	0	2	2	0	0	2
6.	AECC601	Indian Constitution	VI	2	0	0	2	2	0	0	2
		Total		**12**			**12**	**12**			**12**

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Skill Enhancement Compulsory/Elective Courses

(i) Number of Skill Enhancement Courses: 6
(ii) Credits: 12

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	SECC101	Industrial Internship	I	0	2	0	2	0	2	0	2
2.	SECC102	Foundation Course	I	2	0	0	2	2	0	0	2
3.	SECC201	Industrial Internship	II	0	2	0	2	0	2	0	2
4.	SECC301	Industrial Internship	III	0	2	0	2	0	2	0	2
5.	SECC401	Industrial Internship	IV	0	2	0	2	0	2	0	2
6.	SECC501	Industrial Internship	V	0	2	0	2	0	2	0	2
Skill Enhancement Elective Courses											
7.	BSCM305	Statistics – I	III	2	0	0	2	2	0	0	2
8.	BSCM306	Fuel Chemistry	III	2	0	0	2	2	0	0	2
9.	BSCM405	Statistics – II	IV	2	0	0	2	2	0	0	2
10.	BSCM406	Quantum Mechanics	IV	2	0	0	2	2	0	0	2
		Total		**10**	**10**		**20**	**10**	**10**		**20**

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

About the Programme :

The B.Sc. Chemistry program is a comprehensive undergraduate program that offers students a strong foundation in the field of chemistry. This program is designed to provide students with theoretical knowledge and practical skills necessary to pursue a successful career in various sectors including research, academia, industry, and more. It not only focuses on imparting chemical knowledge but also integrates crosscutting issues relevant to professional ethics, gender, human values, environment, and sustainability into the curriculum. One of the key aspects of the B.Sc. Chemistry program is its local, national, and international relevance. Chemistry is a universal science, and its principles are applicable in various contexts and industries around the world. The program equips students with a deep understanding of chemical concepts and their applications, enabling them to contribute to local industries and research initiatives while also having the potential to make a global impact. The B.Sc. Chemistry program also emphasizes employability, entrepreneurship, and skill development. The curriculum is designed to equip students with practical skills and knowledge that are in demand in the industry. Students are exposed to various laboratory techniques, instrumental analysis, and research methodologies, enabling them to develop strong analytical and problem-solving skills. The emphasis on employability, entrepreneurship, and skill development, along with student-centric learning methods, enhances the learning experience and prepares students for the challenges of the field.

Teaching Scheme
Semester – I B. Sc Chemistry

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.	AECC101	Fundamentals of English	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	B. Skill Enhancement Courses															
2.	SECC101	Internship	0	2	0	2	0	2	0	2	0	0	0	0	0	50
3.	SECC102	Foundation Course	0	2	0	2	0	2	0	2	0	0	0	0	0	50
	B. Core Course															
3.	BSCM111	Inorganic Chemistry – I	3	4	0	7	3	2	0	5	20	40	40	100	50	150
4.	BSCM112	Physical Chemistry – I	3	4	0	7	3	2	0	5	20	40	40	100	50	150
	C. Discipline Specific Courses (Any One)															
5.	BSPY115	Physics – I	3	4	0	7	3	2	0	5	20	40	40	100	50	150
6.	BSMA115	Mathematics – I	3	4	0	7	3	2	0		20	40	40	100	50	
		Total	**14**	**16**	**00**	**26**	**14**	**12**	**00**	**23**						**650**

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

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**
30	00	00	30	30	00	00	2

Course Pre-requisites	Student should have cleared 12th 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	1 To emphasize the development of listening and reading skills among learners 2 To equip them with writing skills needed for academic as well as workplace context 3 To enable learners of Engineering and Technology develop their basic communication skills in English 4 To strengthen the fundamentals in English Language. 5 To build up the confidence to communicate with the world.

Course Content (Theory)	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, group discussion, debate, public speaking	**30%**	**9**
Unit 4: Practicing and Identifying the Common Error Tense, subject-verb agreement, noun-pronoun agreement, articles, prepositions, modal auxiliaries, voice, reported speech	**20%**	**6**

Instructional Method and Pedagogy:

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

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 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.	Textbook
2.	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

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

Theory: Continuous Evaluation Component Marks	Attendance	10 marks
	MCQs	10 marks
	Skill enhancement activities / case study	10 marks
	Presentation/ miscellaneous activities	10 marks
	Total	**20 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM111	COURSE NAME Inorganic Chemistry – I	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	30	00	75	3	2	0	5

Course Pre-requisites	Students should have basic knowledge of chemistry till 12th grade
Course Category	Basic Science Courses/Laboratory course
Course focus	Employability/ Skill development
Rationale	Inorganic chemistry is fundamental to many practical technologies including catalysis and materials, energy conversion and storage, and electronics. Basic concepts of inorganic chemistry are required for the overall excellence in the field of chemistry and for performing various inorganic chemistry practical in laboratory.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1. To understand the importance of atomic theory in developing the model of the atom. 2: To understand and learn Schrodinger wave equation and apply it for numerical calculations. 3: To understand and learn and analyse various trends in the periodic table. 4: To understand and learn about the various redox processes and apply them in understanding reactions. 5: To understand and apply VBT and VSEPR on various molecules.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Atomic Structure Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.	**23%**	**14**
Unit 2: Periodicity of Elements s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-block. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.	**27%**	**16**
Unit 3: Oxidation-Reduction Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.	**7%**	**04**
Unit 4: Theory: Chemical Bonding - I (i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. (ii) Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2,	**27%**	**16**

B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.		
Unit 5: Chemical Bonding – II (i) Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. (ii) Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.	**16%**	**10**

List Of Practical	Weightage	Contact hours
1. To determine the normality and strength of xN Na_2CO_3 by titrating it against 0.2 N HCl solution	**4%**	**4**
2. To determine the normality and strength of xN KOH by titrating it against 0.2 N HCI solution	**4%**	**4**
3. To determine the normality and strength of xN H_2SO_4 by titrating it against 0.2 N HCI solution	**4%**	**4**
4. To determine the normality and strength of xN $H_2C_2O_4$ bytitrating it against 0.2 N NaOH solution	**4%**	**4**
5. To determine the normality and strength of xN FAS by titrating it against 0.5 N $KMnO_4$ solution	**4%**	**4**
6. To determine the normality and strength of base mixture $NaHCO_3$ + Na2CO3 by titrating it against 0.1 N HCl solution	**4%**	**4**
7. To determine the normality and strength f base mixture Na_2CO_3+ NaOH by titrating it against 0.1 N HCl solution	**4%**	**4**
8. To determine the normality and strength of xN $H_2C_2O_4$ and H_2SO_4 by titrating it against 0.2N KOH solution	**4%**	**4**

9. To estimate the amount of Cu presenting given solution by titrating it against 0.1M EDTA solution	**4%**	**4**
10. To estimate the amount of Mg presenting given solution by titrating it against 0.1M EDTA solution	**4%**	**4**
11. Determination of Hardness by EDTA method.	**4%**	**4**
12. Preparation of solutions of different Molarity/Normality of titrants.	**4%**	**4**
13. Revision of experiments	**4%**	**4**
14. Revision of experiments	**4%**	**4**
15. Revision of experiments	**4%**	**4**

Instructional Method and Pedagogy:

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

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
CO1: The students will be able to **understand** the importance of atomic theory in developing the model of the atom.	Understand	Define, Classify & Describe
CO2: The students will be able to **understand** and **remember** Schrodinger wave equation and **apply** it for numerical calculations.	Understand, Remember & Analyse	Define, Classify, Describe, Demonstrate & Examine
CO3: The students will be able to **understand** and **remember** and analyse various trends in the periodic table.	Understand, Remember & Apply	Define, Classify, Describe & Demonstrate
CO4: The students will be able to **understand** and **apply** about the various redox processes and apply them in understanding reactions.	Understand, Remember, Apply	Define, Classify, Describe, Demonstrate & Examine

CO5: The students will be able to **understand, analyse and apply** VBT and VSEPR on various molecules.	Understand, Analyse & Apply	Define, Describe & Demonstrate

Learning Resources	
1.	Reference Books: 1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991. 2. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970. 3. Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006. 4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
2.	Journals & Periodicals: 1. Journal of Chemical Sciences 2. Chemistry World
3.	Other Electronic Resources: NPTEL, SWAYAM, MERLOT

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

Mapping of POs& COs

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

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

COURSE CODE BSCM112	COURSE NAME Physical Chemistry – I	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	30	00	75	3	2	0	5

Course Pre-requisites	Fundamental knowledge of concepts related to chemistry up to school (10+2) level.
Course Category	Core Course
Course focus	Employability
Rationale	The fundamental concepts of physical chemistry help in understanding the kinetic theory of gases, solid state as well as various surface properties like viscosity and surface tension and ionic equilibria. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: To understand the fundamental building blocks of matter and remember their behaviour under different conditions. 2: To understand and remember the kinetic theory of gases and apply these concepts for analysing the phenomenon. 3: To understand & remember the concepts of viscosity and surface tension and apply them on the liquid state of matter. 4: To understand and remember the basics related to ionic equilibria, buffer solutions and able to analyse respective remembered phenomena in different applications. 5: To understand and remember related to the laws of governing solubility, Ksp and applying them in solving numerical.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Gaseous State Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Vander Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.	**20%**	**12**
Unit 2: Liquid State Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.	**20%**	**12**
Unit 3: Solid State Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.	**20%**	**12**
Unit 4: Ionic Equilibria-I Strong, moderate and weak electrolytes, degree of ionization,	**20%**	**12**

factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di and triprotic acids (exact treatment). Salt hydrolysis calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body		
Unit 5: Ionic Equilibria-II Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.	**20%**	**12**

List of Practical	Weightage	Contact hours
1: To determine the relative viscosity of the unknown solution with respect to water at room temp using oswald's viscometer-Ethyl Acetate	**12.5%**	**4**
2: To determine the relative viscosity of the unknown solution with respect to water at room temp using oswald's viscometer-carbon tetrachloride	**12.5%**	**4**
3: To determine the relative viscosity of the unknown solution with respect to water at room temp using oswald's viscometer-Chloroform	**12.5%**	**4**
4: To determine the relative viscosity of the unknown solution with respect to water at room temp using oswald's viscometer-Acetone	**12.5%**	**4**
5: To determine the surface tension of the unknown solution with respect to water at room temp using stalagmometer-Ethyl Acetate	**12.5%**	**4**
6: To determine the surface tension of the unknown solution with respect to water at room temp using stalagmometer-Carbon Tetrachloride	**12.5%**	**4**
7: To determine the surface tension of the unknown solution with respect to water at room temp using stalagmometer-Chloroform	**12.5%**	**4**
8: To determine the surface tension of the unknown solution with respect to water at room temp using stalagmometer-Acetone	**12.5%**	**4**

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

Course Outcome:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Subdomain**
After successful completion of the above course, students will be able to:		
CO1: The students will be able to **understand** the fundamental building blocks of matter and **remember** their behaviour under different conditions.	Understand & remember	Define, Classify & Describe
CO2: The students will learn basic **understanding** and will be able to **remember** the kinetic theory of gases and **apply** these concepts for **analysing** the phenomenon.	Understand, Remember & Analyse	Define, Classify, Describe, Demonstrate & Examine
CO3: The students will be able to **understand** & **remember** the concepts of viscosity and surface tension and **apply**them on the liquid state of matter.	Understand, Remember & Apply	Define, Classify, Describe & Demonstrate
CO4: The students will develop **understanding** related to basics related to ionic equilibria, buffer solutions and able to **analyse** respective **remembered** phenomena in different **applications**.	Understand, Remember, Apply & Analyse	Define, Classify, Describe, Demonstrate & Examine
CO5: The students will develop **understanding** and **remembering** related to the laws of governing solubility, Ksp and **applying** them in solving numericals.	Understand, Remember, Analyse & Apply	Define, Describe & Demonstrate

Learning Resources	
1.	Reference/Text Books: 1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011). 2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed*.; McGraw- Hill: New York (2003). 3. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003) 4. Principals of Physical Chemistry by Puri Sharma Pathania
2.	Journals & Periodicals: 1.Journal of Chemical Sciences 2. Chemistry World
3.	Other Electronic Resources: NPTEL, SWAYAM, MERLOT

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<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
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<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>
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<tr><td>Practical Exam</td><td>20 marks</td></tr>
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<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
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<tr><td>Total</td><td>50 Marks</td></tr>
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</td></tr>
</table>

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSMA115	COURSE NAME Mathematics-I	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
75	0	15	90	5	0	1	6

Course Pre-requisites	Knowledge of basic precalculus concepts
Course Category	Discipline Specific Generic Elective
Course focus	Skill development
Rationale	This course involves the basics of Trigonometry and inverse trigonometry. Also develop the concepts of Limit, continuity, differentiation and integration of functions of one variable and basic applications of it. students will also get to know about Matrices, determinants and their applications.
Course Revision/ Approval Date:	14/03/2020
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: Trigonometry and its identities, inverse trigonometric functions, Concept of a limit and functions, Continuity and derivative of elementary functions, Rules of differentiation (without proof), Chain rule (without proof), differentiation of implicit functions.	**20%**	**15**
Unit 2: Indeterminate forms, L. Hospital's rules, Applications of Derivatives: maxima and minima of function. Standard integration formulae, Integration by the method of substitution	**20%**	**15**
Unit 3: Integration by parts, Integration by the method of partial fractions, definite integration, fundamental theorem of calculus Applications of Integrations: Area and volume	**20%**	**15**
Unit 4: Introduction to matrices, different types of matrices, Elementary operations on matrices and types of matrices, Symmetric and skew- symmetric matrices, Hermitian and skew — Hermitian matrices. Rank of a matrix. Row Reduced Eichel on form of a matrix and matrix in version using it. Determinant of 2 x 2 and 3 x 3 matrices. Inverse of a square matrix	**20%**	**15**
Unit 5: Homogeneous and Non-homogeneous linear equations. Application of matrices in solving a system of simultaneous linear equations. Eigen values, Eigen vectors and the characteristic equation of a matrix. Cayley Hamilton theorem (without proof) and its use in finding inverse of a matrix.	**20%**	**15**

List Of Practical Tutorial	Weightage	Contact hours
Unit 1: Problem solving Examples on limit, continuity and differentiation.	**20%**	**3**
Unit 2: Problem solving on Indeterminant forms and L'Hosptitals Rule.	**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, Eigenvalue and eigenvalues and Cayley Hamilton theorem.	**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:	Apply	Describe, Find
CO1: **Demonstrate** knowledge of basic precalculus concepts and skills.	Understand, Remember	Demonstrate & Examine, Find
CO2: **Evaluate** limits, recognize continuity and use the properties of continuous functions.		
CO3: **Find** derivatives of algebraic and trigonometric functions using the definition or basic rules of differentiation.	Understand, Remember	Demonstrate & Examine, Find
CO4: **Find** rates of change, solve related rate problems, Find extreme values in optimization problems.	Evaluate	Examine, Find
CO5: **Apply** the concepts and methods described in the syllabus, solve problems using linear algebra and will know a number of applications of linear algebra.	Understand, Remember,	Define, Classify, Describe,

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.	20 marks
Practical understanding of the subject on the Project/Industrial.	10 marks
Industry/ University mentor's feedback on the Project/ Industrial.	10 marks
Attendance	10 marks
Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSPY115	COURSE NAME Physics-I	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	30	00	75	3	2	0	5

Course Pre-requisites	Understanding of basic physics up to school level (10+2 level).
Course Category	Generic Elective
Course focus	Employability/ 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:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Understand** the basic laws of motion and responsible forces. 2: **Understand** the basic principles of oscillations and laws of Fluid dynamics and its **application.** 3: A**nalyse** the behaviour of materials based on their mechanical properties 4: R**emember** the laws of thermodynamics and their **applications** 5: **Understand** the nature of charges under static and dynamic condition

