School of Basic Sciences and Research

Department of Chemistry and Biochemistry

Program Structure: B.Sc. (Hons) Chemistry

Program Code: SBR0102

AY: 2019-22

1.1 Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. **Transformative educational experience**
2. **Enrichment by educational initiatives that encourage global outlook**
3. **Develop research, support disruptive innovations and accelerate entrepreneurship**
4. **Seeking beyond boundaries**

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

1.2 Vision and Mission of the School

Vision of the School

Achieving excellence in the realm of basic and applied sciences to address the global challenges of evolving society

Mission of the School

1. **To equip the students with knowledge and skills in basic and applied sciences**
2. **Capacity building through advanced training and academic flexibility.**
3. **To establish center of excellence for ecologically and socially innovative research.**
4. **To strengthen interinstitutional and industrial collaboration for skill development and global employability.**

1.3 Vision and Mission of Department of chemistry and Biochemistry

Vision of Chemistry and Biochemistry Department

Strive to achieve excellence in teaching and research in the field of Chemistry and Biochemistry and to build human resource for solving contemporary problems.

Mission of Chemistry and Biochemistry Department

- **Providing distinctive and relevant education in Chemistry and Biochemistry to students.**
- **Motivating young minds through innovative teaching methods, to acquire theoretical knowledge and practical skills in different disciplines of chemistry and empowering them with problem solving skills.**
- **Nurturing innovation by carrying out world class research and scholarly work**
- **Promoting interdisciplinary research in collaboration with national/international laboratories/Institutions.**

1.4 Programme Educational Objectives (PEO)

PEO 1: Providing distinctive and relevant education in chemistry and biochemistry to students.

PEO 2: Motivating young minds to acquire theoretical knowledge and practical skills in different disciplines of chemistry and empowering them with problem solving skills through innovative teaching methods.

PEO 3: Promoting scholarly research work and innovation among faculties and students.

PEO 4: Encouraging interdisciplinary research in collaboration with National/ International laboratories.

1.4.3 Program Outcomes (PO's)

PO1: Ability to gain the knowledge of chemical principles with a thorough understanding in chemistry and its sub-discipline such as analytical, organic, inorganic and physical.

PO2: Capacity to identify the problems and formulate the strategy to find the solution by applying analytical and rational thinking.

PO3: Capability to combine the knowledge in Chemistry with mathematics, physics and biology to solve problems of interdisciplinary nature.

PO4: Competency in using modern library search tools to locate and retrieve scientific information.

B. Program Structure

1. TITLE: Bachelor of Science (Hons.) in Chemistry

2. DURATION OF THE COURSE: 3 Years

3. YEAR OF IMPLIMENTATION

This syllabus will be implemented for the session 2018-2021 onwards.

4. PREAMBLE

Total Credits- 145

Total Number of Semesters – 6 (Two semesters per year)

Total Number of Theory Papers – 31

Total Number of Practical courses – 12

Total Number of Minor Projects/Dissertations- 02

Number of papers (theory) per semester – 05/06

Number of Laboratory courses per semester – 03/02

Community Connect: 01

Semester 1					Semester 2			
No.	**Code**	**Course**	**Credit**		**No.**	**Code**	**Course**	**Credit**
1	BCH101	Physical Chemistry-I	4		1	BCH102	Organic Chemistry-I	4
2	PHB114/BBC102	Mechanics & Properties of Matter/ Biomolecules	4		2	BCH103	Analytical Chemistry-I	4
3	MSM101/ BBC101	Foundation Course in Mathematics/ Fundamentals of Life Sciences	4		3	MSM105/ MTH215	Calculus I /Biostatistics	4
4	ARP101	Communicative English-1	2		4	PHB115/BBC104	Optics/ Cell Biology	4
5	CSE 115	Introduction to 'C' Programming (Theory and Lab)	4		5	EVS106	Environmental Studies	3
6	BCH151	Chemistry Lab-I	1		6	BCH152	Chemistry Lab-II	1
7	PHB151/BBC151	Physics Lab-1/ Biological Science Lab-1	1		7	PHB152/ BBC152	Physics Lab-2/ Biological Science Lab-2	1
		Total Credit	**20**				**Total Credit**	**21**
Semester 3					**Semester 4**			
No.	**Code**	**Course**	**Credit**		**No.**	**Code**	**Course**	**Credit**
1	BCH201	Inorganic Chemistry-I	4		1	BCH204	Physical Chemistry-II	4
2	BCH207	Analytical Chemistry-II	4		2	BCH205	Organic Chemistry-II	4
3	PHB218/BBC202	Solid State Physics/ Molecular Biology-I	4		3	BCH206	Inorganic Chemistry-II	4
4	MSM204/ BBC203	Calculus II/ Introduction to Microbiology	4		4	BCH210	Analytical Chemistry-III	4
5	BCH203	Industrial Chemistry	4		5	BCH208/BCH209 E	Chemical Kinetics and Catalysis/ Solid state Chemistry	4
6		Elective From University List	2					
7		Community Connect	2					
7	PHB251/BGB251	Physics Lab-3/ Biological Science Lab-3	1		6	BCH252	Chemistry Lab-IV	2
8	BCH251	Chemistry Lab-III	1		7	BCH253	Chemistry Lab-V	2
		Total Credit	**26**				**Total Credit**	**24**
Semester 5					**Semester 6**			
No.	**Code**	**Course**	**Credit**		**No.**	**Code**	**Course**	**Credit**
1	BCH301	Physical Chemistry-III	4		1	BCH307	Physical Chemistry-IV	4
2	BCH302	Organic Chemistry-III	4		2	BCH308	Organic Chemistry-IV	4
3	BCH303	Inorganic Chemistry-III	4		3	BCH309	Inorganic Chemistry-IV	4
4	BCH313	Advanced Topics in Chemistry	4		4	BCH310	Biological Chemistry	4
5	BCH305/ BCH306 E	Chemistry in Action/Polymer Science	4		5	BCH311/BCH312 (E)	Important inorganic compounds / Industrial inorganic chemicals, energy and environment	4
6	BCH351	Chemistry Lab-VI	2		6	BCH354	Chemistry Lab-VIII	2
7	BCH352	Chemistry Lab-VII	2		7	BCH355	Chemistry Lab-IX	2
8	BCH359	Project-1/Dissertation-1	3		8	BCH360	Project-2/Dissertation-2	3
		Total Credit	**27**				**Total Credit**	**27**
Total credits of the B.Sc. (Hons) program: 145								

Department of Chemistry and Biochemistry, SBSR, Sharda University
Scheme for CBCS in B.Sc. Hons. (Chemistry), effective from 2018-19

Semester	CORE COURSE (17)	Ability Enhancement Compulsory Course (AECC) (2)	Ability Enhancement Elective Course (AEEC) (Skill Based) (2)	Elective: Discipline Specific DSE (6)	Elective: Generic (GE) (6)
I	Physical Chemistry-I	AECC-1	AEEC-1		GE-1
					GE-2
II	Organic Chemistry-I	AECC-2			GE-3
	Analytical Chemistry-I				GE-4
III	Inorganic Chemistry-I	AECC-3	AEEC-2	DSE-1	GE-5
	Analytical Chemistry-II				GE-6
IV	Physical Chemistry-II			DSE-2	
	Organic Chemistry-II				
	Inorganic Chemistry-II				
	Analytical Chemistry-III				
V	Physical Chemistry-III			DSE-3	
	Organic Chemistry-III				
	Inorganic Chemistry-III			DSE-4	
	Advanced Topics in Chemistry				
VI	Physical Chemistry-IV			DSE-5	
	Organic Chemistry-IV			DSE-6	
	Inorganic Chemistry-IV				
	Biological Chemistry				
Credits	**83**	**7**	**6**	**22**	**27**

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I	Ability Enhancement Compulsory Course-I	Communicative English-1	2
	Core course-I	Physical Chemistry-I	4
	Core course-I Practical	Chemistry Lab-I	1
	Ability Enhancement Elective Course-I	Introduction to 'C' Programming	4
	Generic Elective-I	GE-I	4
	Generic Elective-I Practical		1
	Generic Elective-II	GE-II	4
II	Ability Enhancement Compulsory Course-II	Environmental Studies	3
	Core course-II	Organic Chemistry-I	4
	Core course-II Practical	Chemistry Lab-II	1
	Core course-III	Analytical Chemistry-I	4
	Generic Elective-III	GE-III	4
	Generic Elective-I Practical		1
	Generic Elective-IV	GE-IV	4
	Core course-IV	Inorganic Chemistry-I	4
III	Core course-V	Analytical Chemistry-II	4
	Discipline Specific Elective-I	DSE-I	4
	Core course Practical	Chemistry Lab-III	1
	Ability Enhancement Elective Course-II	From University List	2
	Generic Elective-V	GE-V	4
	Generic Elective-V Practical		1
	Generic Elective-VI	GE-VI	4
	Core course-VI	Physical Chemistry-II	4
	Ability Enhancement Elective Course-II	Community Connect	2
IV	Core course-VII	Organic Chemistry-II	4
	Core course-VIII	Inorganic Chemistry-II	4
	Core course-IX	Analytical Chemistry-III	4
	Discipline Specific Elective-II	DSE-II	4
	Core course Practical	Physics Lab-4	2
	Core course Practical	Physics Lab-5	2
	Core course-X	Physical Chemistry-III	4
V	Core course-XI	Organic Chemistry-III	4
	Core course-XII	Inorganic Chemistry-III	4
	Core course-XIII	Advanced Topics in Chemistry	4
	Core course Practical	Chemistry Lab-VI	2
	Core course Practical	Chemistry Lab-VII	2
	Discipline Specific Elective-III	DSE-III	4
	Discipline Specific Elective-IV	DSE-IV	3
	Core course-XIV	Physical Chemistry-IV	4
VI	Core course-XV	Organic Chemistry-IV	4
	Core course-XVI	Inorganic Chemistry-IV	4
	Core course-XVII	Biological Chemistry	4
	Core course Practical	Chemistry Lab-VIII	2
	Core course Practical	Chemistry Lab-IX	2
	Discipline Specific Elective-V	DSE-V	4
	Discipline Specific Elective-VI	DSE-VI	3

Core Papers (C):

1. Physical Chemistry-I
2. Analytical Chemistry-I
3. Organic Chemistry-I
4. Inorganic Chemistry-I
5. Analytical Chemistry-II
6. Physical Chemistry-II
7. Organic Chemistry-II
8. Inorganic Chemistry-II
9. Analytical Chemistry-III
10. Physical Chemistry-III
11. Organic Chemistry-III
12. Inorganic Chemistry-III
13. Advanced Topics in Chemistry
14. Physical Chemistry-IV
15. Organic Chemistry-IV
16. Inorganic Chemistry-IV
17. Biological Chemistry

Discipline Specific Elective Papers:

1. Industrial Chemistry
2. Chemical Kinetics and Catalysis/ Solid state Chemistry
3. Project-1/ Dissertation-1
4. Chemistry in Action/Polymer Science
5. Important inorganic compounds / Industrial inorganic chemicals, energy and environment
6. Project-2/ Dissertation-2

Other Discipline – GE-I to GE-VI

1. Mechanics & Properties of Matter/Biomolecules
2. Foundation Course in Mathematics/ Introduction to life Science
3. Calculus I/ Biostatistics
4. Optics /Cell Biology
5. Solid State Physics/ Molecular Biology-I
6. Calculus II/ Introduction to Microbiology

Program Structure
School of Basic Sciences & Research
B. Sc. (H) Chemistry
Batch: 2019-22
TERM: I

S. No.	Subject Code	Subjects	Teaching Load			Credits	Core/Elective
			L	T	P		
THEORY SUBJECTS							
1.	PHB 114/BBC 102	Mechanics and Properties of Matter/ Biomoloecules	3	1	0	4	GE1
2.	BCH 101	Physical Chemistry-1	3	1	0	4	CC
3.	MSM 101/BBC 101	Foundation Course in Mathematics/Fundamentals of Life Sciences	3	1	0	4	GE2
4.	CSE115	Introduction to 'C' Programming .	2	0	0	2	SEC1
5.	ARP101	Communicative English-1	2	0	0	2	AECC
Practical							
6.	PHB 151/ BBC 151	Physics Lab-1/Biological Science Lab-1	0	0	2	1	GE1
7.	BCH 151	Chemistry Lab-1	0	0	2	1	CC
8.	CSP115	C' Programming Lab	0	0	4	2	SEC1
TOTAL CREDITS						**20**	

Program Structure
School of Basic Sciences & Research
B. Sc. (H) Chemistry
Batch: 2019-22
TERM: II

S. No.	Course Code	Course	Teaching Load			Credits	Core/Elective
			L	T	P		
THEORY SUBJECTS							
1.	PHB 115/BBC 104	Optics/Cell Biology	3	1	0	4	GE
2.	BCH 102	Organic Chemistry-1	3	1	0	4	CC
3.	MSM 105/ MTH 215	Calculus I / Biostatistics (for Chemistry)	3	1	0	4	GE
4.	BCH 103	Analytical Chemistry-I	3	1	0	4	CC
5.	EVS106	Environmental Sciences	3	0	0	3	AECC
Practical							
6.	PHB 152/BBC 152	Physics Lab-2/Biological Science Lab-2	0	0	2	1	GE
7.	BCH 152	Chemistry Lab-2	0	0	2	1	CC
TOTAL CREDITS						**21**	

Program Structure
School of Basic Sciences & Research
B. Sc. (H) Chemistry
Batch: 2019-22
TERM: III

S. No.	Course Code	Course	Teaching Load			Credits	Core/Elective
			L	T	P		
THEORY SUBJECTS							
1.	PHB 218/ BBC 202	Solid State Physics/Molecular Biology-I	3	1	0	4	GE
2.	BCH 201	Inorganic Chemistry-I	3	1	0	4	CC
3.	MSM 204/ BBC 203	Calculus-2/ Basic Microbiology	3	1	0	4	GE
4.	BCH 207	Analytical Chemistry- II	3	1	0	4	CC
5.	BCH 203	Industrial Chemistry	3	1	0	4	DSE
6.		Elective from University List	2	0	0	2	SEC2
7.	CCU401	Community Connect	0	0	4	2	AECC3
PRACTICAL							
8.	PHB 251/ BBC 251	Physics Lab-3/ Biological Science Lab-III	0	0	2	1	GE
9.	BCH 251	Chemistry Lab-III	0	0	2	1	CC
TOTAL CREDITS						**26**	

Program Structure
School of Basic Sciences & Research
B. Sc. (H) Chemistry
Batch: 2019-22
TERM: IV

S. No.	Course Code	Course	Teaching Load			Credits	Core/Elective
			L	T	P		
THEORY SUBJECTS							
1.	BCH 204	Physical Chemistry-II	3	1	0	4	CC
2.	BCH 205	Organic Chemistry-II	3	1	0	4	CC
3.	BCH 206	Inorganic Chemistry-II	3	1	0	4	CC
4.	BCH 210	Analytical Chemistry-II	3	1	0	4	CC
5.	BCH 208/ BCH 209	Chemical Kinetcs and Catalysis/ Solid state Chemistry	3	0	0	4	DSE
PRACTICAL							
6.	BCH 252	Chemistry Lab IV	0	0	3	2	CC
7.	BCH 253	Chemistry Lab V	0	0	3	2	CC
TOTAL CREDITS						**24**	

Program Structure
School of Basic Sciences & Research
B. Sc. (H) Chemistry
Batch: 2019-22
TERM: V

S. No.	Course Code	Course	Teaching Load			Credits	Core/Elective
			L	T	P		
THEORY SUBJECTS							
1.	BCH 301	Physical Chemistry-III	3	1	0	4	CC
2.	BCH 302	Organic Chemistry-III	3	1	0	4	CC
3.	BCH 303	Inorganic Chemistry-III	3	1	0	4	CC
4.	BCH 313	Advance Topics in Chemistry	3	1	0	4	CC
5.	BCH 305/ BCH 306	Chemistry in Action/ Polymer Science	3	1	0	4	DSE
Practical/ Project							
6.	BCH 351	Chemistry Lab-VI	0	0	3	2	CC
7.	BCH 352	Chemistry Lab-VII	0	0	3	2	CC
8.	BCH 359	Project-I/Dissertation-I	0	0	5	3	DSE
TOTAL CREDITS						**27**	

Program Structure
School of Basic Sciences & Research
B. Sc. (H) Chemistry
Batch: 2019-22
TERM: VI