Course Content (Theory)	Weightage	Contact hours
Unit 1: Laws of Motion Physical quantities and their dynamics: definitions and dimensions; vectors and scalars; concept of displacement, velocity, acceleration, angular momentum, torque, force, power, work, energy, and the relation between these physical quantities; elastic and inelastic collisions. Newton's laws of motion. Gravitation and weightlessness.	**20%**	**12**
Unit 2: Oscillations and Fluid Dynamics Simple harmonic motion. Amplitude, period, frequency and wavelength. Kinetic and Potential Energy, Total Energy, and their time averages. Damped oscillations. Fluids: diffusion, dissipation, random walks and directed motions; Reynolds number, buoyant forces, Bernoulli's equation, viscosity, turbulence, surface tension, adhesion.	**20%**	**12**
Unit 3: Elasticity of materials Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional pendulum - Determination of Rigidity modulus and moment of inertia - q, η and σ by Searle's method.	**20%**	**12**
Unit 4: : Laws of Thermodynamics Basic laws; kinetic theory of gases; conduction, convection, and radiation; relations between pressure, volume and temperature; concept of thermal equilibrium, heat, temperature, internal energy, entropy, temperature and free energy, enthalpy. Introduction to laws of Thermodynamics	**20%**	**12**
Unit 5: Laws of Electrostatics and Electrodynamics Basic laws, conductors and insulators, basic electrical quantities: current, voltage and power, Ohm's law and calculations related to simple resistor circuits, electric field and potential, energy of charges, ionic conductance; electrolyte conductivity, capacitors and capacitance, dielectrics.	**20%**	**12**

List Of Practical	Weightage	Contact hours
1: Error Analysis-I: (i) Uncertainties and error propagation. (ii) use of significant figures in the propagation of uncertainty. (iii) Plotting of graph and curve fitting	**5%**	**3**
2: Error Analysis-II: (i) Combining and reporting uncertainties in experimental measurements. (ii) Estimating uncertainties in an averaged measurement.	**5%**	**3**
3. To **Measure** the value of acceleration due to gravity using Bar Pendulum	**15%**	**4**
4: To **determine** the young's modulus of elasticity of given wire.	**15%**	**4**
5: To **Determine** the moment of inertia of an irregular body about an axis passing through its center of gravity and perpendicular to its plane	**15%**	**4**
6: To D**etermine** the moment of inertia of the given disc using torsion pendulum, with identical masses using Torsional Pendulum	**15%**	**4**
7: To **Study** the relationship between the temperature of a hot body and time by plotting a cooling curve and **verify** Newton's law of cooling.	**15%**	**4**
8: Measurement of charge and discharge characteristics of a capacitor.	**15%**	**4**

Instructional Method and Pedagogy:
Power point presentation, video, case study, demonstration

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: **Understand** the basic laws of motion and responsible forces.	Understanding	Describe
CO2: **Understand** the basic principles of oscillations and laws of Fluid dynamics and its application.	Understanding	Explain
CO3: **Analyse** the behaviour of materials based on their mechanical properties	Analyse	Distinguish and examine
CO4: **Define** the laws of thermodynamics and their applications	Remember	Define
CO5: **Understand** the nature of charges under static and dynamic	Understanding	Classify and Explain

Learning Resources	
1.	Reference Books: 1. Jearl Walker, David Halliday, Robert Resnick, Fundamentals of Physics, Wiley, 2011. 2. Charles Kittel, Mechanics, Tata Mc Graw-Hill, 2007. 3. D. C. Tayal, Electricity and Magnetism, Himalaya Publishing House, 1988.
2.	Journals & Periodicals: Journal of Undergraduate Reports in Physics (JURP), Society of Physics Students.
3.	Other Electronic Resources: **Feynman Lectures in Physics: https://www.feynmanLectures.caltech.edu/**

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<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
<tr><td>Research Paper Review</td><td>10 marks</td></tr>
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Mapping of PSOs & COs

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

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

Teaching Scheme
Semester – II B. Sc Chemistry

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.	AECC201	Communication Skills in English	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	B. Skill Enhancement Courses															
2.	SECC201	Internship	0	2	0	2	0	2	0	2	0	0	0	0	0	50
	B. Core Course															
3.	BSCM211	Organic Chemistry – I	3	4	0	7	3	2	0	5	20	40	40	100	50	150
4.	BSCM212	Physical Chemistry – II	3	4	0	7	3	2	0	5	20	40	40	100	50	150
	C. Discipline Specific Courses (Any One)															
5.	BSPY215	Physics – II	3	4	0	7	3	2	0	5	20	40	40	100	50	150
6.	BSMA215	Mathematics – II	3	4	0	7	3	2	0		20	40	40	100	50	
		Total	**18**	**16**	**00**	**26**	**18**	**12**	**00**	**22**						**600**

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

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**
30	00	00	30	30	00	00	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 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 & Inferential)	**30%**	**9**
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**

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

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	10 marks	
	MCQs	10 marks	
	Skill enhancement activities / case study	10 marks	
	Presentation/ miscellaneous activities	10 marks	
	Total	**20 Marks**	

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM211	COURSE NAME Organic Chemistry-I	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	30	00	75	3	2	0	5

Course Pre-requisites	Fundamental knowledge of concepts related to organic chemistry.
Course Category	Core Course
Course focus	Employability
Rationale	The fundamental concepts of physical chemistry help in understanding the basics of organic chemistry, stereochemistry and chemistry of aromatic hydrocarbons.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1. To understand the basics of organic chemistry. 2. To understand and remember the concepts of aromaticity. 3. To understand, remember and apply the concepts of stereochemistry. 4. To understand and apply the reactions mechanisms of various organic reactions. 5. To understand and remember the chemistry of aliphatic and aromatic hydrocarbons.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Basics of Organic Chemistry Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electrometric, resonance and mesomeric effects,	**20%**	**12**

hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.		
Unit 2: Stereochemistry Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.	**20%**	**12**
Unit 3: Chemistry of aliphatic compounds Carbon-Carbon sigma bonds Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions.	**20%**	**12**
Unit 4: Chemistry of aliphatic compounds Hydration to form carbonyl compounds, Alkylation of terminal alkynes. B. Carbon-Carbon pi bonds: Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Cycloalkanes and Conformational Analysis Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with	**20%**	**12**

energy diagrams.		
Unit 5: Aromatic Hydrocarbons Aromaticity Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.	**20%**	**12**

List of Practical	Weightage	Contact hours
1: To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
2: To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
3: To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
4: To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
5: To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
6: To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
7: To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
8: To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
9. To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
10. To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
11. To identify the given unknown organic compound-Organic Spotting	**4%**	**4**

12. To identify the given unknown organic compound-Organic Spotting	**4%**	**4**
13. Revision	**4%**	**4**
14. Revision	**4%**	**4**
15. Revision	**4%**	**4**

Instructional Method and Pedagogy:

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

Course Outcome:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Subdomain**
After successful completion of the above course, students will be able to:		
CO1: The students will understand the basics of organic chemistry.	Understand	Define, Classify & Describe
CO2: The students will understand and remember the concepts of aromaticity.	Understand, Remember	Define, Classify, Describe,
CO3: The students will understand, remember and apply the concepts of stereochemistry.	Understand, Remember & Apply	Define, Classify, Describe & Demonstrate
CO4: The students will understand and apply the reactions mechanisms of various organic reactions.	Understand, Apply	Define, Classify, Describe,
CO5: The students will understand and remember the chemistry of aliphatic and aromatic hydrocarbons.	Understand, Remember & Apply	Define, Describe

Learning Resources	
1.	Reference/Text Books: 1. Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005. 2.Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 4. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
2.	Journals & Periodicals: 1.Journal of Chemical Sciences 2. Chemistry World
3.	Other Electronic Resources: NPTEL, SWAYAM, MERLOT

<table>
<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
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<tr><td>MCQs</td><td>10 marks</td></tr>
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<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
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Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM212	COURSE NAME Physical Chemistry – II	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	30	00	75	3	2	0	5

Course Pre-requisites	Fundamental knowledge of concepts related to physical chemistry.
Course Category	Core Course
Course focus	Employability
Rationale	The fundamental concepts of physical chemistry help in understanding the various laws of thermodynamics, chemical equilibrium and colligative properties. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: To understand and remember the fundamental concepts of various thermodynamics parameters 2: To understand about entropy and remember Maxwell and Gibbs-Helmholtz equation and apply these concepts for analysing the phenomenon. 3: To understand & remember the systems of Variable Composition and apply them on the behaviour of ideal gases. 4: To understand the concepts related to chemical equilibrium and able to analyse respective remembered phenomena in different applications. 5: To develop understanding and remembering concepts related to colligative properties and applying them in solving numerical.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Chemical Thermodynamics - I Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. *First law:* Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. *Thermochemistry:* Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.	**20%**	**12**
Unit 2: Chemical Thermodynamics – II *Second Law:* Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes. *Third Law:* Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. *Free Energy Functions:* Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.	**20%**	**12**
Unit 3: Systems of Variable Composition Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.	**20%**	**12**
Unit 4: Chemical equilibrium Criteria of thermodynamic equilibrium, degree of advancement of	**20%**	**12**

reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants *Kp*, *Kc* and *Kx*. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases & a pure condensed phase.		
Unit 5: Solutions and Colligative Properties Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties: (i) Relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.	**20%**	**12**

List of Practical	Weightage	Contact hours
1. To study the saponification reaction for preparation of soap.	**16%**	**4**
2. To study the reaction rate of the reaction of iodide ions with hydrogen peroxide at different concentrations of iodide ions.	**16%**	**4**
3. Separation of given sample using Paper Chromatography.	**16%**	**4**
4. To determine the strength of a given potassium dichromate solution with N/20 Sodium thiosulphate solution.	**17%**	**4**
5. To determine concentration of $CuSO_4$.$5H_2O$ with 0.05N Na_2SO_3 iodometrically.	**17%**	**4**
6. Determine of concentration of a strong acid solution, HCl with a strong base, NaOH solution, by a pH metric titration method including standardization of NaOH.	**17%**	**4**

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, films on various topics of physical chemistry, group discussions, quizzes and seminars are some of the methods adopted to improve the student ability to grasp the principles of physical chemistry. The hands-on sessions

during laboratory sessions will help students to apply the concepts learnt and analyse the results and draw conclusion.

Course Outcome:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Subdomain**
After successful completion of the above course, students will be able to:		
CO1: The students will be able to **understand** and **remember** the fundamental concepts of various thermodynamics parameters.	Understand &remember	Define, Classify & Describe
CO2: The students will learn basic **understanding** of entropy and remember Maxwell and Gibbs-Helmholtz equation and **apply** these concepts for **analysing** the phenomenon.	Understand, Remember & Analyse	Define, Classify, Describe, Demonstrate & Examine
CO3: The students will be able to **understand** & **remember** the systems of Variable Composition and **apply** them on the behaviour of ideal gases.	Understand, Remember & Apply	Define, Classify, Describe & Demonstrate
CO4: The students will develop **understanding** related to basics related to chemical equilibrium and able to **analyse** respective **remembered** phenomena in different **applications**.	Understand, Remember, Apply & Analyse	Define, Classify, Describe, Demonstrate & Examine
CO5: The students will develop **understanding** and **remembering** concepts related to colligative properties and **applying** them in solving numerical.	Understand, Remember, Analyse & Apply	Define, Describe & Demonstrate

Learning Resources	
1.	Reference/Text Books: 1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011). 2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed*.; McGraw- Hill: New York (2003). 3. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003)

	4. Principals of Physical Chemistry by Puri Sharma Pathania
2.	Journals & Periodicals: 1. Journal of Chemical Sciences 2. Chemistry World
3.	Other Electronic Resources: NPTEL, SWAYAM, MERLOT

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	Industry/ University mentor's feedback on the Project/ Industrial.	10 marks
	Attendance	10 marks
	Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSMA215	COURSE NAME Mathematics-II	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
75	0	15	90	5	0	1	6

Course Pre-requisites	Basic knowledge of Derivatives and Integration
Course Category	Discipline Specific Generic Elective
Course focus	Skill development
Rationale	In this course students will learn methods to solve first ordered and first degree ordinary differential equations. They also learn to solve homogeneous and non-homogeneous higher ordered linear differential equations with constant coefficients. In this courses students will learn functions of several variables their limit continuity and parietal derivative and its applications to find maxima and minima.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Demonstrate** understanding of the meaning of an ordinary differential equation (ODE), its order, degree, its general solution, and its particular solution. 2: **Recognize** and solve different types of first-order ODES, including separable, exact, homogeneous and linear and Bernoulli equations. 3: **Solve** simple applied initial value problems (IVPs) modelled with first-order ODES, including population models, Newtonian mechanics problems, and heating and cooling problems. 4: **Understand** differentiation and integration of two or more variable by partial derivative. 5: **Find** maxima and minima of functions of two variables, Understand the optimization problems with functions of two variables.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Ordinary Differential Equations Degree and order of a differential equation, Equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear equations and equations reducible to the linear form.	**20%**	**15**
Unit 2: Exact differential equations, Integrating factors. Applications of first order equations: Mixture problem, Orthogonal trajectories, Decay and Growth problems, Temperature problem	**20%**	**15**
Unit 3: Linear differential equations of higher order, Homogeneous equations, Differential operators, Method of solving homogeneous equations, Non-homogeneous equations, Inverse operators, Methods of solving nonhomogeneous equations. Application Cardiography (ECG).	**20%**	**15**
Unit 4: Function of several variables, Limit and continuity of function of several variables, partial derivatives of function of two variables, Total differential, Chain rule, implicit differentiation, Euler's theorem for homogeneous function	**20%**	**15**
Unit 5: Applications of Partial Derivatives, Tangent plane, Normal line, Linear approximation, Maximum and minimum values by second derivative test, Lagrange's method of multipliers and Taylor's formula for two variables.	**20%**	**15**

List Of Practical Tutorial	Weightage	Contact hours
Unit 1: Problem solving on first ordered and first degree differential equations.	**20%**	**3**
Unit 2: Problem solving on applications of first ordered ODE.	**20%**	**3**
Unit 3: Problem solving on Higher ordered ODE.	**20%**	**3**
Unit 4: Problem solving on partial derivatives.	**20%**	**3**
Unit 5: Problem solving on applications of partial derivatives.	**20%**	**3**

Instructional Method and Pedagogy:
Chalk-Talk, Classroom Discussions, Notes, Use of flip classroom.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Apply	Describe, Find
CO1: **Demonstrate** understanding of the meaning of an ordinary differential equation (ODE), its order, degree, its general solution, and its particular solution.	Understand, Remember	Demonstrate & Examine, Find
CO2: **Recognize** and solve different types of first-order ODEs, including separable, exact, homogeneous and linear and Bernoulli equations	Understand, Remember	Demonstrate & Examine, Find
CO3: **Solve** simple applied initial value problems (IVPs) modelled with first-order ODEs, including population models, Newtonian mechanics problems, and heating and cooling problems.	Evaluate	Examine, Find
CO4: **Understand** differentiation and integration of two or more variable by partial derivative	Understand, Remember,	Define, Classify, Describe,
CO5: **Apply** of partial derivatives to solve optimization problems.	Apply & Analyse	Demonstrate & Examine

Learning Resources	
1.	Reference Books: 1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons Inc,1983 2. Zafer Ahson, Differential equations, Differential Equations and Their Appilcations, Prentice Hall India, 2016.
2.	Journals & Periodicals:
3.	Other Electronic Resources:

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSPY215	COURSE NAME PHYSICS-II	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	30	00	75	3	2	0	5