S. No.	Course Code	Course	Teaching Load			Credits	Core/Elective
			L	T	P		
THEORY SUBJECTS							
1.	BCH 307	Physical Chemistry-IV	3	1	0	4	CC
2.	BCH 308	Organic Chemistry-IV	3	1	0	4	CC
3.	BCH 309	Inorganic Chemistry-IV	3	1	0	4	CC
4.	BCH 310	Biological Chemistry	3	1	0	4	CC
5.	BCH 311/ BCH 312	Important inorganic compounds / Industrial inorganic chemicals, energy and environment	3	1	0	4	DSE
Practical/ Project							
6.	BCH 354	Chemistry Lab –VIII	0	0	3	2	CC
7.	BCH 355	Chemistry Lab-IX	0	0	2	2	CC
8.	BCH 360	Project II/Dissertation-II	3	0	0	3	DSE
TOTAL CREDITS						**27**	
GRAND TOTAL						**145**	

2.1: PHYSICAL CHEMISTRY-I (BCH 101)

School: SBSR		**Batch : 2019-22**
Program: B. Sc		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: 01**
1	Course Code	BCH 101
2	Course Title	**PHYSICAL CHEMISTRY-I (C)**
3	Credits	4.0
4	Contact Hours (L-T-P)	(3 1 0)
	Course Status	Compulsory
5	Course Objective	1. To provide the understanding of physical states of matter and how they are related to daily life application 2. To define how the initially primitive models of real gases in physical chemistry are elaborated to take into account more detailed observations. 3. To understand the laws of solid state chemistry and the arrangement of ions/atoms/molecules in a crystal lattice 4. To list different properties of liquids involving surface tension and viscosity coefficients. 5. To extend the concept of solutions from Raoult's Law to industrial application processes. 6. To provide the introduction and application of solid, liquid and gaseous states.
6	Course Outcomes	CO1: The structural features of solid-state material by having the knowledge of packing arrangements. CO2: Different properties of liquids and their application in daily life. CO3: The separation processes of steam distillation and solvent extraction. CO4: Ideal and Non ideal gas behaviour and their properties. CO5: The basics of thermodynamics to the lab-scale heat exchange processes. CO6: Fundamental properties, thermodynamical properties and application of all states of mater
7	Course Description	Course emphasizing on the various solid state structures and its correlation to atomic coordinated, distinguishing properties of liquid state, physical properties of molecule's in solutions and gaseous state, thermochemistry aspects of chemical process.
8	Outline syllabus	
	Unit 1	**Solid State**
	A	Crystalline and amorphous solids, crystal lattices and unit cell, Crystal

		systems, types, close packing,		
	B	Packing fraction, crystal density, Ionic Radii, radius ratio. X–Ray diffraction: Bragg's law		
	C	Structures of NaCl, KCl and CsCl (qualitative treatment only). Point Defects. Glass and liquid crystals.		
	Unit 2	**Liquid State**		
	A	Qualitative treatment of the structure of the liquid state, Radial distribution function		
	B	Physical properties of liquids: vapour pressure, surface tension, coefficient of viscosity and their determination.		
	C	Effect of addition of various solutes on surface tension and viscosity. Temperature variation of viscosity of liquids and comparison with that of gases.		
	Unit 3	**Solution**		
	A	Deviations from Raoult's law – non-ideal solutions. Colligative properties: vapour pressure-composition and temperature composition curves of ideal and non-ideal solution, azeotropes, distillation of solutions.		
	B	Partial miscibility of liquids: critical solution temperature, effect of impurity on partial miscibility of liquids.		
	C	Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.		
	Unit 4	**Gaseous State**		
	A	Kinetic theory of gases, derivation of Ideal gas equation, Maxwell distribution of molecular velocities and molecular energies, principle of equipartition of energy,		
	B	Deviation of gases from ideal behaviour, compressibility factor (Z) and expansitivity factor, van der Waal's equation of state and its application to explain deviation of gases.		
	C	Critical constant of gas in terms of van der Waal's constant: derivation of P_c, T_c and V_c, principle of corresponding states.		
	Unit 5	**Thermodynamics and Thermochemistry**		
	A	Recapitulation of Laws of Thermodynamics, Entropy changes in reversible and irreversible processes, Entropy changes for an ideal gas in isothermal, isobaric and isochoric processes,		
	B	Physical significance of entropy, Helmholtz free energy (A) and Gibbs free Energy (G), variation of Free Energy with pressure and temperature, Maxwell relations, Gibbs-Helmholtz equ.		
	C	Relation between Enthalpy of reaction at constant volume and pressure, Enthalpy of formation, Kirchhoff equation, Hess's Law and application, measuring the enthalpy of combustion.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. P.W. Atkins and Julio de Paula, "Physical Chemistry", 8th Ed., W. H. Freeman Publication, 2006.		

		2. G.M. Barrow, “Physical Chemistry” Tata McGraw-Hill Education, 2008. 3. Puri, Sharma and Pathania, “Principles of Physical Chemistry” Vishal Publishing Co. 4. Bahl Arun, Bahl B.S. and J.D Tuli, “Essentials of Physical Chemistry”, S.Chand & Co. 5. KL Kapoor , “Textbook of Physical Chemistry” Volume 1 and 2, Macmillan Publishers

2.1 Organic Chemistry-1 (BCH102)

School: SBSR		**Batch : 2019-2022**
Program: B. Sc		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: 02**
1	Course Code	BCH 102
2	Course Title	**Organic Chemistry-1 (C)**
3	Credits	4.0
4	Contact Hours (L-T-P)	(3 1 0)
	Course Status	Compulsory
5	Course Objective	1. To introduce students to many of the key concepts of organic chemistry through a survey of the basic reactions types. 2. To promote understanding of basic facts and concepts and to inculcate interest in Organic chemistry. 3. To elaborate various electronic factors, an understanding of nucleophiles, electrophiles, electronegativity, and resonance, reaction intermediates and their effect on the course of organic reactions. 4. To discuss the theories of organic acids/bases, the concept of Formal charges and Curley Arrow rule. 5. To explain, classify and apply fundamental organic reactions such as SN2, SN1, E2, E1, alkene addition, electrophilic aromatic substitution, 1,2/1,4-additions to organic molecules. 6. To elaborate logical and detailed mechanisms for various fundamental reactions which involves nomenclature, physical properties, synthesis, reactions, of alkanes, alkenes, dienes, and alkynes. 7. To demonstrate the basics of Stereochemistry, Classify molecules as chiral or achiral, identify chiral carbons as (R) or (S), identify relationships between pairs of molecules as enantiomers, diastereomers, or equivalent, and identify when a solution is racemic versus optically active. 8. To provide knowledge of basics of organic chemistry, alkanes and cycloalkanes, alkenes and dienes, alkynes and stereochemistry.
6	Course Outcomes	Students will be able to: CO1: explain many concepts like electronic displacement, bond fission, Reaction intermediates, curly arrow rule, nucleophilicity etc. CO2: understand the synthesis, reactions of alkanes, cycloalkanes and their mechanism CO3: explain the synthesis, reactions of alkenes and dienes CO4: summarize the physical and chemical properties of alkynes

		CO5: explain and apply the concept of stereoisomerism and conformation CO6: apply the basic concept of organic chemistry in synthesis & reactions of hydrocarbons and analyze the stereochemistry of hydrocarbons
7	Course Description	Course emphasizing basic organic chemistry which encompasses various types of electronic displacement, reaction intermediates. Further this course enables the students to generalize the structure properties relationship of Alkanes, alkenes, alkynes and cycloalkane. It also gives in-depth idea to prepare various above compounds by different methods. It also covers the basic information about stereoisomerism.
8	Outline syllabus	
	Unit 1	**Basics of Organic Chemistry**
	A	Electronic Displacements- Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Homolytic and Heterolytic fission with suitable examples,
	B	Reaction Intermediates types, shape and relative stability of carbocations, carbanions, free radicals and carbenes Dipole moment; Organic acids and bases; their relative strength..
	C	Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity. Introduction to types of organic reactions and their mechanism: Addition, Elimination, Substitution and rearrangement reactions.
	Unit 2	**Alkanes and Cycloalkanes**
	A	Alkanes- Methods of synthesis (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids & their salts)
	B	Chemical reactions: Nitration, Halogenation, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.
	C	Cycloalkanes- Nomenclature, synthesis, relative stability-Baeyer Strain Theory, physical properties & Chemical properties.
	Unit 3	**Alkenes and Dienes**
	A	Methods of synthesis, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination,
	B	Relative stabilities of alkenes Chemical reactions – hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration, oxidation, oxymercuration-reduction.
	C	Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization. Dienes, Relative stability of dienes, Conjugated dienes, 1,2 and 1,4 additions.
	Unit 4	**Alkynes**
	A	Methods of synthesis, chemical reactions, acidity of terminal alkynes,
	B	Mechanism of electrophilic and nucleophilic addition reactions

	C	Hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.		
	Unit 5	**Stereochemistry**		
	A	Concept of isomerism and its types, Projection: Newman projection and Sawhorse formulae, Fischer and flying wedge formulae and their interconversion, Difference between conformation and configuration.		
	B	Conformational isomerism in ethane, n-butane and unsubstituted cyclohexane (axial and equatorial bonds), Optical isomerism –Molecular chirality, enantiomers, stereogenic center, optical activity, chiral and achiral molecules with one & two stereogenic centers		
	C	Disasteromers, meso compounds, Absolute configuration, sequence rules, R & S systems of nomenclature. Geometric isomerism – cis/trans, E/Z system of nomenclature, geometric isomerism in alicyclic compounds.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Organic Chemistry by Solomon & Fryhle. 2. Advanced Organic Chemistry by Bahl and Bahl. 3. Organic Chemistry by Morrison and Boyd. 4. Stereochemistry of carbon compounds; E. L. Eliel. 5. Stereo Chemistry: Conformation and Mechanism; D. Nasipuri. 6. Stereochemistry: conformation and Mechanism; P. S. Kalsi. 7. Conformational analysis; Eliel, Allinger, Angyal and Morrison.		

2.1 Analytical Chemistry-I (BCH 103)

School: SBSR		**Batch : 2019-2022**
Program: B. Sc		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: 03**
1	Course Code	BCH 103
2	Course Title	**ANALYTICAL CHEMISTRY-I**
3	Credits	4.0
4	Contact Hours (L-T-P)	(3 1 0)
	Course Status	Compulsory
5	Course Objective	1. Provide and enrich the students to analytical techniques, various types of errors knowingly/ unknowingly introduced, accuracy and confidence limit in analytical process, 2. Equip the students with the knowledge of making different kinds of standard solutions and how to standardize the secondary standards and determining the strength of unknown solution volumetrically, 3. Inculcate the theoretical and experimental knowledge of volumetric and gravimetric quantitative analysis in presence of interfering agents, 4. Provide theoretical and experimental knowledge qualitative analysis of various cations and anions in a pure sample mixture of unknown analyte. 5. Provide theoretical and experimental knowledge qualitative analysis of various cations and anions containing interfering cations and anions in a mixture of unknown analyte. 6. Provide correlation between theoretical aspect of qualitative and quantitative analysis of cations, anions and molecular systems
6	Course Outcomes	CO1: Prepare different types of standard solutions for quantitative estimation of unknown analyte CO2: Correlate and apply theoretical knowledge to estimate the unknown analyte volumetrically CO3: Correlate and apply theoretical knowledge to estimate the unknown analyte gravimetrically CO4: Understand the various principles of chemistry and apply them for qualitative analysis of various cations and anions in pure and impure samples of analysis CO5: Model the analytical procedure to analyse the industrial samples applying the theoretical concepts of volumetry and gravimetry. CO6: Correlate theoretical aspect of qualitative and quantitative analysis of cations, anions and molecular systems

7	Course Description	Analytical chemistry I comprises of following descriptions as below. 1. Qualitative and quantitative aspects of chemical analysis 2. Volumetric Method of Analysis 3. Gravimetric Analysis 4. Qualitative analysis-I 5. Qualitative analysis-II
8	Outline syllabus	
	Unit 1	**Qualitative and quantitative aspects of chemical analysis**
	A	Scope and functions of analytical processes, Calibration and standardization of NaOH, $KMnO_4$ and $HClO_4$.
	B	Types of Errors- Systematic, random and Gross; definition of terms: mean and median,precision and accuracy
	C	Absolute and relative error, Random errors. Sources of error in experimental data, standard deviation, relative standard deviation
	Unit 2	**Volumetric Method of Analysis**
	A	Principals of volumetric analysis, Primary and Secondary standards, Indicators and their types. Titrations and their theories,
	B	Acid- base titration (strong acid and strong base, weak acid and strong base, weak base and strong acid, weak acid and weak base), Complexometric titrations (titration of mixtures, selectivity, masking and demasking agents);
	C	Precipitation titrations; Redox titrations, calculation of equivalent weight. Theoretical aspects of titration curves and end point evaluation; Choice of indicators in each case.
	Unit 3	**Gravimetric Analysis**
	A	Basic principle, Precipitation reactions; precipitation methods; conditions of precipitation; nucleation; particle size
	B	Crystal growth; Colloidal state; aging; impurities in the analytical precipitate; co-precipitation
	C	Precipitation from homogenous solution; washing of precipitate; drying and ignition of precipitate; Applications
	Unit 4	**Qualitative analysis-I**
	A	Qualitative analysis and its type; systematic analysis of anions in terms of dilute and concentrate sulphuric acid group (CO_3^{2-}, NO^{2-} , S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$)
	B	systematic analysis of anions in terms of dilute and concentrate sulphuric acid group (CH_3COO^-, F^- ,Cl^- , Br^- , I^- , $C_2O_4^{2-}$, NO_3^-)
	C	Interfering anions and their removal (fluoride, borate, oxalate and phosphate) (BO_3^{3-}, PO_4^{3-}, SO_4^{2-}), Sodium carbonate extract preparation and its advantages
	Unit 5	**Qualitative analysis-II**
	A	Basic principles involved in analysis of cations and anions and solubility products, common ion effect.
	B	Principle involved in division of cations into groups and group reagent. Qualitative semimicro analysis of mixtures containing two anions and two cations
	C	Qualitative semimicro analysis of mixtures containing two anions and two cations (Emphasis should be given to the understanding of the chemistry of

		qualitative analysis of cations of group I to VI including zero group).		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Text book of quantitative Chemical Analysis, Vogel. 2. Text book of qualitative Chemical Analysis, Vogel.		

2.1 Inorganic Chemistry-I (BCH 201)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc		**Current Academic Year: 2019**
Branch:Chem (H)		**Semester:3rd**
1	Course Code	BCH201
2	Course Title	Inorganic Chemistry-I
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory /Elective/Open Elective
5	Course Objective	1. To provide the basics of structure of atoms and the basics of theories involve there in. 2. To introduce the concept of ionic bonding of solids and the different factors that affect ionic bonding. 3. To illustrate the importance of covalent bonding and its usefulness in predicting fundamental properties of the molecules. 4. To explain to the student about shapes of a covalent molecule 5. To provide an introduction to the basic concepts in Molecular Orbital Theory and apply them to understand and compare the stability and reactivity of the molecules. 6. To introduce other types of non-covalent interaction that could be present in a molecule.
6	Course Outcomes	The student will be able to CO1 :understand the various theories to describe atomic structure CO2 :know about ionic bonding, significance and factors affecting the strength of ionic bonding CO3: explain the basis of covalent bonding in molecules CO4 : explain the basics of M.O Theory CO5: explain about band theory of solids and non-covalent interactions present in them CO6 :gain insight about various ionic, covalent and non-covalent interactions that are present in the molecule and their structural studies
7	Course Description	This course describes the basic theories involved in atomic structure and chemical bonding. This course satisfies the requirement of B.Sc chemistry honors' programme.
8	Outline syllabus	
	Unit 1	**Atomic Structure**
	A	Bohr's theory, its limitations and atomic spectrum of hydrogen atom.
	B	Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Radial and angular wave functions for hydrogen atom.

	C	Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations,		
	Unit 2	**Chemical Bonding-I**		
	A	Ionic bond and factors affecting ionic bond; lattice energy and its calculation by Born-Haber cycle.Madelung constant,		
	B	solvation energy, factors affecting solvation energy and solubility of ionic solids.		
	C	Polarizing power and polarizability; Ionic Potential, Fajan's rules.		
	Unit 3	**Chemical Bonding-II**		
	A	Covalent bonding: Concept of Hybridization, Extent of d-orbital participation in molecular bonding (SO_2, PCl_5, SO_3).		
	B	Bent's Rule, Resonance in Inorganic molecules and ions, VSEPR theory, Shortcomings of VSEPR theory,		
	C	Prediction of structures and variation of bond angles on the basis of VSEPR theory, prediction of hybridization and shapes of simple inorganic molecules and ions such as NH_3, H_3O^+, SF_4, ClF_3, ICl_2^-, and H_2O by valence shell electron pair repulsion (VSEPR) theory.		
	Unit 4	**Chemical Bonding-III**		
	A	Valence bond theory - A mathematical approach and its limitations, directional characteristics of covalent bond. Molecular orbital theory (LCAO method)		
	B	Symmetry of molecular orbitals, Applications of MOT to homo- and hetero-nuclear diatomic molecules,		
	C	Molecular orbital energy level diagrams (He_2, B_2, C_2, Be_2, N_2, O_2, F_2, NO, CO, HF, CN^-), Applications of MO theory to explain the stability of homo and hetero dinuclear diatomic molecules.		
	Unit 5	**Chemical Bonding-IV**		
	A	Polar covalent bonds, Dipole moment.		
	B	Hydrogen bonding and its effect on the physical and chemical properties of compounds of the main group elements. van der Waal's forces (dipole-dipole interactions, ion-dipole interactions, ion-induced dipole interactions)		
	C	Metallic bonding: Band theory and its illustration.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	**References** 1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.		
	Other References	1. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970 2. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th Ed., Oxford University Press, 2014. 3. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962. 5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.		