Course Pre-requisites	Fundamental knowledge of concepts related to physics up to school (10+2) level.
Course Category	Mandatory courses/Mandatory Generic Elective
Course focus	Employability
Rationale	The fundamental concepts of physics help in understanding the laws of nature and the behaviour of diverse materials under specific conditions. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: To **understand** the fundamental building blocks of matter and **remember** their behaviour under different conditions. 2: To **understand** & **remember** the dual nature of matter and radiation and **apply** these concepts to **analyse** the phenomenon. 3: To **understand** & **remember** the working of optical objects like lenses, mirrors, etc and **apply** these concepts to **understand** different optical phenomena. 4: To **understand** & **remember** the basic quantities governing in the regime of electricity and electronics and **analyse** respective phenomena in different **applications**. 5: To **understand** & **remember** the basic laws of vibration and its **application** in acoustics via **applying** governing laws.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Atoms & Nuclei Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, Radioactivity, alpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission, nuclear fusion.	**20%**	**12**
Unit 2: Dual nature of Matter & Radiation Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation; particle nature of light. Matter waves - wave nature of particles, de Broglie relation. Davisson-Germer experiment	**20%**	**12**
Unit 3: Ray Optics Reflection of light, spherical mirrors, mirror formula, refraction of light, total internal reflection and its applications, refraction at spherical surfaces, lenses, thin lens formula, Lens maker's formula, magnification, power of a lens, combination of thin lenses in contact, refraction of light through a prism. Scattering of light - blue colour of sky and reddish appearance of the sun at sunrise and sunset.	**20%**	**12**
Unit 4: Fundamentals of Electricity & Electronics Electric Cell and its Internal resistance, potential difference and emf of a cell, a combination of cells in series and in parallel. Kirchhoff's laws and their applications. Wheatstone bridge, Meter bridge. Potentiometer – principle and its applications. Semiconductors; semiconductor diode: I-V characteristics in forward and reverse bias; diode as a rectifier; I-V characteristics of LED, photodiode, solar cell and Zener diode; Zener diode as a voltage regulator.	**20%**	**12**
Unit 5: Sound Simple harmonic motion - vibrations and resonance - Fourier's Theorem - Application to sawtooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.	**20%**	**12**

List of Practical	Weightage	Contact hours
1: To study the Emission spectra of Hydrogen atom.	**10%**	**4**
2: To study the Photoelectric effect and calculate (i) Planck's constant (ii) Work-function of the material and, verify the inverse square law of radiation using a photo-voltaic cell.	**15%**	**4**
3: Determination of refractive index of a given liquid using optical parallax method.	**15%**	**4**
4: To find the Temperature coefficient of resistance (TCR) of a given coil.	**10%**	**4**
5: Introduction to CRO/DSO: (i)To understand the functions of CRO/DSO. (ii)Measure frequency of AC signal and AC & DC voltage.	**15%**	**4**
6: To study the I-V characteristics of solar cells / Zener diodes.	**15%**	**4**
7: Ultrasonic Interferometer: To find the adiabatic compressibility of a given liquid using an ultrasonic interferometer.	**10%**	**3**
8: Ultrasound Imaging: B-mode Ultrasound Scanner for medical diagnostics.	**10%**	**3**

Instructional Method and Pedagogy:

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

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Subdomain
After successful completion of the above course, students will be able to:		
CO1: The students will be able to **understand** the fundamental building blocks of matter and **remember** their behaviour under different conditions.	Understand & Remember	Define, Classify & Describe
CO2: The students will learn basic **understanding** and will be able to **remember** the dual nature of matter and radiation and **apply** these concepts for **analysing** the phenomenon.	Understand, Remember & Analyse	Define, Classify, Describe, Demonstrate & Examine
CO3: The students will be able to **understand** & **remember** the working of optical objects like lenses, mirrors, etc and will learn to **apply** these concepts to **understand** different optical phenomena.	Understand, Remember & Apply	Define, Classify, Describe & Demonstrate
CO4: The students will develop **understanding** related to basic quantities governing the electricity and electronics and will be able to **analyse** respective **remembered** phenomena in different **applications**.	Understand, Remember, Apply & Analyse	Define, Classify, Describe, Demonstrate & Examine
CO5: The students will develop **understanding** related to the laws of vibrations and its application in acoustics via **applying** the **remembered** governing laws of acoustics.	Understand, Remember, Analyse & Apply	Define, Describe & Demonstrate

Learning Resources	
1.	Reference/Text Books: 1. Jearl Walker, David Halliday, Robert Resnick, Fundamentals of Physics, Willey Publication, 9th edition, 2011. 2. Ronald Lane Reese, University Physics, Thomson Brooks, Cole, 2003. 3. V. K. Mehta & Rohit Mehta, Principles of Electronics, Sultan Chand Publishing, 11th edition, 2008. 4. F. A. Jenkins and H. E White, Fundamentals of Optics, McGraw-Hill Publishing, 4th edition, 2001. 5. N. Subrahmanyam & Brij Lal, Textbook of Sound, Vikas Publishing

	House, 2nd edition, 2006. 6. A. Srivastava & R.K. Shukla, Practical physics electricity, magnetism, electronics and optics, New Age International, 2nd edition, 2018.
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: Richard Feynman, 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 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.	20 marks
Practical understanding of the subject on the Project/Industrial.	10 marks
Industry/ University mentor's feedback on the Project/ Industrial.	10 marks
Attendance	10 marks
Total	**50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

Teaching Scheme
Semester – III B. Sc Chemistry

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Ability Enhancement Compulsory Course															
1.	AECC301	Entrepreneurship Development	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	B. Skill Enhancement Compulsory Courses															
2.	SECC301	Internship	0	2	0	2	0	2	0	2	0	0	0	0	0	50
	C. Skill Enhancement Elective Courses (Any One)															
3.	BSCM305	Statistics – I	2	2	0	2	2	0	0	2	0	0	0	50	0	50
4.	BSCM306	Fuel Chemistry	2	0	0	2	2	0	0	2	0	0	0	50	0	
	D. Core Course															
5.	BSCM301	Inorganic Chemistry – II	4	4	0	8	4	2	0	6	20	40	40	100	50	150
6.	BSCM302	Organic Chemistry – II	4	4	0	8	4	2	0	6	20	40	40	100	50	150
7.	BSCM303	Physical Chemistry – III	4	4	0	8	4	2	0	6	20	40	40	100	50	150
	E. Discipline Specific Generic Electives (Any One)															
8.	BSPY307	Physics – III	4	4	0	6	4	2	0	6	20	40	40	100	50	150
9.	BSMA307	Mathematics – III	5	1	0	6	4	2	0		20	40	40	100	50	
10.	BSBO307	Biotechnology – I	4	4	0	6	4	2	0		20	40	40	100	50	
		Total	**18**	**16**	**00**	**26**	**18**	**12**	**00**	**30**						**800**

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

COURSE CODE AECC301	COURSE NAME ENTREPRENEURSHIP DEVELOPMENT	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	0	0	30	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 entrepreneurial ventures 3: Analyze Feasibility of the project (Financial and Non-Financial) and interpret business plan. 4: Demonstrate and present successful work, collaboration and division of tasks in a multidisciplinary and multicultural team. 5: Demonstrate understanding and application of the tools necessary to create sustainable and viable Businesses.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Entrepreneurship Concept, knowledge and skills requirement; characteristic of successful entrepreneurs; role of entrepreneurship in economic development; entrepreneurship process; factors impacting emergence of entrepreneurship; managerial vs. entrepreneurial approach and emergence of entrepreneurship. Entrepreneurial Motivation.	**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 & Angel Investing	**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**
Instructional Method and Pedagogy: Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of environmental studies.		

Course Objectives:	Blooms' Taxonomy	Blooms' Taxonomy

	Domain	Sub Domain
After successful completion of the above course, students will be able 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, & Examine
CO3: Analyse Feasibility of the project (Financial and Non-Financial) and interpret business plan.	Analysis	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, Demonstrate and Examine
CO5: Demonstrate understanding and application of the tools necessary to create sustainable and viable Businesses	Create and Understand	

Learning Resources	
1.	**Textbook:** 1. Fundamentals of Entrepreneurship. 2. Managing Entrepreneurship.
2.	**Reference books** 1. Holt DH. Entrepreneurship: New Venture Creation. 2. Kaplan JM Patterns of Entrepreneurship. 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/

<table>
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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

COURSE CODE	COURSE NAME	SEMESTER
BSCM302	**Organic Chemistry-II**	**III**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	00	120	4	0	1	6

Course Pre-requisites	Students should have basic knowledge of chemistry up to 10,2 level.
Course Category	Core Course
Course focus	Subject Enhancement
Rationale	The fundamental concepts of organic chemistry help in understanding the chemistry of halogenated hydrocarbons, phenols, ethers, epoxides, reactions of Carbonyl Compounds and sulphur containing compounds.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **1: Remember &Understand** This course explores the importance of chemistry of halogenated hydrocarbons. **2: Remember &Understand** Preparation, properties and reactivity of alcohols, phenols, ethers, epoxides. **3: Understand & Apply** Preparation and different reactions of Carbonyl Compounds. **4: Remember, Understand &Apply** Study of carboxylic acid and their derivatives. **5: Understand Create & Apply** Preparation, reactivity and applications of sulphur containing compounds.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Chemistry of Halogenated Hydrocarbons Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent Pre-requisites; nucleophilic substitution vs. elimination. Aryl halides: Preparation, including preparation from diazonium salts. Nucleophilic aromatic substitution; SNAr, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.	**20%**	**16**
Unit 2: : **Alcohols, Phenols, Ethers and Epoxides** Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-BlancReduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement. Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism; Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4	**20%**	**16**
Unit 3: Carbonyl Compounds Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α – substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH4, NaBH4, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition.Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.	**20%**	**14**
Unit 4: Carboxylic Acids and their Derivatives Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of Dicarboxylic acids,	**20%**	**10**

hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group - Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement.		
Unit 5: Sulphur containing compounds Preparation and reactions of thiols, thioethers and sulphonic acids.	**20%**	**04**

List Of Practical	Weightage	Contact hours
1 Bromination of any one of the following: (a) Acetanilide by conventional methods	**20%**	**3**
2: b) Acetanilide using green approach (Bromate-bromide method)	**20%**	**3**
3: Nitration of any one of the following: (a) Acetanilide/nitrobenzene by conventional method	**20%**	**3**
4: Spotting of bi-functional Organic Compounds via elemental analysis and functional group analysis (14)	**20%**	**3**

Instructional Method and Pedagogy:
Chalk-Talk, Classroom Discussions, Notes, Use of chem draw.

Course Objectives	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: **Remember &Understand** After completing this course student will be able to explainThe chemistry of Halogenated Hydrocarbons.	Analyze and apply	Describe
CO2: **Remember &Understand** After completing this course student will be able to explain Preparation and reactions of Alcohols, Phenols, Ethers and Epoxides.	Understanding	Explain
CO3: **Understand & Apply** After completing this course student will be able to explain Reactions involving Carbonyl Compounds	Apply	Distinguish and examine
CO4: **Remember, Understand &Apply** After completing this course student will be able to explain Carboxylic Acids and their Derivatives	Understand and apply	Define
CO5: **Understand Create & Apply** After completing this course student will be able to explain the Preparation and reactions of Sulphur containing compounds.	Create	Classify and explain

Learning Resources	
1.	Reference Books: 1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2.	Journals & Periodicals: Journal of American Chemical Society
3.	Other Electronic Resources: NPTEL, SWAYAM, MERLOT

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Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM303	COURSE NAME Physical Chemistry-III	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	2	0	6

Course Pre-requisites	Understanding of basic physics up to school level (10+2 level).
Course Category	Core course
Course focus	Employability
Rationale	The concepts of physical chemistry help in understanding the phase equilibria, 3 component system, Chemical kinetics, catalysis and surface chemistry. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Understand** This course describes the concept of phase equilibrium. 2: **Understand** This course describes the concept of 3 component system Gibbs-Duhem-Margules Equation and concept of azeotropic mixture. 3: A**nalyse** Understanding the rates of chemical reactions through chemical kinetics, The acceleration of a chemical reaction by a catalysis and effect of T. 4: R**emember** Study of physical and chemical phenomena that occur at the interface of two phases 5: **Understand** Study of Physical and Chemical Adsorption.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Phase Equilibrium Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions.	**20%**	**15**
Unit 2: Three component systems Three component systems, water-chloroform-acetic acid system, triangular plots. Binary solutions: Gibbs-DuhemMargules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.	**20%**	**15**
Unit 3: Chemical Kinetics Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.	**20%**	**15**
Unit 4: Catalysis Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis - Menten mechanism, acid-base catalyst	**20%**	**09**
Unit 5: Surface Chemistry Physical adsorption, chemisorption, adsorption isotherms, nature of adsorbed state.	**20%**	**06**

List Of Practical	Weightage	Contact hours
1: Chemical kinetics	**5%**	**3**
2: Phase equilibrium: Construction of the phase diagram using cooling curves or ignition tube method: a) simple eutectic	**5%**	**3**
3. Distribution of acetic/ benzoic acid between water and cyclohexane.	**15%**	**4**
4: Adsorption: Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal. Any other experiment carried out in the class.	**15%**	**4**
5: Phase equilibria: Construction of the phase diagram using cooling curves or ignition tubemethod: b) congruently melting systems.	**15%**	**4**
Instructional Method and Pedagogy: Power point presentation, video, case study, demonstration		

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: **Analyze and Apply:** After completing this course student will be able to explain An insight in chemical kinetics and rate laws**.**	Analyse and apply	Describe
CO2: **Understand and Create:** After completing this course student will be able to explain The concept of phase equilibrium and phase diagrams of different systems	Understanding	Explain
CO3 **Understand and Apply:** After completing this course student will be able to explain Factors affecting rate of reaction and laws governing them.	Apply	Distinguish and examine
CO4 **Understand and Apply:** After completing this course student will be able to explain the concept of catalysis	Understand and apply	Define
CO5: **Create:** After completing this course student will be able to explain the concept of physisorption and chemisorption.	Create	Classify and Explain

Learning Resources	
1.	Reference Books: 1. Peter Atkins & Julio De Paula, Physical Chemistry 9 th Ed., Oxford University Press (2010). 2. Castellan, G. W. Physical Chemistry, 4 th Ed., Narosa (2004). 3. McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi (2004). 4. Engel, T. & Reid, P. Physical Chemistry 3 rd Ed., Prentice-Hall (2012). 5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011). 6. Zundhal, S.S. Chemistry concepts and applications Cengage India (2011). 7. Ball, D. W. Physical Chemistry Cengage India (2012). 7. 8. Mortimer, R. G. Physical Chemistry 3 rd Ed., Elsevier: NOIDA, UP (2009)
2.	Journals & Periodicals: The Journal of Physical Chemistry.
3.	Other Electronic Resources: NPTEL, SWAYAM, MERLOT (Links available in GSFC University Link

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Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM301	COURSE NAME Inorganic Chemistry-III	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	00	120	4	2	0	6

Course Pre-requisites	Students should have basic knowledge of chemistry up to 10,2 level.
Course Category	Core Course
Course focus	Subject Enhancement
Rationale	The fundamental concepts of inorganic chemistry help in understanding the importance of general principle of metallurgy, various theories proposed to define acid and bases, behaviour of noble gases and different applications of inorganic polymers.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Demonstrate** Explains the importance of general principle of metallurgy imparting Chief modes of occurrence of metals based on standard electrode potentials. 2: **Evaluate** Understand the theory proposed to define acid and bases. 3: **Find** Learn about chemistry of s and p-block elements. 4: **Find** Understand the behavior of noble gases 5: **Apply** Understand the type and applications of inorganic polymers.