2.1 Industrial Chemistry (BCH 203)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc.		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: 3**
1	Course Code	**BCH 203**
2	Course Title	**INDUSTRIAL CHEMISTRY (C)**
3	Credits	4.0
4	Contact Hours (L-T-P)	(3 1 0)
	Course Status	Compulsory
5	Course Objective	1. Learn about the water and water technology in terms of hardness, alkanity, various boiler troubles and their removal 2. Understand and determine the rank of solid and gaseous fuels by determining the calorific value 3. Understand and select the suitable lubricant for lubrication in two movable metallic parts 4. Select the raw materials, suitable processes and industrial operations to manufacture the pulp and papers 5. Choose the raw materials, suitable processes and industrial operations to manufacture the technologically important carbon materials as activated carbon, carbon fibres and carbon black. 6. Provide deep understanding of water, fuel, lubrication, pulp and paper and carbon technologies which can utilized at societal ground.
6	Course Outcomes	1. Determine the different kind of hardness and alkalinity in water sample and will be able to avoid the boiler trouble at industrial scales using different suitable technology 2. Calculate experimentally the calorific value of solid or gaseous fuels and model the industrial combustion process. 3. Avoid the wear and tear in the moving metallic components by use of suitable lubricants. 4. Model and device the industrial process and operations for manufacture of technologically important materials. 5. Explain activated carbon and manufacturing of carbon fibres and carbon black. 6. Deep understanding of water, fuel, lubrication, pulp and paper and

		carbon technologies which can utilized at societal ground.		
7	Course Description	Course emphasize on the 1.Water and water technology, 2. Fuel and combustion, 3. Lubricants, 4. Paper and pulp industries and 5. Carbon technology		
8	Outline syllabus			
	Unit 1	**Water technology**		
	A	Water quality parameters; Standards for drinking water; Hardness of water: Units, determination		
	B	Determination of alkalinity of water; Methods of Treatment of domestic water supply: Sedimentation, Coagulation, Filtration, Sterilization, Break point chlorination		
	C	Boiler Troubles: Carry Over, Priming, Foaming, Scale, Sludge, Corrosion, Caustic Embrittlement; Desalination of water; Softening of water: Ion exchange process, Zeolite process.		
	Unit 2	**Fuel and Combustion**		
	A	Classification of fuels; Calorific value of fuel (gross and net); Determination of calorific value of solid fuels using bomb calorimeter.		
	B	Coal- composition, ranking and analysis of coal (proximate and ultimate); Petroleum processing-refining, cracking and reforming		
	C	Gaseous fuels: Natural gas, liquefied petroleum gas, Bio gas; combustion of fuel and calculation of oxygen demand.		
	Unit 3	**Lubricants**		
	A	Functions of' lubricant; Mechanism of lubrication; Fluid or Hydrodynamic Lubrication		
	B	Thin film or Boundary lubrication & Extreme pressure lubrication		
	C	Lubricants for Extreme ambient conditions and for special applications; Properties of lubricants and tests		
	Unit 4	**Pulp & paper**		
	A	Introduction, Raw Materials, pulping processes, sulphate pulp, soda pulp, sulphite pulp, beating, refining, filling, sizing and colouring		
	B	Manufacture of paper, calendaring, pollution problem		
	C	Recovery of chemicals from spent liquor from sulphate and sulphite process		
	Unit 5	**Carbon Technology**		
	A	Introduction, Classification of activated carbons, raw materials and manufacture of activated carbons		
	B	Precursors for carbon fibres, manufacture of carbon fibres from polyacrylonitrile		
	C	Manufacture of carbon black by furnace black process, Applications.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Applied Chemistry, Volume 1; V. M. Balsaraf, V. M. Balsaraf, A. V. Pawar, P. A. Mane, A. V. Pawar, P. A. Mane.		

	Other References	1. Introduction to Materials Chemistry, H. R. Allcock, John-Wiley & Sons; New York. 2. Shreve, R.N. & Brink, J.A.: Chemical Process Industries, 5th Edition, McGraw Hill, 1987. 3. Austine, G.T.: Shreeves Chemicals Process Industries, 5th Edition, Mc Graw Hill, 1984. 4. Dryden, C.E., Rao M.G. & Silting, M.: Outlines of Chemical Technology, 3rd Edition, Affiliated East West Press Pvt. Ltd., N. Delhi, 2008. 5. Pandey, G.N.: Chemical Technology, Volume-I, Lion Press, Kanpur. 6. Donnet J. B., Bansal R. C.: Carbon Fibres, Marcel Dekker Inc. 7. Donnet J. B., Bansal R. C., Wang M. J.: Carbon Black, Marcel Dekker Inc. 8. Bansal R. C., Donnet J. B., Stoeckli F.: Active Carbon, Marcel Dekker Inc.

2.1 ANALYTICAL CHEMISTRY II (BCH 207)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Hons.)		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: III**
1	Course Code	BCH207
2	Course Title	Analytical Chemistry-II
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. Provide knowledge of interaction of electromagnetic spectrum with matter and to record the information in the form of signals 2. Provide knowledge of various rules for electronic transition in a molecule upon irradiation with UV-Vis electromagnetic radiation in order to analyse the structure of unknown molecule 3. Provide theoretical knowledge of various rules for molecular vibrations in a molecule upon irradiation with infra-red electromagnetic radiation in order to analyse the structure of unknown molecule 4. Analyse the structure of molecule with help of various rules of fragmentation pattern in a molecules through mass spectrum and NMR signals 5. Elucidate the structure of any unknown simple molecules integrating the results of various spectroscopic techniques such as UV-Vis, IR, NMR and Mass. 6. Provide detailed knowledge of solving the molecular structural problems by integrating various spectroscopic techniques
6	Course Outcomes	CO1: Establish firm knowledge of various spectropic principle to elucidate the structure of analyte CO2: Theoretically calculate the absorption frequencies of molecule and predict the colour, concentration and structure of polyenes and enone systems CO3: Correlate the various modes of vibration in a molecules based on absorption/ transmitted light to evaluate the presence of functional groups in a molecule; helpful to elucidate the structure CO4: Understand the various modes of fragmentation on high energy electron impact helpful to elucidate the structure of alkane, alkene, alcohol and ethers CO5: Understand the appearance of proton signal in a molecule depending on the environment helpful to elucidate the structure of molecule. CO6: Develops analytical skills to think, analyse and solve the molecular structural problems by integrating various spectroscopic techniques such 1. Introduction to spectro-analytical methods 2. UV-Visible Spectroscopy 3.

		Infrared Spectroscopy 4. Mass spectroscopy 5.Nuclear Magnetic Resonance Spectroscopy		
7	Course Description	Analytical chemistry II comprises of following analytical techniques as given below 1. Introduction to spectro-analytical methods 2. UV-Visible Spectroscopy 3. Infrared Spectroscopy 4. Mass spectroscopy 5. Nuclear Magnetic Resonance Spectroscopy		
8	Outline syllabus			
	Unit 1	**Introduction to spectro-analytical methods**		
	A	Properties of electromagnetic radiations, interaction of radiation with matter		
	B	Absorption, and emission of electromagnetic radiations		
	C	Fourier transform spectroscopy		
	Unit 2	**UV-Visible Spectroscopy**		
	A	Lambert's-Beer's law; Different type of electronic transitions; Chromophores; auxochromes		
	B	Red shift; blue shift; Effect of conjugation; solvent effect; absorption in dyes		
	C	Woodward's rule for conjugated cyclic and acyclic dienes; absorption in aromatic compounds		
	Unit 3	**Infrared Spectroscopy**		
	A	Introduction; Theory; electromagnetic range (functional group region and finger print region); frequency of vibrations of diatomic molecules		
	B	Modes of vibrations of atoms in polyatomic molecules; fundamental frequencies and overtones, selection rules		
	C	IR spectrum as a tool of structural analyses of alkanes, alkenes, alkynes, alcohol, aldehydes and ketones, carboxylic acids and amines.		
	Unit 4	**Mass spectroscopy**		
	A	Basic principle and Theory, Components of mass spectrometer, exact masses of nucleides		
	B	Molecular ions; isotope ions; fragment ions, metastable ions, Mc-lafferty rearrangement		
	C	Factors affecting cleavage pattern, structural elucidation of alkane, alkene, alcohol and ethers.		
	Unit 5	**Nuclear Magnetic Resonance Spectroscopy**		
	A	NMR active nuclei, Proton NMR Spectroscopy (^{1}H): Introduction; Theory; shielding and deshielding of magnetic nuclei		
	B	Equivalent and non-equivalent protons, chemical shift and its measurements; factors influencing chemical shift		
	C	Peak area; spin-spin interactions; coupling constant 'J' and factors influencing 'J' value		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%

	Text book/s*	Spectroscopy-Pavia, Lampman, Kriz, Vyvyan, Brooks/Cole CENGAGE Learning
	Other References	1. Instrumental Methods of Chemical Analysis– B. K. Sharma. 2. Spectroscopy-Pavia, Lampman, Kriz, Vyvyan, Brooks/Cole CENGAGE Learning 3. Fundamentals of molecular spectroscopy, 4th Edition- C. N. Banwell 4. Molecular Spectroscopy- Jeanne L. McHale 5.Infrared and Raman Spectra of Inorganic and Coordination Compounds: Part A: Theory and Applications. Kazuo Nakamoto 6. Spectrometric Identification of organic compounds, Robert M. *Silverstein*, Francis X. Webster, and David J.

2.1 Physical Chemistry II (BCH204)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc.		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: 4**
1	Course Code	**BCH 204**
2	Course Title	**PHYSICAL CHEMISTRY II (C)**
3	Credits	4.0
4	ContactHours (L-T-P)	(3 1 0)
	Course Status	Compulsory
5	Course Objective	1. To provide the concept of strong and weak electrolytes, buffer solution, solubility and solubility product, indicators used in different analysis. 2. To introduce them with the concept of buffer solutions and pH and their applications. 3. To introduce them with the concept of components, phases and degree of freedom and describe equilibrium processes of one and more than one component systems such as congruent and incongruent melting points. 4. To inculcate concept of equilibrium, equilibrium constant and to calculate free energy change from it and to provide detailed concepts in Electrochemistry, theories for strong and weak electrolytes. 5. To introduce them with the concept of buffer solutions and pH and their applications. 6. Provide detailed knowledge of ionic, chemical and phase equilibria, electrochemistry and molecular thermodynamics
6	Course Outcomes	CO1: The concept and components of galvanic cell function of salt bridge. CO2: The generation and calculation of electromotive force. CO3: Deduce the maximum partial solubility of a solute in a multi component system using phase diagrams. CO4: The theoretical basis of calculation of different thermodynamic parameters using EMF technique and difference between ionic and electrolytic conductance. CO5: The generation and calculation of electromotive force and the application of electrochemical series in daily life. CO6: Develop critical analytical thinking about ionic, chemical and phase equilibria, electrochemistry and molecular thermodynamics
7	Course Description	Course emphasizes on the process in chemical and ionic equilibrium and associated phenomenon. The concept of Acid and basic behavior of liquid solution will be extensively discussed. Phase characteristics of binary and ternary mixtures correlated with degree of freedom. Electrochemistry aspects of process. Thermodynamical behavior at molecular level.
8	Outline syllabus	
	Unit 1	**Ionic Equilibria**
	A	Strong, weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. pH scale, common ion effect; dissociation constants of mono (acetic acid), di (carbonic acid) and

		triprotic (phosphoric acid) acids.		
	B	Buffer solutions, its types and Henderson-Hasselbalch equation for calculation of pH, buffer capacity, Hydrolysis of salts; degree of hydrolysis and pH of salt solutions. Solubility and solubility product of sparingly soluble salts,		
	C	Applications of solubility product principle. Theory of acid–base indicators; selection of indicators and their limitations.		
	Unit 2	**Chemical Equilibrium**		
	A	Law of mass action; Thermodynamic treatment of Law of mass action, Relation between Kp, Kc and Kx;		
	B	Variation of equilibrium constant with temperature - The van't Hoff Equation; Le-Chatelier's principle and its application to the formation of ammonia and phosgene,		
	C	Le-Chatelier's principle and physical equilibria.		
	Unit 3	**Phase Equilibria**		
	A	Introduction to phase, component and degree of freedom, Gibbs phase rule for condensed systems,		
	B	Phase diagrams: one component systems (H_2O), Two component systems: Eutectics,		
	C	Congruent and Incongruent melting point (Fe-C, $FeCl_3$-H_2O, Na-K)		
	Unit 4	**Electrochemistry**		
	A	Types of Electrodes, Introduction and Conventional representation of electrochemical cells; Electrolytic and Galvanic cells; Salt Bridge, Reversible and irreversible cells;		
	B	The Nernst equation and its application for measurement of EMF; Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and ΔS); concentration cells (with and without transference),		
	C	Liquid junction potential, Application of concentration cells. Electrochemical corrosion and its mechanism in acid and neutral media.		
	Unit 5	**Molecular Thermodynamics**		
	A	Partial Molar Free Energy, concept of Chemical potential, Gibbs Duhem equation,		
	B	Variation of chemical potential with temperature and pressure, Integrated form of Clausius Clapeyron Equation and its applications.		
	C	Fugacity and activity. Nernst heat theorem, Third law and determination of absolute entropies of solid, liquid and gases.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. N. Levine, "Quantum Chemistry" 4th ed.. Prentice-Hall, 2. F. L. Pilar, "Elementary Quantum Chemistry" 2nd Edition, Dover Publications, 2001. 3. P.W. Atkins and Julio de Paula, "Physical Chemistry", 8th Ed., W. H. Freeman Publication, 2006. 4. G.M. Barrow, "Physical Chemistry" Tata McGraw-Hill Education, 2008. 5. KL Kapoor , "Textbook of Physical Chemistry" Volume 2, Macmillan Publishers		

2.1 Organic Chemistry-II (BCH 205)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch: Chemistry		**Semester:04**
1	Course Code	BCH205
2	Course Title	Organic Chemistry-II
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To introduce the students with the concept of aromaticity, aromatic compounds, structure of benzene and its homologues, synthesis and reactions. 2. To discuss the reactivity, structure and synthesis of polynuclear aromatic hydrocarbons including naphthalene, anthracene and phenanthrene. 3. To enable the students to learn the chemistry of alkyl halides, aryl halides, alcohols, phenols, poly nuclear hydrocarbons. 4. To explain the structure and uses of organometallic compounds made up with magnesium and Lithium. 5. To explain the preparation methods, reactions specifically nucleophilic substitution reactions of alkyl and aryl halides. 6. To discuss the preparation routes, physical and chemical properties of alcohols, ethers, and epoxides. 7. To elaborate the preparation, properties and reactions of phenols.
6	Course Outcomes	Students will be able to: CO1: Discuss the structure, reactivity of benzene, its homologues, and polynuclear aromatic hydrocarbons like naphthalene, anthracene and phenanthrene. CO2: Understand the different processes of synthesis of organic molecules like alkyl and aryl halides. CO 3: Illustrate various uses of organometallic compounds made up with magnesium and Lithium CO 4: Identiy and categorize many functional groups like alcohol, ether, phenol and epoxides and their reactivity. CO 5: Describe the structure reaction and properties of alcohols. Ethers, and epoxides and phenol. CO6: Apply the knowledge in organic synthesis