Course Content (Theory)	Weightage	Contact hours
Unit 1: General Principles of Metallurgy Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.	**20%**	**6**
Unit 2: Acids and Bases Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.	**20%**	**8**
Unit 3: Chemistry of s and p Block Elements Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens	**20%**	**30**
Unit 4: Noble Gases Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF2, XeF4 and XeF6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds (VSEPR theory).	**20%**	**8**
Unit 5: Inorganic Polymers Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates	**20%**	**8**

List Of Practical	Weightage	Contact hours
1 Preparation of Chrome Alum	**20%**	**3**
2: Preparation of Potash Alum	**20%**	**3**
3: Preparation of Mohr's salt	**20%**	**3**
4: Preparation of Nickel Ammonium Sulphate	**20%**	**3**
5: Determination of chlorine in Bleaching powder	**20%**	**3**
6: Salt analysis (5 mixtures)	**20%**	**3**

Instructional Method and Pedagogy:

Chalk-Talk, Classroom Discussions, Notes, Use of flip classroom.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: **Remember & Understand** After completing this course student will be able to explain the metallurgical processes of extraction and purification of metals	Remember & Understand	Describe
CO2: **Remember & Apply** After completing this course student will be able to explain the concept of acid and bases.	Remember & Apply	Explain
CO3: **Remember & Analyses** After completing this course student will be able to Recognize concepts of s and p block elements.	Remember & analyze	Distinguish and examine
CO4: **Remember & Understand** After completing this course student will be able to explain Explain the behavior of noble gases.	Understand and remember	Define
CO5: **Understand & Apply** After completing this course student will be able to explain Deliver concept of types, synthesis and applications of inorganic polymers.	Understand and apply	Classify and Explain

Learning Resources	
1.	Reference Books: 1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991. 2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y.1994. 3. Greenwood, N.N. & Earnshaw. Chemistry of the Elements, Butterworth Heinemann. 1997
2.	Journals & Periodicals: Journal of American Chemical Society
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 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**

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

Mapping of POs & COs

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

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

COURSE CODE BSMA307	COURSE NAME MATHEMATICS-III	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
75	0	15	90	5	0	1	6

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:	14/03/2020
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.

Course Content (Theory)	Weightage	Contact hours
Unit 1: **Errors:** Notions of round off, truncation and other errors, Errors in numerical computations **Solution of Algebraic and Transcendental Equations:** Bisection, False position, Iterative Method, Newton Raphson Method, Secant Method. Solution using Matlab	**20%**	**15**
Unit 2: **Solution of system of Linear Equations:** Gauss Elimination method, Gauss Jordan Method, LU decomposition method, Gauss Jacobi Method, Gauss Seidel method. Solution using Matlab	**20%**	**15**
Unit 3: **Interpolation:** Newton's forward and backward interpolation, Newton's divided difference interpolating polynomials, Lagrange Interpolating polynomials. Solution using Matlab.	**20%**	**15**
Unit 4: **Numerical Differentiation:** First and second order differentiation Equations of Equally Spaced Data. Solution using Matlab. **Numerical Integration:** Trapezoidal rule, Simpson's one third and 3/8th rule. Solution using Matlab	**20%**	**15**
Unit 5: **Numerical methods for Solution of ordinary differential equation:** Taylor's series method, Euler's method, Modified Euler's method, Runge Kutta forth ordered method, Milne's Predictor Corrector Method. Finite element method to solve second order ODE. Solution using Matlab. **Curve Fittings:** General Linear Least Squares, Fitting of quadratic and exponential curves.Solution using Matlab.	**20%**	**15**

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

Instructional Method and Pedagogy:
Chalk-Talk, Classroom Discussions, Notes, Use of flip classroom.

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 under different conditions, and numerical solution of system of algebraic equations.	Apply	Describe, Find
CO2: **Demonstrate, find:** Apply various interpolation methods and finite difference concepts	Understand, Remember	Demonstrate & Examine, Find
CO3: **Demonstrate:** Work out numerical differentiation and integration whenever and wherever routine methods are not applicable	Understand, Remember	Demonstrate & Examine, Find
CO4: **Solve:** Work numerically on the ordinary differential equations using different methods through the theory of finite differences.	Evaluate	Examine, Find
CO5: **Understand:** Work numerically on the partial differential equations using different methods through the theory of finite differences.	Understand, Remember,	Define, Classify, Describe

Learning Resources	
1.	Reference Books: 1. Probability and Statistics By T K V Iyengar, S chand, 3rd Edition, 2011. 2. Fundamentals of Mathematical Statistics by S C Gupta & V K Kapoor, Sultan Chand & Sons, New Delhi 2009. 3. Higher Engineering Mathematics By Dr. B. S. Grewal, Khanna Publishers 4. Probability and Statistics for Engineers and Scientists by Sheldon M. Ross, Academic Press 5. Probability & Statistics by Miller and freaud, Prentice Hall India, Delhi 7th Edition 2009
2.	Journals & Periodicals: i.e. Taylor J. R., An Introduction to Error Analysis, Oxford University Press, Mill Valley, CA, USA, 1982
3.	Other Electronic Resources: Geometry and Algebra: Geogebra.org/Calculator MATLAB : Mathworks.com/ **https://www.tutorialspoint.com/matlab/matlab_syntax.htm**

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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 BSPY307	COURSE NAME Physics-III	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	30	0	90	4	2	0	6

Course Pre-requisites	Understanding of basic physics up to school level (10+2 level).
Course Category	Generic Elective
Course focus	Employability
Rationale	The fundamental concepts of physics help in understanding the fundamentals of electrostatics and magnetostatics in daily life applications. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
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, 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.	**23%**	**14**
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 at constant 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 Method and Pedagogy:

PPT, Demonstration, Video, Case study

Course Outcome	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: **Describe** the physical significance of mathematical operations.	Understanding	Describe
CO2: **Employ** the knowledge of electrostatics in daily life applications.	Understand and Apply	Explain and examine
CO3: **Explain** the use of magnetostatics in various applications	Understand and 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), Society of Physics Students.
3.	Other Electronic Resources: **Feynman Lectures in Physics: https://www.feynmanLectures.caltech.edu/**

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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: Mderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BSBO307	COURSE NAME Biotechnology-I	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	30	0	90	4	2	0	6

Course Pre-requisites	Understanding of basic physics up to school level (10+2 level).
Course Category	Generic Elective
Course focus	Employability
Rationale	The fundamental concepts of physics help in understanding the fundamentals of electrostatics and magnetostatics in daily life applications. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: The objective of this course is to familiarize students with the biomolecules. 2: Understand the structure and function of important biological molecules such as DNA, RNA and some enzymes, Proteins Pre-requisites 3: This course will also provide an overview of the organic chemical principles in life processes. 4: To make students understand the Structure and functions of lipids. 5: To explain physical & chemical properties of Nucleic acids.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Carbohydrates Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, ucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions, Biotechnologically important polysaccharides.	**20%**	**12**
Unit 2: Proteins Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.	**20%**	**12**
Unit 3: Enzymes Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories.	**20%**	**12**
Unit 4: Lipids Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.	**20%**	**12**
Unit 5: 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.	**20%**	**12**

List Of Practical	Weightage	Contact hours
1: Qualitative tests for Carbohydrates.	**8%**	**3**
2: Preparation of buffers.	**14%**	**4**
3: Separation of Amino acids by paper chromatography.	**14%**	**4**
4: Qualitative tests for proteins.	**14%**	**4**
5: To verify Stefan-Boltzmann law of thermal radiation by electrical method.	**8%**	**3**
6: Principles of Colorimetry: (i) Verification of Beer's law (ii) To study relation between absorbance and % transmission.	**14%**	**4**
7: To study activity of any enzyme under optimum conditions.	**14%**	**4**
8: Qualitative tests for lipids.	**14%**	**4**

Instructional Method and Pedagogy:
PPT, Demonstration, Video, Case study

Course Outcome	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: Basic knowledge of Biomolecules	Understanding	Describe
CO2: Explain the structure and function of important biological molecules such as DNA, RNA and some enzymes, Proteins Pre-requisites	Understand and Apply	Explain and examine
CO3: Explain the basic concepts of chemical reactions that occur in living systems.	Understand and Apply	Explain and examine
CO4: Interpret the various perspectives of applied sciences that benefit the mankind.	Remember and Understand	Define and explain
CO5: Explain the overview of the organic chemical principles in life processes.	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), Society of Physics Students.
3.	Other Electronic Resources: **Feynman Lectures in Physics: https://www.feynmanLectures.caltech.edu/**

<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>Research Paper Review</td><td>10 marks</td></tr>
<tr><td>Total</td><td>40 Marks</td></tr>
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</td></tr>
<tr><td>Practical Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
</table>
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<tr><td>Project/ Industrial Internship Marks</td><td>
<table>
<tr><td>Quantity of the Project/Industrial in terms of Language, Presentation & format.</td><td>30 marks</td></tr>
<tr><td>Practical understanding of the subject on the Project/Industrial.</td><td>30 marks</td></tr>
<tr><td>Industry/ University mentor's feedback on the Project/ Industrial.</td><td>30 marks</td></tr>
<tr><td>Attendance</td><td>10 marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
</table>
</td></tr>
</table>

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

Teaching Scheme
Semester – IV B. Sc. Chemistry

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Ability Enhancement Compulsory Course															
1.	AECC401	Environmental Science	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	B. Skill Enhancement Compulsory Courses															
2.	SECC301	Internship	0	2	0	2	0	2	0	2	0	0	0	0	0	50
	C. Skill Enhancement Elective Courses (Any One)															
3.	BSCM405	Statistics – II	2	0	0	2	2	0	0	2	0	0	0	50	0	50
4.	BSCM406	Quantum Mechanics	2	0	0	2	2	0	0	2	0	0	0	50	0	
	D. Core Course															
5.	BSCM401	Inorganic Chemistry – III	4	4	0	8	4	2	0	6	20	40	40	100	50	150
6.	BSCM402	Organic Chemistry – III	4	4	0	8	4	2	0	6	20	40	40	100	50	150
7.	BSCM403	Physical Chemistry – IV	4	4	0	8	4	2	0	6	20	40	40	100	50	150
	E. Discipline Specific Generic Electives (Any One)															
8.	BSPY407	Physics – IV	4	4	0	6	4	2	0	6	20	40	40	100	50	150
9.	BSMA407	Mathematics – IV	5	1	0	6	4	2	0		20	40	40	100	50	
10.	BSBO407	Biotechnology – II	4	4	0	6	4	2	0		20	40	40	100	50	
		Total	**18**	**18**	**00**	**36**	**22**	**10**	**00**	**30**						**800**

COURSE CODE AECC401	COURSE NAME ENVIRONMENTAL SCIENCE	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	0	0	30	2	0	0	2

Course Pre-requisites	10 +2 with Science
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:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Remember:** To acquire an awareness of and sensitivity to the total environment and its allied problems. **Understand:** To make educated judgments about environmental issues. **Apply:** Develop skills and a commitment to act independently and collectively to environmental sustainability **Analyse:** Students can able to debate environmental science with use of appropriate scientific information **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 Method and Pedagogy:
Utilizing models, PowerPoint Presentations, group discussions, and seminars are some of the methods adopted to improve the student's ability to grasp the principles of environmental studies.

Course Outcome:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Subdomain**
After successful completion of the above course, students will be able to:		
CO1: Skills for identifying environmental problems: Evaluate information from popular 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 beyond their current knowledge base, students will actively research data, concepts, histories, and narratives necessary for adequate consideration of the issue.	Understand, Remember, Apply & Analyse	Define, Classify, 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 & DM Wilkinson,

	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 channel for films about environmental issues. 2. Climate Change TV—funded by companies, governments and organisations, and produced by the magazine Responding to Climate Change—the world's first web channel specific to climate change videos. 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—weekly video show about science and natural history.

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<tr><td>Practical Exam</td><td>20 marks</td></tr>
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<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
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<tr><td>Attendance</td><td>10 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
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</table>

Mapping of PSOs & Cos for AECC401: Environmental Studies

PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO						
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 for AECC401: Environmental Studies

PO	PO1	PO2	PO3	PO4	PO5	PO6
CO						
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 BSCM401	COURSE NAME Inorganic Chemistry III	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	2	0	6

Course Pre-requisites	Students should have basic knowledge of chemistry up to 10,2 level.
Course Category	Core Course
Course focus	Subject Enhancement
Rationale	The fundamental concepts of inorganic chemistry helps in understanding the concept of coordination compounds and their stereochemistry, the geometry of different types of metal complexes, the chemistry of transition elements and the role of metals in biology. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Understand** Understand the concept of coordination compounds and stereochemistry. 2: **Understand** Explain the geometry of different types of metal complexes. 3: A**nalyse** Understand the chemistry of transition elements. 4: R**emember** Understand the properties and separation techniques of lanthanoids and actinoids. 5: **Understand** Understand the role of metals in biology.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Coordination Chemistry - I Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.	**20%**	**13**
Unit 2: **Coordination Chemistry - II** Crystal field theory, measurement of 10 Dq (o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (o,t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.	**20%**	**13**
Unit 3: Transition Elements General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)	**20%**	**18**
Unit 4: Lanthanoids and Actinoids Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only)	**20%**	**06**
Unit 5: Bioinorganic Chemistry Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / Kpump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.	**20%**	**10**

List Of Practical	Weightage	Contact hours
1: Preparation of Sodium tri oxalate ferrate	**5%**	**3**
2: Preparation of Tetraammine copper (II) Sulphate.	**5%**	**3**
3. Preparation of Hexaammine Nickel(II) Chloride	**15%**	**4**
4: Preparation of Hexaammine Plumbus(II)	**15%**	**4**
5: Identification of Cation and Anion from given mixture	**15%**	**4**

Instructional Method and Pedagogy:

Power point presentation, video, case study, demonstration

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: **Remember & Understand** After completion of the course student will be able to Interpret the concept of coordination chemistry.	Understanding	Describe
CO2: Create & **Understand** After completion of the course student will be able to Describe the shapes and structures of coordination complexes.	Understanding	Explain
CO3: **Remember & Understand** After completion of the course student will be able to Explain the typical physical and chemical properties of the transition metals.	Remember &Understand	Remember &Understand
CO4: **Remember & Analyses** After completion of the course student will be able to Explain the physical and chemical properties of lanthanoids and actinoids	Remember &Analyses	Remember &Analyses
CO5: **Understand & Apply** After completion of the course student will be able to Explain the role of different metals in biology.	Understand & Apply	Understand & Apply

Learning Resources	
1.	Reference Books: 1.Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993. 2. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994. 3. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999.
2.	Journals & Periodicals: Journal: Journal of American Chemical.
3.	Other Electronic Resources: NPTEL, SWAYAM.