7	Course Description	This course course covers the arenes, aromaticity, alkyl halide, aryl halide, alcohol, ether, epoxide and phenol.
8	Outline syllabus	
	Unit 1	**Arenes and Aromaticity**
	A	Structure of benzene; molecular formula and kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.
	B	Aromaticity: The Huckel rule, aromatic ions.
	C	Aromatic electrophilic substitution – general pattern of the mechanism, role of σ and π complexes, Mechanism of nitration, alogenations, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams, activating and deactivating substituents, Directive influence of groups(orientation and ortho/para ratio), Side chain reactions of benzene derivatives, Birch reduction.
	Unit 2	**Polynuclear Hydrocarbons**
	A	Structure elucidation, preparation and Reactions of naphthalene, phenanthrene and anthracene
	B	Structure, Preparation and important derivatives of naphthalene
	C	Structure, Preparation and important derivatives of anthracene
	Unit 3	**Alkyl and Aryl Halides**
	A	Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN^1, SN^2 and SN^i mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs elimination
	B	Aryl halides: Preparation (including preparation from diazonium salts), nucleophilic aromatic substitution; SN^{Ar}, Benzyne mechanism Relative reactivity of Alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.
	C	Organometallic compounds of Mg and Li – and their applications in organic compounds.
	Unit 4	**Alcohols, Ethers and Epoxides**
	A	**Alcohols**: Preparation, properties and relative reactivity of 1^0, 2^0, 3^0 alcohols, Bouvaeult-Blanc Reduction; Preparation and properties of polyhydric alcohols: glycols and glycerol.
	B	Ethers: Preparation (Williamson Synthesis), Physical and Chemical properties, Diethyl ether, Crown ethers.
	C	Epoxides- Synthesis & reactions of Ethylene Oxide.
	Unit 5	**Phenols**
	A	Preparation and properties; acidity and factors affecting acidity, Ring substitution reactions,
	B	Reimer-Tiemann and Kolbe's-Schmidt Reactions
	C	Fries and Claisen rearrangements with mechanism
	Mode of	Theory

	examination			
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Organic Chemistry by Solomon & Fryhle. 2. Advanced Organic Chemistry by Bahl and Bahl. 3. Organic Chemistry by Morrison and Boyd. 4. Advanced Organic Chemistry by Jerry March. 5. Organic Reaction and mechanism by P.S. Kalsi		

2.1 INORGANIC CHEMISTRY-II (BCH 206)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc		**Current Academic Year: 2019**
Branch:Chem (H)		**Semester:4th**
1	Course Code	BCH-206
2	Course Title	Inorganic Chemistry-II
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory
5	Course Objective	1. To know about the different components of periodic table 2. To compare as well as predict the different periodic property of the elements. 3. To gain an in depth knowledge about the property of s-block elements 4. Make it comprehended the structure, bonding and properties of hydrides, oxides and oxyacids or Nitrogen, Phosphorus and Sulphur 5. To provide the basic concepts in acid-base theory and apply them to understand and compare the reactive acidity, basicity and reactivity of the molecules. 6. To describe redox chemistry of inorganic compounds.
6	Course Outcomes	Students will be able to: CO1 : Have a thorough understanding of the construction as well as the development of periodic table of elements CO 2 : Gain knowledge about the properties and uses of s-block elements CO3: Gain knowledge about the properties and uses of p-block elements CO4 : Acquire knowledge of various theories about acids and bases and apply them in real life problems CO5: understand redox chemistry og inorganic compounds CO6 : Explain different properties of inorganic elements.
7	Course Description	This course describes the periodic properties of elements and chemistry of s block and p block elements. This course also includes acidic, basic and redox properties of elements.
8	Outline syllabus	
	Unit 1	**Periodic Table and Periodic Properties**
	A	Mendeleev-Seaborg's periodic table: basis and possible extension, Classification of elements on the basis of electronic configuration. Modern IUPAC Periodic table;

	B	Effective nuclear charges, screening effects, Slater's rules, ionic radii (Pauling's univalent), covalent radii;
	C	Ionization potential, electron affinity and electronegativity (Pauling's and Allred-Rochow's Scales) and factors influencing these properties.
	Unit 2	**s-Block elements**
	A	General trends of variation of electronic configuration, metallic nature, oxidation states,
	B	properties and reactions of some selected compounds such hydrides, halides, oxides, oxyacids
	C	complex chemistry in respect of s-block elements (Group 1 and group 2)
	Unit 3	**p-Block elements**
	A	Structure and bonding in hydrides of group 13 (only Diborane), group 14, group 15 (EH_3 where E=N, P, As) and group 16.
	B	Oxides: Oxides of nitrogen, phosphorus, sulphur. Oxoacids: Oxoacids of nitrogen, phosphorus, peroxoacids of sulphur.
	C	Halides: Halides of nitrogen and phosphorus.
	Unit 4	**Acids and Bases**
	A	Concepts of Acids and Bases : Arrhenius concept ; Bronsted – Lowry concept ; Acidity and Basicity on the basis of stability of conjugate acid base pair
	B	Lewis acid – base concept ; Usanovich Concept; Superacids,
	C	HSAB principle and its applications, Amphoterism, Lux-Flood concept.
	Unit 5	**Redox Chemistry**
	A	Oxidation-reduction as electron transfer process, oxidizing and reducing agents
	B	Ion-electron method of balancing redox reaction,
	C	Standard Electrode Potential and its application to inorganic reactions with an emphasis to MnO_4^-/Mn^{+2} (acidic, basic and neutral medium), $Cr_2O_7^{2-}/Cr^{+3}$ (acidic and basic medium), Fe^{+3}/Fe^{+2}.
	Mode of examination	Theory
	Weightage Distribution	CA: 30% | MTE: 20% | ETE: 50%
	Text book/s*	**References** 2. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
	Other References	4. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970 5. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th Ed., Oxford University Press, 2014. 6. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962. 5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.

2.1 Chemical Kinetics and Catalysis (BCH 208)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch:Chemistry		**Semester: lV**
1	Course Code	BCH 208
2	Course Title	**Chemical Kinetics and Catalysis**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Elective
5	Course Objective	1. To familiarise differences between order and molecularity, associated rate laws and activation processes. 2. To discuss the theoretical aspects of chemical kinetics 3. Identify the importance of rate equations for studying the kinetics of complex reactions 4. Understand the significance of collision theory along with experimental methods of rate determination 5. Introduction to catalysis and understanding the mechanism of various catalyzed reactions
6	Course Outcomes	CO1: Students will be able to understand the basic concepts of kinetics and its applications CO 2: To discuss the The effect of temperature on rate constant and identify the the basis of transition state theories CO 3: Analyze Influence of physical and chemical parameters on reaction rates CO 4: Analyze in-depth various experimental methods to determine rate constants for fast reactions CO 5: Understand the importance and influence of catalysts on different reactions CO6: Students will have in depth knowledge of order, rate expressions, theories, catalysis and mechanism of different kinetic phenomenon and reaction dynamics.
7	Course Description	This course covers the detailed information of Chemical kinetics, catalysis, reaction kinetics and different collision theories.
8	Outline syllabus	
	Unit 1	**Chemical Kinetics**
	A	Molecularity and order, 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,
	B	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.
	C	Effect of temperature on rate of reaction, Arrhenius equation, activation energy.

	Unit 2	**Collision theory**		
	A	Transition State Theory: Activated complex theory; Primary kinetic salt effect. Lindemann theory of unimolecular reaction		
	B	qualitative treatment of the theory of absolute reaction rates. Influence of pressure on reaction rates in solution.		
	C	Significance of value of activation; Influence of substituents on reaction rates.		
	Unit 3	**Fast Reactions**		
	A	Experimental Techniques for Fast Reaction; Relaxation methods		
	B	; Flow techniques-Stopped flow, Continuous Flow and Quenched Flow techniques		
	C	Pulse Method - Flash photolysis, Pulse radiolysis.		
	Unit 4	**Catalysis**		
	A	Catalyst and catalysis, positive and negative catalysis, Characteristics of catalytic reactions, Type of catalysis,		
	B	Heterogeneous- Acid Base Catalysis and homogeneous catalysis, Activation energy and catalysis,		
	C	promoters, Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.		
	Unit 5	**Reaction Dynamics**		
	A	Introduction to Reaction Dynamics; Reaction kinetics and dynamics; From Cross-sections to rate coefficients; Potential Energy Surfaces: Types of potential energy surface; Experimental probes for potential energy surfaces		
	B	Motion over the surface; The Differential Cross-Section; Elastic Scattering; Reactive Scattering; Case Studies; State-Specific Cross Sections		
	C	Experimental considerations; Molecular beam and Spectroscopic experiments; Models of energy utilization and disposal; Kinematic constraints; Case Studies; Rate coefficients and illustrative experiments		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. KL Kapoor , "Textbook of Physical Chemistry" Volume 5, Macmillan Publishers 2. Puri, Sharma and Pathania, "Principles of Physical Chemistry"		
	Other References	1. Laidler , "Chemical Kinetics" Pearson Education India 2. Rajaram and J. C. Kuriacose, Kinetics and mechanism of chemical transformation, Macmillan Publishers India Limited, 2000.		