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

Mapping of POs & COs

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

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

COURSE CODE BSCM402	COURSE NAME Organic Chemistry -III	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	2	0	6

Course Pre-requisites	Student should have successfully completed Organic Chemistry - II
Course Category	Core Courses
Course focus	Employability
Rationale	The fundamental concepts of physics help in understanding the laws of nature and the behaviour of different physical entities/phenomena under specific conditions. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: Explain the importance of nitrogen containing functional groups. 2: Understand the effects of substituents and solvent on basicity. 3: Understand the concepts of preparations and derivatives of polynuclear hydrocarbons. 4: gain knowledge on the basics of heterocyclic chemistry. 5: explain different types of alkaloids found in nature.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Nitrogen Containing Functional Groups Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann- elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.	**10%**	**18**
Unit 2: Polynuclear Hydrocarbons Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons**.**	**20%**	**08**
Unit 3: Heterocyclic Compounds – I Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction, Derivatives of furan: Furfural and furoic acid**.**	**30%**	**22**
Unit 4: Alkaloids Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine	**20%**	**06**
Unit 5: Terpenes Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and α-terpineol.	**20%**	**06**

List of Practical	Weightage	Contact hours
1. Organic analysis of Binary mixture no.1	**4%**	**4**
2. Organic analysis of Binary mixture no.2	**4%**	**4**
3. Organic analysis of Binary mixture no.3	**4%**	**4**
4. Organic analysis of Binary mixture no.4	**4%**	**4**
5. Organic analysis of Binary mixture no.5	**4%**	**4**
6. Organic analysis of Binary mixture no.6	**4%**	**4**
7. Organic analysis of Binary mixture no.7	**4%**	**4**
8. Organic analysis of Binary mixture no.8	**4%**	**4**
9. Organic analysis of Binary mixture no.9	**4%**	**4**
10. Organic analysis of Binary mixture no.10	**4%**	**4**
11. Chromatographic separation technique: Thin layer Chromatography	**4%**	**4**
12. Chromatographic separation technique: Thin layer Chromatography	**4%**	**4**
13. Chromatographic separation technique: Thin layer Chromatography	**4%**	**4**
14. Revision of experiments	**4%**	**4**
15. Revision of experiments	**4%**	**4**

Instructional Method and Pedagogy:

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

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: The students will be able Relate importance of nitrogen containing functional groups	Remember &Understand	Define, Classify & Describe
CO2: The students will be able to **understand**, **remember** and **analyse** Recognize effects of substituents and solvent on basicity.	Understand & Apply	Define, Classify, Describe & Examine
CO3: The student will be able to **understand** Interpret concepts of preparations and derivatives of polynuclear hydrocarbons	Understand & Apply	Define, Describe, Demonstrate & Examine
CO4: The students will be able to **understand** the concepts related to Deliver knowledge on the basics of heterocyclic chemistry.	Remember, Understand &Apply	Define, Describe, Demonstrate & Examine
CO5: The students will be able to **understand**, **remember** and **analyse** the Communicate information related to different types of alkaloids found in nature.	Understand & Apply	Define, Describe & Examine

Learning Resources	
1.	Reference/Text Books: 1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009). 2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012). 3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). 4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: QualitativeAnalysis, University Press (2000).
2.	Journals & Periodicals: Journal of Chemical Sciences
3.	Other Electronic Resources: MERLOT

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<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
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<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
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<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
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</table>

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM403	COURSE NAME Physical Chemistry -IV	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	2	0	6

Course Pre-requisites	Students should have basic knowledge of chemistry up to 10,2 level.
Course Category	Core Courses
Course focus	Employability
Rationale	The fundamental concepts of physics help in understanding the laws of nature and the behaviour of different physical entities/phenomena under specific conditions. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: This course describes the concept Conductance and ionic mobility. 2: This course describes the concept of Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen and Kohlrausch Law. 3: Understanding Faraday's law of electrolysis and their applications. 4: Study of electrochemical cell and Nernst equation 5: Study of Electrical & Magnetic Properties of Atoms and Molecules

Course Content (Theory)	Weightage	Contact hours
Unit 1: Conductance Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye- Hückel-Onsager equation, Wien effect, DebyeFalkenhagen effect, Walden's rules	**10%**	**10**
Unit 2: Conductance Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constant of salts.	**20%**	**10**
Unit 3: Electrochemistry Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry	**30%**	**10**
Unit 4: Electrochemistry Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb2O3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)	**20%**	**20**
Unit 5: Electrical & Magnetic Properties of Atoms and Molecules Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their	**20%**	**10**

measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.		
List of Practical	**Weightage**	**Contact hours**
1: Conductometry Perform the following conductometric titrations: Weak acid vs. strong base	**4%**	**4**
2: Conductometry Perform the following conductometric titrations: Mixture of strong acid and weak acid vs. strong base	**4%**	**4**
3. Potentiometry Perform the following potentiometric titrations: Strong acid vs. strong base	**4%**	**4**
4. Potentiometry Perform the following potentiometric titrations: Weak acid vs. strong base	**4%**	**4**
5. To determine the normality and strength of xN FAS by titrating it against 0.5 N KMnO4solution	**4%**	**4**
6. To determine the normality and strength of base mixture NaHCO3 + Na2CO3 by titrating it against 0.1 N HCl solution	**4%**	**4**
7. To determine the normality and strength of xN H2C2O4and H2SO4 by titrating it against 0.2N KOH solution	**4%**	**4**
8. To estimate the amount of Cu presenting given solution by titrating it against 0.1MEDTA solution.	**4%**	**4**
9. To estimate the amount of Cu presenting given solution by titrating it against 0.1M EDTA solution	**4%**	**4**
10. To estimate the amount of Mg presenting given solution by titrating it against 0.1M EDTA solution	**4%**	**4**
11. Determination of Hardness by EDTA method.	**4%**	**4**
12. Preparation of solutions of different Molarity/Normality of titrants.	**4%**	**4**
13. Revision of experiments	**4%**	**4**

Instructional Method and Pedagogy:

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

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: This course describes the concept Conductance and ionic mobility.	Remember	Define, Classify & Describe
CO2: This course describes the concept of Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen and Kohlrausch Law.	Understand & apply	Define, Classify, Describe & Examine
CO3: Understanding Faraday's law of electrolysis and their applications.	Understand, Remember& apply	Define, Describe, Demonstrate & Examine
CO4: Electrochemical cell and Nernst equation.	Understand, Remember& apply	Define, Describe, Demonstrate & Examine
CO5: Electrical & Magnetic Properties of Atoms and Molecules	Understand & Remember	Define, Describe & Examine

Learning Resources	
1.	Reference/Text Books: 1.Peter Atkins & Julio De Paula, Physical Chemistry 9 th Ed., Oxford University Press (2010). 2. Castellan, G. W. Physical Chemistry, 4 th Ed., Narosa (2004). 3. McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi (2004). 4. Engel, T. & Reid, P. Physical Chemistry 3 rd Ed., Prentice-Hall(2012). 5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011). 6. Zundhal, S.S. Chemistry concepts and applications Cengage India (2011). 7. Ball, D. W. Physical Chemistry Cengage India (2012).

2.	Journals & Periodicals: Journal of American Chemical Society
3.	Other Electronic Resources: MERLOT

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Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSCM405	COURSE NAME STATISTICS-II	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	0	0	30	2	0	0	2

Course Pre-requisites	Students should have basic knowledge of statistics
Course Category	Core course
Course focus	Skill development
Rationale	Local, national, and international relevance should be highlighted
Course Revision/ Approval Date:	14/03/2020
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:** Study Curve fitting by using MS-Excel tools. 5 **Understand, Apply:** Explain what is meant by statistical inference..

Course Content (Theory)	Weightage	Contact hours
Unit 1: Probability distribution: Study of Binomial, Poisson and Normal Distribution, Application of these distributions in Bio – Sciences.	**20%**	**6**
Unit 2: Correlation and Regression: Correlation and its types, Properties of correlation coefficients, Measurement of correlation coefficient and Rank correlation coefficient. Regression: Linear regression, Properties of regression coefficients and linear regression.	**20%**	**6**
Unit 3: Test of Hypothesis: Introduction, Test of significance for large samples— single proportion, difference of proportion, single mean, difference of mean, difference of standard deviation	**20%**	**6**
Unit 4: Small sample test--Students' t distribution, chi-square distribution, snedecer's, F distribution,	**20%**	**6**
Unit 5: Curve fitting Least square method, fitting of linear, quadratic, exponential and logarithmic curves. Use of MS-Excel in Curve fitting.	**20%**	**6**

Instructional Method and Pedagogy:

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

Course outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: **Understand, apply:** Calculate and interpret the correlation between two variables. CO2: **Apply:** Calculate the simple linear regression equation for a set of data. 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.	Apply Understand, Remember Understand, Remember Evaluate Understand, Remember, Apply & Analyse	Describe, Find Demonstrate & Examine, Find Demonstrate & Examine, Find Examine, Find Define, Classify, Describe, Demonstrate & Examine

Learning Resources	
1.	Reference Books: 1. Probability and Statistics By T K V Iyengar, S chand, 3rd Edition, 2011. 2. Fundamentals of Mathematical Statistics by S C Gupta & V K Kapoor, Sultan Chand & Sons, New Delhi 2009. 3. Higher Engineering Mathematics By Dr. B. S. Grewal, Khanna Publishers 4. Probability and Statistics for Engineers and Scientists by Sheldon M. Ross, Academic Press 5. Probability & Statistics by Miller and freaud, Prentice Hall India, Delhi 7th Edition 2009
2.	Journals & Periodicals: i.e. Taylor J. R., An Introduction to Error Analysis, Oxford University Press, Mill Valley, CA, USA, 1982
3.	Other Electronic Resources: Geometry and Algebra: Geogebra.org/Calculator MATLAB : Mathworks.com/ **https://www.tutorialspoint.com/matlab/matlab_syntax.htm**

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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 BSBO407	COURSE NAME BIOTECHNOLOGY - II	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Students should have basic knowledge of biology
Course Category	Professional Elective Course
Course focus	Skill development
Rationale	To have an idea about application of biotechnology in different fields; including agriculture, environments, industry, health and forensics. The subject also deals with the recent trends, techniques and application of biotechnology.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Understand and analyze** To understand industrial application of biomolecules. 2. **Remember and Understand** To explore application of biotechnology in agriculture and animal husbandry. 3. **Create and apply** To learn how biotechnology can play important role in environmental sustainability. 4. **Understand** To know application of biotechnology to solve criminal investigations. 5. **Remember** Learn about next generation vaccines.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Industry vity and secretion, alcohol and antibiotic formation.	**20%**	**10**
Unit 2: Agriculture N2 fixation: transfer of pest resistance genes to plants; inteProtein engineering; enzyme and polysaccharide synthesis, actiraction between plants and microbes; qualitative improvement of livestock.	**20%**	**10**
Unit 3: Environments chlorinated and non-chlorinated organic pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB	**20%**	**15**
Unit 4: Forensic science solving violent crimes such as murder and rape; solving claims of paternity and theft Pre-requisites using various methods of DNA finger printing.	**20%**	**12**
Unit 5: Health Development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.	**20%**	**13**

Instructional Method and Pedagogy:
Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments. Practical sessions are also included for better understanding of subject.

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Student will able to discuss application of biotechnology in industrial sector	Remember	Explain, Describe, Discuss
CO2	Student will able to explain importance of transgenic plant	Apply	Apply, Practice, Select
CO3	Student will able to discuss application of DNA finger printing in forensic investigations	Analyses and Evaluation	Compare, Classify, Investigate
CO4	Student will able to explain application of biotechnology in environment pollution control	Create	Construct, Develop, Produce
CO5	Student will able to discuss gene therapy	Understand	Explain, Describe, outline, Predict

Learning Resources	
1.	**Reference Books:** 1. Sheldon J. Park, Jennifer R. Cochran – 2009 Protein Engineering and Design 2. Max M. Houck, Jay A. Siegel – 2009 Fundamentals of Forensic Science
2.	**Journals & Periodicals** 1. Journal of Cell Biology 2. Current Science
3.	Other Electronic resources: NPTEL and UGC pathsala web pages.

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 and CO for BSBO407: BIOTECHNOLOGY - II

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

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

Mapping of PO and CO for BSBO407: BIOTECHNOLOGY - II

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

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

COURSE CODE BSMA407	COURSE NAME MATHEMATICS-IV	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
75	0	15	90	5	0	1	6

Course Pre-requisites	Students should have basic knowledge of Mathematics up to 10+2 level
Course Category	Discipline Specific elective course
Course focus	Skill development
Rationale	This course focuses on Optimization techniques. Students get exposure of real life problems and learn to convert them in to mathematical models. They also learn to solve them using different algorithm.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1. **Recognize:** Identify and develop operational research models from the verbal description of the real system. 2 **Understand:** Understand the mathematical tools that are needed to solve optimization problems. 3. **Solve:** Use optimization techniques to solve the proposed models. 4. **Solve:** Develop a report that describes the model and the solving technique, analyse the results 5. **Understand:** To understand the decision-making processes in Management Engineering

Course Content (Theory)	Weightage	Contact hours
Unit 1: General discussions of Linear programming problems and their illustrations, Graphical method of solving two variable problem, Convex sets and their properties, Feasible solution, optimum solution, Slack and Surplus variables, L.P.P.in a standard form, Properties of a solution (without proof), Simplex method and its computational procedure, Artificial basis technique.	**20%**	**15**
Unit 2: Transportation problem, Methods for finding initial basic feasible solution: Northwest corner rule, Matrix minima method, Vogel's approximation method, optimal solution: MODI Method. Assignment problem: Hungarian Method.	**20%**	**15**
Unit 3: Project Management (PERT): Construction of networks, Network computations, Floats (free floats and total floats), Critical path method (CPM), Crashing.	**20%**	**15**
Unit 4: Game Theory: Definitions, Rules for Game Theory, Dominance Principle, Two-person zero-sum game, Game with mixed strategies, Graphical method.	**20%**	**15**
Unit 5: Sequencing Problem, Assumptions, Processing n jobs through 1 machine, 2 machines and 3 machines, Processing 2 jobs through m machines, Processing n jobs through m machines.	**20%**	**15**

List Of Practical Tutorial	Weightage	Contact hours
Unit 1: Practise examples on Unit 1	**20%**	**3**
Unit 2: Practise examples on Unit 2	**20%**	**3**
Unit 3: Practise examples on Unit 3	**20%**	**3**
Unit 4: Practise examples on Unit 4	**20%**	**3**
Unit 5: Practise examples on Unit 5	**20%**	**3**

Instructional Method and Pedagogy:

Chalk-Talk, Classroom Discussions, Notes, Use of flip classroom.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Understand, Demonstrate	Describe, Find
CO1: **Understand, Demonstrate:** Identify and develop operational research models from the verbal description of the real system.	Understand, Remember	Demonstrate & Examine, Find
CO2: **Understand:** Understand the mathematical tools that are needed to solve optimization problems.	Evaluate	Examine, Find
CO3. **Solve:** Use optimization techniques to solve the proposed models.	Understand, Remember, Apply & Analyse	Define, Classify, Describe, Demonstrate & Examine
CO4. **Demonstrate, Apply:** Develop a report that describes the model and the solving technique, analyse the results		
CO5. **Understand:** To understand the decision-making processes in Management Engineering	Understand, Remember, Apply & Analyse	Define, Classify, Describe, Demonstrate & Examine

Learning Resources	
1.	Reference Books: 1. P K Gupta, D S Hira, Operations Research, S. Chand and Company Limited, 2018. 2. Kanti Swaroop, Man Mohan and P.K. Gupta, Operations Research, Sultan Chandand Sons, 2005. 3. Hamdy A. Taha, Operations Research: An Introduction, McMillan Publishing Company, 2007. 4. S. I. Gass, Linear programming, Mc Graw Hill Book Company, 1985.
2.	Journals & Periodicals: i.e. Taylor J. R., An Introduction to Error Analysis, Oxford University Press, Mill Valley, CA, USA, 1982
3.	Other Electronic Resources: Geometry and Algebra: Geogebra.org/Calculator

	MATLAB : Mathworks.com/ **https://www.tutorialspoint.com/matlab/matlab_syntax.htm**

<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>
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<tr><td>Practical Marks</td><td>
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<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
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<tr><td>Attendance</td><td>10 marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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</td></tr>
</table>

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

COURSE CODE BSPY407	COURSE NAME PHYSICS-IV	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	30	0	90	4	2	0	6

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

Course Content (Theory)	Weightage	Contact hours
Unit 1: Wave Motion Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.	**10%**	**6**
Unit 2: Theory of Radiation Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. Fundamentals of electromagnetic radiation and related spectrum. Overview of basic applications of Electromagnetic radiation. LASERs, and related safety aspects. Optical Fibers and their applications.	**20%**	**12**
Unit 3: Wave Optics Electromagnetic nature of light. Definition and Properties of wavefront. Huygens Principle. Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. Michelson's Interferometer: (1) Idea of form of fringes (no theory needed), (2) Determination of wavelength, (3) Wavelength difference, (4) Refractive index, and (5) Visibility of fringes.	**30%**	**18**
Unit 4: Wave Optics Diffraction: Fraunhofer diffraction - Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Halfperiod zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization	**20%**	**12**
Unit 5: Maxwell's equations and Electromagnetic wave propagation Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.	**20%**	**12**

List of Practical	Weightage	Contact hours
1: Sonometer: To **determine** the frequency of A.C. Mains using Sonometer.	**8%**	**3**
2: Melde's Experiment: To **determine** the frequency of an electrically maintained tuning fork by transverse and longitudinal mode of vibration.	**12%**	**4**
3: Stefan-Boltzmann's law: To **verify** Stefan-Boltzmann law of thermal radiation by electrical method.	**8%**	**3**
4: Newton's ring: To **determine** the wavelength of source light and radius of curvature of the given convex lens by measuring the diameters of Newton's rings.	**14%**	**4**
5: Michelson's Interferometer: Using Michelson's Interferometer to **determine** the refractive index of a glass plate.	**14%**	**4**
6: Diffraction Grating - **Determining** wavelength of a given light source using a diffraction grating.	**14%**	**4**
7: To **study** variation of refractive index with (a) temperature of the liquid sample. (b) wavelength of the light source.	**14%**	**4**
8: Spectrometry: (i) **Determination** of angle of Prism. (ii) **Determination** of refractive index of prism using spectrometer.	**14%**	**4**

Instructional Method and Pedagogy:

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

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

Learning Resources	
1.	Reference/Text Books: 1. A. Srivastava, R.K. Shukla Practical physics electricity, magnetism, electronics and optics, 2/e, New Age International, 2018. 2. E. M. Purcell, Electricity and Magnetism, McGraw-Hill Education, 1986. 3. D. Chattopadhyay and P.C. Rakshit, Electricity and magnetism: with electromagnetic theory and special theory of relativity, New Central Book Agency, 2017. 4. D.J. Griffiths, Introduction to Electromagnetism, 4/e, Cambridge University Press 2017. 5. B. Lal, P.S. Hemne, N. Subrahmanyam, Heat thermodynamics and statistical physics, S. Chand Publishing, 2010,
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: Richard Feynman, 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 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.: 20 marks Practical understanding of the subject on the Project/Industrial.: 10 marks Industry/ University mentor's feedback on the Project/ Industrial.: 10 marks Attendance: 10 marks **Total: 50 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

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

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

Teaching Scheme
Semester – IV B. Sc Chemistry

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.	AECC501	Disaster Risk Management	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	B. Skill Enhancement Compulsory Courses															
2.	SECC501	Internship	0	2	0	2	0	2	0	2	0	0	0	0	0	50
	C. Core Course															
3.	BSCM401	Inorganic Chemistry – IV	4	4	0	8	4	2	0	6	20	40	40	100	50	150
4.	BSCM402	Organic Chemistry – V	4	4	0	8	4	2	0	6	20	40	40	100	50	150
	D. Discipline Specific Generic Electives (Any One)															
5.	BSCM503	Industrial Chemistry	4	4	0	6	4	2	0	6	20	40	40	100	50	150
6.	BSCM504	Green Chemistry	5	1	0	6	4	2	0		20	40	40	100	50	
7.	BSCM505	Polymer Chemistry	4	4	0	8	4	2	0	6	20	40	40	100	50	150
8.	BSCM506	Novel Inorganic Chemistry	4	4	0	8	4	2	0		20	40	40	100	50	
		Total	**18**	**16**	**00**	**26**	**18**	**12**	**00**	**28**						**750**

COURSE CODE AECC501	COURSE NAME DISASTER RISK MANAGEMENT	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	0	0	30	2	0	0	2

Course Pre-requisites	10 +2 with Science
Course category	Ability enhancement compulsory course.
Course focus	Employability
Rationale	The fundamental concepts of Disaster risk management help in understanding the types of disasters and risk associated with it. Moreover, understanding this subject provides students with proper guidance and a line of action to deal with consequences raised during deadly disasters.
Course revision/ approval date:	14/03/2020
Course objectives (as per blooms' taxonomy)	To enable the student to: **Remember:** to introduce inter-relationship between disaster and development. **Apply:** to introduce types of disasters with case studies and create awareness. **Understand:** to study the effective use of science for mitigating disasters **Analyse:** to study case studies of various famous disasters. **Apply:** to introduce various disaster management frameworks and strategies adopted at national and international levels.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Theory: Introduction to Disasters-Understanding the Concepts and Definitions of Disaster, Hazard, Vulnerability Risk, Capacity Disaster and Development, and Disaster Management Fundamental of Disasters-Types, Trends, Causes, Consequences and Control: Geological Disasters, Hydro-Meteorological Disasters, Biological Disasters, Technological Disasters, and Man-made Disasters. Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.	**20%**	**6**
Unit 2: Theory: Disaster Management Cycle and Framework-Disaster Management Cycle – Paradigm Shift in Disaster Management, Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, Zonation, Micro zonation, Prevention and Mitigation of Disasters, Early Warning System, Preparedness, Capacity Development; Awareness, During Disaster – Evacuation – Disaster Communication – Search and Rescue, Emergency Operation Centre– Incident Command System – Relief And Rehabilitation. Post -disaster Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action, Sendai framework.	**20%**	**6**
Unit 3: Disaster Management in India Disaster Profile of India – Mega Disasters of India and Lessons Learnt, Disaster, Management Act 2005 – Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies. Disaster Management Act in relation to COVID 19 Pandemic.	**20%**	**6**
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), Land, Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters, S&T Institutions for Disaster	**20%**	**6**

Management in India.		
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%**	**6**

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

Course Outcome:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Subdomain**
After successful completion of the above course, students will be able to:		
CO1: Possess awareness to mitigate the effects of disaster	Understand	Define, Classify & Describe
CO2: Know local disaster management policies, regulations and authorities.	Apply	Define, Classify, Describe, Demonstrate & Examine
CO3: Contribute in capacity-building measures to mitigate disasters	Analyses and Evaluation	Define, Classify, Describe & Demonstrate
CO4: Understanding role of science in mitigating disasters	Understand	Define, Classify, Describe, Demonstrate & Examine
CO5: Contribute to safe society by the study of various disasters.	Remember & apply	Define, Describe & Demonstrate

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

<table>
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<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
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<tr><td>Total</td><td>50 Marks</td></tr>
</table>
</td></tr>
</table>

Mapping of PSOs & Cos for AECC501: Disaster Risk Management

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

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

Mapping of POs & Cos for AECC501: Disaster Risk Management

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

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

Teaching Scheme
Semester – V B. Sc Chemistry

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.	AECC501	Disaster Risk Management	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	B. Skill Enhancement Compulsory Courses															
2.	SECC501	Internship	0	2	0	2	0	2	0	2	0	0	0	0	0	50
	C. Core Course															
3.	BSCM501	Inorganic Chemistry – IV	4	4	0	6	4	4	0	6	20	40	40	100	50	150
4.	BSCM502	Organic Chemistry – V	4	4	0	6	4	4	0	6	20	40	40	100	50	150
	C. Discipline Specific Courses (Any Two)															
5.	BSCM503	Industrial Chemistry	4	4	0	6	4	2	0	6	20	40	40	100	50	150
6.	BSCM504	Green Chemistry	4	4	0	6	4	2	0	6	20	40	40	100	50	150
7.	BSCM505	Polymer Chemistry	4	4	0	6	4	2	0	6	20	40	40	100	50	150
8.	BSCM506	Novel Inorganic Chemistry	4	4	0	6	4	2	0	6	20	40	40	100	50	150
		Total	**18**	**18**	**00**	**28**	**18**	**14**	**00**	**28**						**750**

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

COURSE CODE BSCM601	COURSE NAME Inorganic Chemistry-IV	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Student should have successfully completed inorganic chemistry - III
Course Category	Core Professional.
Course focus	Employability
Rationale	To have an overview of metal carbonyls and organometallic compounds, is essential for understanding the unique bonding and reactivity of transition metals. It provides insights into catalysis, materials science, and the development of new synthetic methodologies. Additionally, it has applications in fields such as pharmaceuticals, renewable energy, and chemical synthesis.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** Understand the principals involved in analysis of cations and anions. 2. **Apply** Understand the concept of organometallic compounds. 3. **Analyses** Explain the chemistry of metal alkyls and ferrocene. 4. **Create** Gain knowledge on reaction kinetics and mechanism. 5. **Understand** Understand the catalysis of organometallic compounds.

List Of Practical	Weightage	Contact hours
1: Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. (10)	**20%**	**12**
2: Complex Preparation (4)	**20%**	**12**
3: Bleaching Powder	**20%**	**12**
4: Analysis Mixtures should preferably contain one interfering anion, or insoluble component (BaSO4, SrSO4, PbSO4, CaF_2 or Al_2O_3 or combination of anions e.g., CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^-, NO_3^- and I^-.	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Explain the principles involved in separation of cations and anions.	Understanding & remember	Explain, Discuss, Recall, Locate
CO2	Recognize bonding in organometallic compounds, preparation of metal carbonyl compounds, MO diagrams and synergic effect with that in carbonyls.	Analyse & remember	Apply, Practice, Correlate
CO3	Deliver knowledge on reactions of metal alkyls and ferrocene.	Analyze & remember	Compare, Investigate
CO4	Interpret concept of reaction kinetics and mechanism.	Evaluate & apply	Construct, Develop
CO5	Explain industrial processes and mechanism of different reactions involved in catalysis by organometallic compounds.	Understanding & analyze	Explain, Predict, Summarize

Learning Resources	
1.	Reference books: 1. Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006. 2. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
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 and CO for BSCM501: Inorganic Chemistry-IV

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

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

Mapping of PO and CO for BSCM501: Inorganic Chemistry-IV

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

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

COURSE CODE BSCM502	COURSE NAME Organic Chemistry-V	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Basic knowledge of Macromolecules such as Carbohydrates, Proteins, Lipids, Nucleic acids and Enzymes.
Course Category	Core Professional.
Course focus	Employability
Rationale	To have an overview of carbohydrates, proteins, lipids, nucleic acids, and enzymes is crucial for understanding their structure, function, and role in biological systems. This knowledge is essential for fields like biochemistry, molecular biology, and medicine, enabling advancements in drug development, disease diagnosis, and biotechnology.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** This course defines the large macromolecules such as Carbohydrates, Proteins, Lipids, Nucleic acids. 2. **Apply** Concept of Energy in Biosystems 3. **Analyses** Pharmaceutical Compounds: Structure and Importance. 4. **Create** Enzymes involving the introduction, biological functions, purification and their reactivity to get general information in terms of biochemistry. 5. **Understand** To make students aware of the Structure and Importance of Pharmaceutical Compound.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Nucleic Acids Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.	**15%**	**09**
Unit 2: Amino Acids, Peptides and Proteins Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C- protecting and C-activating groups -Solid-phase synthesis.	**28%**	**16**
Unit 3: Enzymes Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).	**14%**	**08**
Unit 4: Lipids Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.	**10%**	**05**
Unit 5: Concept of Energy in Biosystems Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD, FAD. Conversion of food to energy: Outline of catabolic pathways of carbohydrate-glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fat and protein. Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types.	**12%**	**07**

Unit 6: Pharmaceutical Compounds: Structure and Importance: Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).	**21%**	**12**

List Of Practical	Weightage	Contact hours
1: Study of the action of salivary amylase on starch at optimum conditions.	**20%**	**12**
2: Effect of temperature on the action of salivary amylase.	**20%**	**12**
3: Saponification value of an oil or a fat.	**20%**	**12**
4: Isolation and characterization of DNA from onion/ cauliflower/peas/bananas.	**20%**	**12**
5: Synthesis of drugs.	**20%**	**12**
6: Preparation of polymers.	**20%**	**12**

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Understanding of Carbohydrates, Proteins, Nucleic acids and Enzymes	Remember	Explain, Describe, Discuss, Recall, Locate
CO2	Concept of Energy in Biosystems	Apply	Apply, Practice, Interpret, Select, Correlate
CO3	Understanding of Pharmaceutical Compounds	Analyse & evaluation	Compare, Classify, Select, Investigate
CO4	Structure and Importance of pharma compound	Create	Construct, Develop, Produce
CO5	Understanding of lipids.	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co. 2. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated 3. Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill.
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
3.	Other Electronic resources: NPTEL, SWAYAM, MERLOT (Links available in GSFC University Link.

<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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</td></tr>
<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 and CO for BSCM502: Organic Chemistry-V

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

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

Mapping of PO and CO for BSCM502: Organic Chemistry-V

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

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

COURSE CODE BSCM503	COURSE NAME Industrial Chemistry	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Basic knowledge of the working of a chemical industry.
Course Category	Core Professional.
Course focus	Employability
Rationale	Industrial chemistry involves the application of chemical principles and processes to large-scale manufacturing, including the production of chemicals, fuels, polymers, pharmaceuticals, and consumer goods. Industrial chemistry drives innovation, economic growth, and sustainability in various industries, improving products and processes for societal benefit.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** It provides the important information regarding basic tools to design industrial gases and chemicals. 2. **Apply** It covers the information about metallurgy and Environment and its segments and biocatalysis at industrial level. 3. **Analyses** Extensive use is made of industrial examples and analogies between the various transport mechanism to encourage lateral thinking. 4. **Create** The course has been designed to professionally familiarize students with the process involved in taking projects from inception as a research proposal, through stages of product development, to commercialization and manufacture. 5. **Understand** The curriculum focusses on relevant concepts of chemistry, mathematics, and physics. Industrial Chemistry professionals are chemists with knowledge of chemical processing, engineering, economics, and industrial management.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Industrial Gases and Inorganic Chemicals Industrial Gases: Large scale production, uses, storage and hazards in handling of the carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene. Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene. Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.	**20%**	**10**
Unit 2: Industrial Metallurgy Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.	**10%**	**04**
Unit 3: Environment and its segments Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO_2, CO_2, CO, NO_x, H_2S and other foul smelling gases. Methods of estimation of CO, NO_x, SO_x and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates. Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, Pre-requisites Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.	**30%**	**30**
Unit 4: Energy & Environment Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, Pre-requisites Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.	**30%**	**10**

Unit 5: Corrosion Introduction – Definition of Corrosion, overall classification of types of corrosion.	**10%**	**6**

List Of Practical	Weightage	Contact hours
1. Preparation of borax and boric acid. 2. Determination of dissolved oxygen in water. 3. Determination of Chemical Oxygen Demand (COD) 4. Determination of Biological Oxygen Demand (BOD) 5. Percentage of available chlorine in bleaching powder. 6. Measurement of chloride, sulphate and salinity of water samples by simple titration method. ($AgNO_3$ and potassium chromate). 7. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method. 8. Isolation of compound using solvent extraction method. 9. A survey-based study on common bio-indicators of pollution and SPM in air samples. 10. Measurement of the electrode potentials of the metals/alloys. 11. Demonstration of the principles of the electroplating process. 12. Demonstration of the principles of electrolysis plating and passivation. 13. Corrosion prevention by cathodic protection. 14. Corrosion mitigation by the addition of inhibitors.	**20%**	**12**

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

	Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Evaluate importance of Industrial chemistry.	Understanding	Explain, Describe, Discuss, Recall, Locate
CO2	Explain the production of inorganic and organic industrial products.	Understanding & Remember	Apply, Practice, Interpret, Select, Correlate
CO3	Learn major causes of air pollution, its control and alarming problem of global warming.	Understanding & Remember	Compare, Classify, Select, Investigate
CO4	Understand the role of petroleum and petrochemical industry, composition, applications, process-cracking. Increasing demand of non-petroleum fuels, synthetic fuels. Petrochemical.	Evaluate, analyse & apply	Construct, Develop, Produce
CO5	Gain the knowledge of Industrial metallurgy and Corrosion Phenomena in Industry.	Evaluate, analyse & apply	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi. 2. K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi. 3. S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi. 4. S.E. Manahan, Environmental Chemistry, CRC Press (2005). 5. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006). 6. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005)
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
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 and CO for BSCM503: Industrial Chemistry

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

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

Mapping of PO and CO for BSCM503: Industrial Chemistry

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

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

COURSE CODE BSCM504	COURSE NAME Green Chemistry	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	A fundamental knowledge of chemistry, equivalent to a basic10+2 level chemistry course.
Course Category	Discipline Specific Course
Course focus	Employability
Rationale	Green chemistry promotes sustainability, resource efficiency, and the reduction of environmental impact in the field of chemistry. By prioritizing principles such as waste prevention, renewable resources, and safer chemical alternatives, green chemistry contributes to a more sustainable and environmentally friendly future.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** This course will present the fundamentals of the 12 principles of green chemistry, and explore relevant examples of their practical use in commercial applications. 2. **Apply** It introduces the principles of green chemistry, outline examples, and establish the arguments for our need to recognize green criteria in the practice of chemistry 3. **Analyses** It involves green synthesis of different compounds by selecting appropriate solvent. 4. **Create** This course covers increasing the efficiency and reducing energy requirements of synthesis, isolation, and purification operations can reduce the environmental impact of a process. 5. **Understand** It helps in minimization of the negative impact of chemicals on the human health & environment and helps in achieving sustainability the chemical production.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Green Chemistry What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.	**20%**	**04**
Unit 2: Principles of Green Chemistry and Designing a Chemical synthesis Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids.	**20%**	**24**
Unit 3: Examples of Green Synthesis/ Reactions (Part-1) Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, ibuprofen, paracetamol, furfural. 2. Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n- phenyl benzamide, methylbenzoate to benzole acid), Oxidation (of toluene, alcohols). Microwave assisted reactions in organic solvents: Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels- Alder Reaction, Decarboxylation. Microwave assisted solid state reactions: Deacetylation, Deprotection. Saponification of esters, Alkylation of reactive methylene compounds, reductions, synthesis of nitriles from aldehydes; anhydrides from dicarboxylic acid; pyrimidine and pyridine derivatives; 1,2-dihydrotriazine derivatives; benzimidazoles.	**20%**	**12**

Unit 4: Examples of Green Synthesis/ Reactions (Part-2) Ultrasound assisted reactions: Esterification, saponification, substitution reactions, Alkylations, oxidation, reduction, coupling reaction, Cannizaro reaction, Strecker synthesis, Reformatsky reaction. 4. Selective methylation of active methylene group using dimethylcarbonate: Solid-state polymerization of amorphous polymers using diphenylcarbonate; Use of "Clayan", a nonmetallic oxidative reagent for various reactions; Free Radical Bromination; Role of Tellurium in organic synthesis; Biocatalysis in organic synthesis.	**20%**	**12**
Unit 5: Future Trends in Green Chemistry Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; on covalent derivatization; Green chemistry in sustainable development.	**20%**	**08**
List Of Practical	**Weightage**	**Contact hours**
Avoiding waste 1. Principle of atom economy. Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry. 2. Preparation of propene by two methods can be studied; 3. Triethylamine ion, OH^- → propene, trimethylpropene, water H_2SO_4/H_2O 4. 1-propanol propene, water The other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.	**20%**	**12**
Alternative sources of energy 1. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II). 2. Photoreduction of benzophenone to benzo pinacol in the presence of sunlight.	**20%**	**12**
Use of enzymes as catalysts 1. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.	**20%**	**12**
Alternative Green solvents 1. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice. 2. Mechanochemical solvent free synthesis of azomethines. 3. Organic green synthesis of many compounds.	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	To understand the Basic concepts of green chemistry	Understanding	Explain, Describe, Discuss
CO2	To understand the environmental status and evolution	Analyse & remember	Apply, Practice, Correlate
CO3	To know about the Pollution and its prevention measures	Evaluate & remember	Compare, Classify, Select, Investigate
CO4	An understanding of several real-world examples where organizations used green chemistry to improve the sustainability performance of their products.	Evaluate & apply	Construct,
CO5	An appreciation of how the practice of green chemistry	Apply	Explain, Describe

Learning Resources	
1.	Reference books: 1. S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001). 2. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000). 3. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society 4. Washington (2002).
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
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 and CO for BSCM504: Green Chemistry

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

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

Mapping of PO and CO for BSCM504: Green Chemistry

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

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

COURSE CODE BSCM505	COURSE NAME Polymer Chemistry	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Student should have successfully completed all courses of Semester - IV.
Course Category	Discipline Specific Course
Course focus	Employability
Rationale	Polymer chemistry focuses on the study of polymers, which are large molecules made up of repeating subunits. It explores the synthesis, structure, properties, and applications of contributing to technological advancements and improving everyday products.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** Explain the general properties and importance of polymers which are widely used 2. **Apply** Understand the industrial application of polymers 3. **Analyses** Understand the concepts of chemical analysis 4. **Create** To gain the knowledge on different type of polymers 5. **Understand** To understand the physical properties of polymers

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction of Polymers, Classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers, Classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization, Relationships between functionality, extent of reaction and degree of polymerization, Bifunctional systems, Poly-functional systems, Mechanism and kinetics of step growth, Radical chain growth polymer	**20%**	**12**
Unit 2: Kinetics of Polymerization Ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, Polymerization techniques, Polymerization techniques, Determination of crystalline melting point, Degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point, Nature and structure of polymers, Structure Property relationships, (Mn, Mw, etc) by end group analysis, Viscometry.	**20%**	**12**
Unit 3: Glass transition temperature, Light scattering and osmotic pressure methods, Molecular weight distribution and its significance, Molecular weight distribution and its significance, Polydispersity index, Polydispersity index, Glass transition temperature (Tg), Determination of Tg, Free volume theory, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg), Factors affecting glass transition temperature (Tg)	**20%**	**12**
Unit 4: Polymer Solution Introduction of Polymer Solution, Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, Entropy, enthalpy, and free energy change of mixing of polymers solutions, Entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory-Huggins theory, Lower critical solution temperatures, Upper critical solution temperatures, Properties of Polymers, Physical, thermal Properties, Flow & Mechanical Properties	**20%**	**12**

Unit 5: Separation techniques Properties of Polymers Brief introduction to preparation, structure of polymers, Properties and application of the following polymers: polyolefins, Polystyrene and styrene copolymers, Poly(vinyl chloride) and related polymers, Poly(vinyl acetate) and related polymers, Acrylic polymers, Fluoro-polymers, Polyamides and related polymers, Phenol formaldehyde resins (Bakelite, Novalac), Polyurethanes, silicone polymers, Polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)] vaccines, gene therapy, diagnostics, monoclonal in E. coli, human genome project.	**20%**	**12**

List Of Practical	**Weightage**	**Contact hours**
1. Preparation of UF Resin and its estimation by saponification. 2. Preparation of PF Resin and its estimation by saponification. 3. Preparation of Glyptal resin and preparation of PF resin. 4. Preparation of Poly Aniline and Preparation of Glyptal Resin. 5. Preparation of Aniline Formaldehyde Resin and PF Resin. 6. Determination of molecular wt. of polystyrene by Viscosity method.	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives:		**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
CO1	Able to know about polymers	Understanding	Explain, Describe
CO2	Will gain knowledge on different classification of polymers	Analyse & remember	Apply, Practice
CO3	Will have a clear vision on physical properties of polymers	Evaluate & remember	Compare, Classify, Select, Investigate
CO4	Able to determine the molecular weight of	Evaluate &	Construct,

	polymers	apply	
CO5	Will gain an idea how design some strategy for polymer synthesis	Apply	Explain, Describe, Summarize

Learning Resources	
1.	Reference books: 1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
5	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 and CO for BSCM505: Polymer Chemistry

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

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

Mapping of PO and CO for BSCM505: Polymer Chemistry

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

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

COURSE CODE BSCM506	COURSE NAME Novel Inorganic Chemistry	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
4	4	0	8	4	2	0	6

Course Pre-requisites	Student should have basic knowledge of chemistry up to 10+2 level.
Course Category	Discipline Specific Course
Course focus	Employability
Rationale	To have an overview of exploration and development of new compounds, materials, and applications in the field of inorganic chemistry. It aims to discover innovative synthesis methods, understand the properties and reactivity of novel compounds, and explore their potential applications in catalysis, energy storage, electronics, and more.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** Understand the synthesis and modification of inorganic solids of technological importance. 2. **Apply** Overview of nanostructures and nanomaterials. 3. **Analyses** Introduction to engineering materials for mechanical construction. 4. **Create** Gain knowledge of composite materials. 5. **Understand** Understand the concept of polymers, ceramics and refractory.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Synthesis and modification of inorganic solids Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion- Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – one- dimensional metals, molecular magnets, inorganic liquid crystals.	**25%**	**15**
Unit 2: Nanomaterials Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites.	**25%**	**12**
Unit 3: Introduction to engineering materials for mechanical construction Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.	**20%**	**12**
Unit 4: Composite materials Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre- reinforced composite, environmental effects on composites, applications of composites.	**15%**	**11**
Unit 5: Speciality polymers Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrole, applications of conducting polymers, Ion- exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.	**15%**	**10**

List Of Practical	Weightage	Contact hours
1. Determination of cation exchange method	**20%**	**12**
2. Determination of total difference of solids.	**20%**	**12**
3. Synthesis of hydrogel by co-precipitation method.	**20%**	**12**
4. Synthesis of silver and gold metal nanoparticles.	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Deliver the concept of synthesis and modification of inorganic solids.	Understanding	Explain, Describe, Discuss, Recall, Locate
CO2	Explain the preparation of metallic nanoparticles, importance of carbon nanotubes and bio-inorganic nanomaterials.	Analyse & remember	Apply, Practice, Interpret, Select, Correlate
CO3	Interpret the characteristics and applications of engineering materials for mechanical construction.	Evaluate & remember	Compare, Classify, Select, Investigate
CO4	Deliver concepts of composite materials.	Evaluate & apply	Construct, Develop, Produce
CO5	Explain the properties, manufacturing and applications of polymers, ceramics and refractory.	Apply	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. Shriver & Atkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012). 2. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. 3. Frank J. Ovens, Introduction to Nanotechnology. 4. Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. Polymer Science, New Age International (P) Ltd. Pub.
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
5	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 and CO for BSCM606: Novel Inorganic Chemistry

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

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

Mapping of PO and CO for BSCM606: Novel Inorganic Chemistry

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

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

Teaching Scheme

Semester – VI B. Sc Chemistry

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.	BSCM601	Organic Chemistry – IV	4	4	0	6	4	4	0	6	20	40	40	100	50	150
3.	BSCM602	Physical Chemistry – V	4	4	0	6	4	4	0	6	20	40	40	100	50	150
	C. Discipline Specific Courses (Any Two)															
4.	BSCM603	Drug and Dyes	4	4	0	6	4	2	0	6	20	40	40	100	50	150
5.	BSCM604	Application of Computers	4	4	0	6	4	2	0	6	20	40	40	100	50	150
6.	BSCM605	Analytical Chemistry	4	4	0	6	4	2	0	6	20	40	40	100	50	150
7.	BSCM606	Instrumental Chemistry	4	4	0	6	4	2	0	6	20	40	40	100	50	150
		Total	**18**	**16**	**00**	**26**	**18**	**12**	**00**	**26**						**700**

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

COURSE CODE BSCM601	COURSE NAME Organic Chemistry-V	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Fundamentals of organic spectroscopic techniques, dyes and polymers.
Course Category	Core Professional.
Course focus	Employability
Rationale	To have an overview of organic spectroscopic techniques, dyes, and polymers is to gain a comprehensive understanding of their principles and applications in chemical analysis and material science. These topics provide essential knowledge and skills for identifying and characterizing organic compounds, analysing dyes for various applications, and understanding the properties and behaviour of polymer materials.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	6. **Remember** General principles Introduction to absorption and emission spectroscopy. 7. **Apply** To learn the fundamentals of organic spectroscopic techniques. 8. **Analyses** Biological importance of carbohydrates. 9. **Create** Synthesis and applications of dyes. 10. **Understand** Synthesis and applications of polymers.

Course Content (Theory)	Weightage	Contact hours
Unit 1: UV Spectroscopy General principles Introduction to absorption and emission spectroscopy. UV Spectroscopy: Types of electronic transitions, λ max, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α, β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.	**20%**	**12**
Unit 2: IR Spectroscopy Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis. NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR for identification of simple organic molecules.	**20%**	**12**
Unit 3: Carbohydrates Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose. Polysaccharides – Elementary treatment of starch, cellulose and glycogen.	**20%**	**12**

Unit 4: Dyes Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes – structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples	**20%**	**12**
Unit 5: Polymers Introduction and classification including di-block, tri- block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index Polymerisation reactions -Addition and condensation - Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.	**20%**	**12**

List Of Practical	Weightage	Contact hours
1: Synthesis of Dyes	**20%**	**12**
2: Spotting of three-functional Organic Compounds via elemental analysis and functional group analysis	**20%**	**12**
3: Argentometric titration	**20%**	**12**
4: Benzoylation	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Students will be able to explain absorption and emission spectroscopy.	Understanding & remember	Explain, Describe
CO2	Understanding on Fundamentals of organic spectroscopic techniques like UV, IR, NMR.	Analyse & remember	Apply, Practice, Interpret,
CO3	Learn biological importance of carbohydrates.	Analyse & remember	Compare, Classify, Investigate
CO4	Understanding, synthesis and applications of dyes.	Evaluate & apply	Construct
CO5	Learning on synthesis and applications of polymers.	Understanding & analyse	Explain, Describe, Summarize

Learning Resources	
1.	Reference books: 1. Billmeyer, F. W. Textbook of Polymer Science, John Wiley & Sons, Inc. 2. Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. Polymer Science, New Age International (P) Ltd. Pub. 3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 4. Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc. 5. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press. 6. Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Prajati Prakashan (2010). 7. Kemp, W. Organic Spectroscopy, Palgrave.
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
5	Other Electronic resources: NPTEL, SWAYAM, MERLOT (Links available in GSFC University Link.

<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>
</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>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 and CO for BSCM601: Organic Chemistry-V

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

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

Mapping of PO and CO for BSCM601: Organic Chemistry-V

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

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

COURSE CODE BSCM602	COURSE NAME Physical Chemistry-V	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Students should have basic knowledge of chemistry up to 10,2 level.
Course Category	Core Professional.
Course focus	Employability
Rationale	To have an overview of quantum chemistry, chemical bonding and physical chemistry, and spectroscopy is to develop a deep understanding of the fundamental principles governing chemical behaviour. These topics provide a strong foundation for understanding atomic and molecular structure, chemical reactivity, and the principles of spectroscopic analysis in various fields of chemistry.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	**1. Remember** This course describes the concept Quantum Chemistry **2. Apply** This course describes the concept chemical bonding **3. Analyses** Understanding and learning spectroscopic techniques like vibrational, rotational, Raman and UV spectroscopy **4. Create** Study of NMR, ESR **5. Understand** Study of Photochemistry

Course Content (Theory)	Weightage	Contact hours
Unit 1: Quantam Chemistry Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two- and three-dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting upof Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).	**20%**	**12**
Unit 2: Chemical bonding Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2,. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory	**20%**	**12**

Unit 3: Spectroscopy Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.	**20%**	**12**
Unit 4: Spectroscopy Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model. Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low-resolution spectra, different scales, spin-spin coupling and high-resolution spectra, interpretation of PMR spectra of organic molecules. Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.	**20%**	**12**
Unit 5: Photochemistry Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical processes, photo stationary states, chemiluminescence.	**20%**	**12**

List Of Practical	Weightage	Contact hours
1: Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ max values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).	**20%**	**12**
2: Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.	**20%**	**12**
3: Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.	**20%**	**12**
4: Extraction Based Experiments	**20%**	**12**
5: Water Analysis	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	This course describes the concept Quantum Chemistry	Understanding & remember	Explain, Describe, Discuss
CO2	Understanding and learning spectroscopic techniques like vibrational, rotational, Raman and UV spectroscopy	Analyse & remember	Apply, Practice, Interpret, Correlate
CO3	Learn biological importance of carbohydrates.	Analyse & remember	Compare, Investigate
CO4	Study of NMR, ESR	Evaluate & apply	Construct
CO5	Study of Photochemistry	Understanding & analyse	Explain, Describe

Learning Resources	
1.	Reference books: 1. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4 th Ed. Tata McGraw- Hill: New Delhi (2006). 2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001). 3. House, J. E. Fundamentals of Quantum Chemistry 2 nd Ed. Elsevier: USA (2004).
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
5	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 and CO for BSCM602: Physical Chemistry-V

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

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

Mapping of PO and CO for BSCM602: Physical Chemistry-V

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

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

COURSE CODE BSCM603	COURSE NAME Drugs and Dyes	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Student should have basic knowledge of chemistry up to 10+2 level.
Course Category	Core Professional.
Course focus	Employability
Rationale	The rationale of studying drugs and dyes is to gain knowledge and understanding of their properties, synthesis, and applications. The field of drugs focuses on the development of therapeutic compounds for various diseases, while dyes involve the study of colorants used in various industries. This knowledge is essential for advancements in medicine, materials science, and other related fields.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** Drugs and Dyes plays an important role in improving quality of life. Properties, discovery and manufacturing have strong roots in chemistry and organic chemistry. 2. **Apply** This course in Drugs and Dyes will help understand the characteristics of the molecules that make it drug like or dye like. 3. **Analyses** Students will develop familiarity with the terms that are used to describe these products, the classification systems adopted based on action and application. 4. **Create** Last chapters on Dyes discusses methods of application of dyes to fabrics and the chemistry behind it. 5. **Understand** To impart the detailed knowledge of drugs and dyes to students.

Course Content (Theory)	Weightage	Contact hours
Unit 1: DRUGS Definition of a drug, sources of drugs, requirements of an ideal drug, classification of drugs (based on therapeutic action). Nomenclature of drugs: Generic name, Brand name, Systematic name. Definition of the following medicinal terms: Pharmacon, Pharmacology, Pharmacophore, Prodrug, Half – life efficiency, LD50, ED50. Brief idea of the following terms: Receptors, Agonists, Antagonists, Drug-receptor interaction, Drug Potency, Bioavailability, Drug Toxicity. Routes of drug administration– Oral and Parenteral. Brief and broad idea of Formulations.	**20%**	**10**
Unit 2: CNS Drugs Classification based on pharmacological actions: CNS Depressants & CNS Stimulants. Concept of sedation and hypnosis, anaesthesia- Few examples to illustrate structure and actions: Phenytoin (Hydantoin), Trimethadione (Oxazolidinediones), Alprazolam (Benzodiazepines), Levetiracetam (Pyrrolidines), Amphetamine (Phenethylamine), Chlorpromazine (Phenothiazines). Analgesics and Antipyretic Drugs: Morphine (Phenanthrene alkaloids), Tramadol (Cyclohexanols), Aspirin (Salicylates), Paracetamol (p-Amino phenols) Anti-inflammatory Drugs: Steroids: Betamethasone, Sodium Diclofenac, Aceclofenac (N-Aryl anthranilic acids), Cetrizene (Piperazine), Chlorpheniramine maleate (Ethyl amines), Pantoprazole (Benzimidazoles)	**20%**	**15**
Unit 3: Different types of drugs Cardiovascular drugs – Generic structures Classification based on pharmacological action: Isosorbide dinitrate (Nitrates), Valsartan (Amino acids) (structure not expected), Atenolol (Aryloxy propanol amines), Amlodipine (Pyridines), Frusemide /Furosemide (Sulfamoyl benzoic acid), Rosuvastatin (Pyrimidine) Antidiabetic Agents General idea and types of diabetes with few examples from below: Glibenclamide (Sulphonyl ureas), Metformin (Biguanides), Dapagliflozin (Pyranose), Pioglitazone (Thiazolidinediones) Drugs for Respiratory System General idea of: Expectorants; Mucolytes; Bronchodilators, Decongestants; Antitussives with few examples: Ambroxol (Cyclohexanol), Salbutamol	**20%**	**15**

Unit 4: Dyes Introduction to the dye-stuff Industry, Definition of dyes, requirements of a good dye i.e. Colour, Chromophore and Auxochrome, Solubility, Linearity, Coplanarity, Fastness, Substantivity, Economic viability.Definition of fastness and its properties and Mordants with examples, Explanation of nomenclature or abbreviations of commercial dyes with few examples. Natural and Synthetic Dyes Natural Dyes: Definition and limitations of natural dyes. Examples and uses of natural dyes w.r.t Indigo, Turmeric, Saffron, (structure not expected) Synthetic dyes: Definition of synthetic dyes, primaries and intermediates. Important milestones in the development of synthetic dyes– Emphasis on Name of the Scientist, dyes and the significance of the discovery (structure is not expected). Substrates for Dyes: Types of fibers Natural: cellulosic and proteinaceous fibers, examples – of dyes applied on them. Synthetic: Example of Nylon, structures and names of dyes applied on it. Binding forces of dyes on substrate: ionic forces, covalent linkages, hydrogen bonding, Van der-waals forces.	**20%**	**12**
Unit 5: Classification of Dyes Classification of dyes based on applicability on substrates (Examples with structures) (a) Acid Dyes, (b) Basic Dyes, (c) Direct cotton Dyes, (d) Azoic Dyes (e) Mordant Dyes, (f) Vat Dyes, (g) Sulphur Dyes, (h) Disperse Dye (i) Reactive Dyes Classification of dyes based on applications and dyeing methods – General methods -Basic Operations involved in dyeing process; Dyeing method of cotton fibers a) Direct b) Vat c) Mordant d) Disperse.	**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 Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	After studying this topic, students are expected to know: Definition of drug, classification of drugs based on therapeutic action, requirement of an ideal drug. Definition of terms related to drugs and its action – Drug receptor, Agonist, Antagonist, Pharmocophore, Prodrug, Toxicity terms Pre-requisites	Understanding	Explain, Describe, Discuss, Recall, Locate
CO2	Classification of drugs based on pharmacological actions. Different Pharmacodynamic agents as listed in the syllabus, its structural features with select synthesis of few drugs.	Understanding & remember	Apply, Practice, Correlate
CO3	General idea of action of the different pharmacodynamic agents. The structural aspects and the pharmacophores that produces drug like action and its similarity. How changes in structural features determine enhanced activity. Not required to memorize the structures but understand the features that make a product drug like.	Understanding & remember	Compare, Classify
CO4	Learn the therapeutic class with few examples' drugs related to CNS, Anti- inflammatory, Anti-pyretics, Analgesic, Antihistaminic, Antidiabetic, Cardiovascular and drugs for respiratory diseases. Definition of dyes, chromophore, auxochrome and related terms, nomenclature of commercial dyes. Relation between colour and chemical constitution.	Evaluate, analyse & apply	Construct
CO5	Definition of natural dyes, its limitations, definition of synthetic dyes and its history. Substrates for dyes-natural and synthetic, the binding actions on the substrates. Classification of dyes based on applicability on substrates with examples -structural features important. Classification of dyes based on applications and dyeing methods.	Evaluate, analyse & apply	Explain, Describe

Learning Resources	
1.	Reference books: 1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 2. Chemistry of Synthetic Dyes, Vol I – VIII, Venkatraman K., Academic Press 1972. 3. The Chemistry of Synthetic Dyes and Pigments, Lubs H.A., Robert E Krieger Publishing Company, NY ,1995. 4. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973. 5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition. 6. Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press. 7. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
5	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 and CO for BSCM603: Drugs and Dyes

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

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

Mapping of PO and CO for BSCM603: Drugs and Dyes

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

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

COURSE CODE BSCM604	COURSE NAME Applications of Computers in Chemistry	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
4	4	0	8	4	2	0	6

Course Pre-requisites	Basic knowledge of MS office.
Course Category	Core Professional.
Course focus	Employability
Rationale	The rationale behind studying the applications of computers in chemistry is to leverage computational tools and techniques for improved analysis, prediction, and understanding of chemical phenomena, ultimately advancing the field of chemistry.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** This Course provides the knowledge of utilization of computers in field of chemistry. 2. **Apply** Chemistry and chemical engineering, like many other disciplines, are being profoundly influenced by increased computing power. 3. **Analyses** The small applications developed in programming aims to produce results for given values of constants and for observed values of inputs for various experiments from curriculum. 4. **Create** Integral calculus and Simultaneous equations through computer applications. 5. **Understand** Data handling and molecular modelling through software applications.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Basics and MS office MS office : Excel, Word and Power point Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions.	**20%**	**12**
Unit 2: BASIC Language Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.	**20%**	**12**
Unit 3: Numerical methods Roots of equations: Numerical methods for roots of equations: Quadratic formula, iterative method, Newton-Raphson method, Binary bisection and Regula- Falsi. Differential calculus: Numerical differentiation.	**20%**	**12**
Unit 4: Integral calculus and Simultaneous equations. Integral calculus: Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values. Simultaneous equations: Matrix manipulation: addition, multiplication. Gauss-Siedal method.	**20%**	**12**
Unit 5: Data handling and molecular modelling Interpolation, extrapolation and curve fitting: Handling of experimental data. Conceptual background of molecular modelling, Potential energy surfaces, monetary ideas of molecular mechanics and practical MO methods.	**20%**	**12**
List Of Practical	**Weightage**	**Contact hours**
1. Computer programs based on numerical methods for Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid).	**20%**	**12**
2. Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).	**20%**	**12**
3. Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values.	**20%**	**12**
4. Matrix operations. Application of Gauss-Siedel method in colourimetry	**20%**	**12**
5.Simple exercises using molecular visualization software.	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Explain the importance of computers in field of chemistry.	Understanding	Explain, Describe, Discuss, Recall, Locate
CO2	Explain the BASIC Language.	Analyse & remember	Apply, Practice, Interpret, Select, Correlate
CO3	Interpret the numerical methods used in problem solving.	Evaluate & remember	Compare, Classify, Select, Investigate
CO4	Learn Integral calculus and Simultaneous equations.	Evaluate & apply	Construct, Develop, Produce
CO5	Relate importance of data handling and molecular modelling.	Apply	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5. 2. Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis, Cambridge Univ. Press (2001) 487 pages. 3. Noggle, J. H. Physical chemistry on a Microcomputer. Little Brown & Co. (1985).
2.	Journals & Periodicals Computers & Chemistry Applications of Computer in Chemistry Education
5	Other Electronic resources: Microsoft office

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 and CO for BSCM604: Applications of Computers in Chemistry

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

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

Mapping of PO and CO for BSCM604: Applications of Computers in Chemistry

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

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

COURSE CODE BSCM605	COURSE NAME ANALYTICAL CHEMISTRY	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Student should have successfully completed all courses of Semester - IV.
Course Category	Discipline Specific Course
Course focus	Employability
Rationale	Analytical chemistry rationale lies in the need to accurately identify and quantify chemical components in various samples. Analytical techniques enable quality control, safety assessment, and development of new materials and technologies, contributing to advancements in numerous fields and improving our understanding of the chemical world.
Course Revision/ Approval Date:	14/03/2020
Course Objectives (As per Blooms' Taxonomy)	**Remember** Explain the importance of analytical chemistry **Apply** Understand the language of analytical chemistry **Analyses** Understand the concepts of chemical analysis **Create** Understand the basics of different analytical techniques **Understand** Understand the principles of separation techniques

Course Content (Theory)	Weightage	Contact hours
Unit 1: Qualitative and quantitative aspects of analysis Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.	**20%**	**05**
Unit 2: Optical methods of analysis Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution. Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative	**20%**	**2**
Unit 3: Thermal methods of analysis Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.	**20%**	**05**

Unit 4: Electroanalytical methods Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.	**20%**	**10**
Unit 5: Separation techniques Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC. Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiralchromatographic techniques using chiral columns (GC and HPLC). Role of computers in instrumental methods of analysis.	**20%**	**15**

List Of Practical	Weightage	Contact hours
I. Separation Techniques		
1. Chromatography: (a) Separation of mixtures (i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.	**20%**	**12**
II. Solvent Extractions:		
To separate a mixture of Ni^{2-}, & Fe^{2-}, by complexation with DMG and extracting the Ni^{2-}, DMG complex in chloroform, and determine its concentration by spectrophotometry. 2. Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium. 3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps. 4. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques. 5. Analysis of soil: (i) Determination of pH of soil. (ii) Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrate	**20%**	**12**
III. Spectrophotometry		
1. Determination of pKa values of indicator using spectrophotometry. 2. Structural characterization of compounds by infrared spectroscopy. 3. Determination of dissolved oxygen in water. 4. Determination of Chemical Oxygen Demand (COD). 5. Determination of Biological Oxygen Demand (BOD). 6. Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	relate importance of analytical chemistry	Understanding	Explain, Describe, Discuss, Recall, Locate
CO2	recognize the utilization of language of analytical chemistry	Analyse & remember	Apply, Practice, Interpret, Select, Correlate
CO3	interpret concepts of chemical analysis	Evaluate & remember	Compare, Classify, Select, Investigate
CO4	deliver knowledge on different types of analytical techniques	Evaluate & apply	Construct, Develop, Produce
CO5	communicate the principles of separation techniques.	Apply	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	Reference books: 1. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009. 2. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore. 3. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London. 4. Ditts, R.V. Analytical Chemistry – Methods of separation.
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
5	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 and CO for BSCM605: Analytical Chemistry

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

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

Mapping of PO and CO for BSCM605: Analytical Chemistry

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

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

COURSE CODE BSCM606	COURSE NAME Instrumental Chemistry	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
4	4	0	8	4	2	0	6

Course Pre-requisites	Students should have basic knowledge of chemistry up to 10+2 level.
Course Category	Discipline Specific Course
Course focus	Employability
Rationale	Instrumental chemistry rationale lies in the need to improve sensitivity, accuracy, and efficiency in chemical analysis. Instrumental chemistry enables the detection and quantification of trace substances, characterization of complex mixtures, and study of molecular interactions, supporting research, industry, and environmental monitoring.
Course Revision/ Approval Date:	14/03/2020
Course Objectives **(As per Blooms' Taxonomy)**	1. **Remember** Explain the importance of analytical chemistry 2. **Apply** To learn about Separation techniques like Gas chromatography. 3. **Analyses** To gain knowledge about Mass Spectrometry and NMR. 4. **Create** To study different Electroanalytical Methods like Potentiometry & Voltammetry

Course Content (Theory)	Weightage	Contact hours
Unit 1: Molecular spectroscopy: Infrared spectroscopy: Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection. UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).	**35%**	**20**
Unit 2: Separation techniques Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis. Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemicalionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).	**20%**	**15**

Unit 3: Elemental analysis: Mass spectrometry (electrical discharges). Atomic spectroscopy: atomic absorption, atomic emission, and atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).	**20%**	**15**
Unit 4: NMR spectroscopy: Principle, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications.	**15%**	**06**
Unit 5: Electroanalytical Methods: Potentiometry & Voltammetry	**10%**	**04**

List Of Practical	Weightage	Contact hours
1. To carry out separation of the constituents of the given unknown mixture by Thin Layer Chromatography (TLC) (Mixture - 1). 2. To carry out separation of the constituents of the given unknown mixture by Thin Layer Chromatography (TLC)(Mixture - 2). 3. Determine the amount of copper present in given solution of CuSO4 by colourimetry titration method using standard solution of EDTA. 4. Synthersis of Copper Oxide Nano particles and it's characterization with UV - Visible Spectrophotometer. 5. To determine the concentration of the given CuSO4 .5H2O with UV - Visible Spectrophotometer. 6. To determine the concentration of strong and weak acid present in mixture with strong base conductometrically. 7. To separate the given mixture of organic compound using silica coloumn.	**20%**	**12**

Instructional Method and Pedagogy:

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

Course Objectives:		Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1	Students will gain knowledge about various spectroscopic techniques like Infrared spectroscopy and UV-Visible/ Near IR.	Understanding	Explain, Describe, Discuss, Recall, Locate
CO2	Students will gain knowledge about Separation techniques like Gas chromatography.	Analyse & remember	Apply, Practice, Interpret, Select, Correlate
CO3	Students will gain knowledge Mass Spectrometry and NMR.	Evaluate & remember	Compare, Classify, Select, Investigate
CO4	Students will gain knowledge about different Electroanalytical Methods like Potentiometry & Voltammetry	Evaluate & apply	Construct, Develop, Produce

Learning Resources	
1.	Reference books: 1. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler and Stanley Crouch (ISBN 0-495-01201-7). 2. Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.
2.	Journals & Periodicals Journal of Chemical Sciences Chemistry World
5	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 and CO for BSCM606: Instrument Chemistry

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

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

Mapping of PO and CO for BSCM606: Instrument Chemistry

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

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