2.1 Solid State Chemistry (BCH 209)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch:Chemistry		**Semester: lV**
1	Course Code	BCH 209
2	Course Title	**Solid State Chemistry**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Elective
5	Course Objective	1. Study Solids and their crystalline structure using X–ray diffraction data and electronic behaviour and preparative methodologies. 2. Identify and analyze the types of solids and their properties 3. Understand the significance of diffraction along with its application for determination of crystal structure 4. Analyze the theories for electronic behaviour of semiconductors and devices 5. Introduction to nanomaterials, synthetic approaches and properties 6. Introduction to advanced synthetic methodologies involving CVD and MOCVD.
6	Course Outcomes	Students will be able to CO1: recognise different types of solids and the crystal systems. CO 2: Interpret the varied X-ray diffraction patterns and deduce the solid state structures. CO 3: Interpret electronic behaviour of different types of solids using band theory CO 4: Identify the physical and chemical properties of nanomaterials along with effect of quantum confinement on their properties. CO 5: Relate the importance of different synthetic methods for preparation of nanomaterials CO6: Develop critical thinking about synthesis and various properties of macroscopic solids and nanoscopic materials.
7	Course Description	This course covers the detailed overview of Solids and nanomaterials, their study and analysis using X-ray Diffraction, their electrical conductivity measurements.
8	Outline syllabus	
	Unit 1	**Introduction to Solids**
	A	Crystalline and amorphous solids, Crystal structures, types, close packing, lattices, Primitive cell, Three dimensional unit cells, Miller indices, interplanar spacings, packing fraction. Crystal density,
	B	Ionic Radii, radius ratio, ionic solids with formula MX (CsCl, NaCl, NiAs, Zinc Blende and Wurtzite Structures), MX_2 (Fluorite and Antifluorite Structures),
	C	Non-Ionic Solids: Covalent solids, molecular solids, heat capacity of solids: Dulong Petit's law, Einstein eqn, Debye eqn.
	Unit 2	**Diffraction of solids**
	A	Principle of diffraction, Generation of X-ray, Principle of X-ray diffraction
	B	Braggs equation and its application, Laue pattern

	C	Comparison of XRD pattern of KCl and NaCl		
	Unit 3	**Electronic conductivity of solids**		
	A	Classical theory, Failure of the classical theory, Free electron theory, Band theory of solids, Electronic structure of solids		
	B	Semiconductors**:** Intrinsic and impurity semiconductors; Carrier concentrations;		
	C	Effect of temperature on electrical conductivity and mobility of electrons in semiconductors; p-n junctions; Organic semiconductors		
	Unit 4	**Introduction to Nanomaterials**		
	A	Elements of nanoscience and nanotechnology; classification of nanomaterials based on their dimension;		
	B	physical and chemical properties of nanomaterials; structure, chemical properties		
	C	application of some nanoscale materials: fullerenes, graphene, carbon nanotubes and semiconductor quantum dots		
	Unit 5	**Synthesis and properties of Nanomaterials**		
	A	Synthesis and fabrication of nanomaterials: Introduction to Top-down approaches (mechanical process, nanolithography, thermal evaporation)		
	B	bottom-up approaches (sol-gel processes)		
	C	Properties of nanomaterials: melting point and phase-transition, quantum size effects.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. 1. A. R. West, Solid State Chemistry, Wiley Student Ed., (2003) (Indian Ed.). 2. C. N. R. Rao and J. Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Ed., Cambridge University Press (1987).		
	Other References	1. L. E. Smart and E. A. Moore, Solid State Chemistry: An introduction, 3rd Ed., Taylor and Francis, 2010. 2. Poole, C.P. & Owens, F.J. Introduction to Nanotechnology, John Wiley & Sons, 2003. 3. T. Pradeep: NANO: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw-Hill Professional, 2007		

2.1 ANALYTICAL CHEMISTRY-III (BCH 210)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc (Hons.)		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: IV**
1	Course Code	BCH210
2	Course Title	Analytical chemistry III
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. Provide theoretical knowledge of distribution constant and ratio and effects of various factors helpful for extraction of pure analyte from liquid-liquid mixed sample. 2. Provide theoretical knowledge of various theories of separation of mixtures even in trace level by chromatographic techniques 3. Provide theoretical knowledge of various theories for qualitative and quantitative determination of solid analyte samples and to calculate the lattice structure. 4. Provide theoretical knowledge of various rules of electron spin resonance and find out the structure of metal complexes, organic free radicals and fused ring molecular systems. 5. Inculcate the knowledge of electrochemical principles useful for qualitative and quantitative estimation of analyte as well as ion selective electrodes for useful for various sensing applications. 6. Inculcate the critical thinking about solvent extraction, chromatographic techniques, X-ray diffraction techniques, electron spin resonance, and electroanalytical methods.
6	Course Outcomes	CO1: Acquire firm knowledge of various theories of liquid-liquid separation, chromatographic separation. CO2: Correlate the theoretical knowledge of X-ray diffraction and X-ray fluorescence with experimental calculation determination of bravais lattice and miller indices and structure of molecules. CO3: Understand and apply the basic principles of electron spin resonance for structural determination of inorganic and organic molecules specially relatively unstable. CO4: Understand the various electroanalytical technique useful for qualitative and quantitative determination of chemical parameters such as pH, pKa and conductance in solution CO5: Design the molecules sensitive and selective for developing chemical sensors.

		CO6: develop critical thinking about solvent extraction, chromatographic techniques, X-ray diffraction techniques, electron spin resonance, and electroanalytical methods.
7	Course Description	Analytical chemistry III consists of following analytical techniques. 1. Solvent extraction 2. Chromatographic methods 3. X-ray Techniques 4. Electron Spin Resonance 5. Electroanalytical methods
8	Outline syllabus	
	Unit 1	**Solvent extraction**
	A	Distribution constant and distribution ratio and their importance in solvent extraction; synergistic extraction; extraction by solvation; chelation
	B	Extraction equilibria for solvation, extraction of metal by Ion pair formation; Efficiency and Selectivity of extraction
	C	Extraction system; Methods of extraction and their applications in analytical chemistry.
	Unit 2	**Chromatographic methods**
	A	Principle; classification of chromatographic techniques
	B	Technique and applications of paper chromatography
	C	Thin–layer chromatography and Column chromatography
	Unit 3	**X-ray Techniques**
	A	Role of X-ray Methods in the Modern Analytical Laboratory, Basis of the Method, X-ray Sources
	B	X-ray fluorescence: Basic principle, Specimen Preparation Techniques for X-ray Fluorescence, Qualitative and quantitative Analysis with the X-ray Spectrometer
	C	Basic principle of powder X-ray diffraction method, Bragg condition; Bragg equation, Miller indices and its calculation; Experimental methods of X-ray diffraction, Typical examples of amorphous and crystalline materials
	Unit 4	**Electron Spin Resonance**
	A	Basic principles of Electron Spin Resonance Spectroscopy
	B	Zero field splitting and Kramer's degeneracy; 'g' value; Applications to metal complexes
	C	Organic free radicals- methyl free radical; naphthalene and benzene free radicals.
	Unit 5	**Electroanalytical methods**
	A	Classification of electroanalytical methods, electrochemical cell, Nernst equation to determine the concentration, basic principle of pH metric
	B	Potentiometric and conductometric titrations. Techniques used for the determination of equivalence points
	C	Techniques used for the determination of pKa values, ion selective electrode, advantages and limitations of ion selective electrodes.
	Mode of examination	Theory

	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Instrumental methods of chemical analysis, Chatwal and Anand 2. Instrumental Methods of Chemical Analysis– B. K. Sharma.		
	Other References	1. Introduction to Instrumental Analysis by R. D. Broun, Mc Graw Hill (1987) 2. Instrumental methods of chemical analysis by H. willard, L.Merrit, J.A. Dean and F.A. settle. Sixth edition CBS (1986) 3. Fundamentals of Analytical Chemistry, 6th edition, D.A. Skoog, D.M. West and F.J. Holler, Saunders college publishing.		

2.1 Physical Chemistry-III (BCH 301)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc.		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: 5**
1	Course Code	**BCH301**
2	Course Title	**PHYSICAL CHEMISTRY-III (C)**
3	Credits	4.0
4	Contact Hours (L-T-P)	(3-1-0)
	Course Status	Compulsory
5	Course Objective	1. To inculcate concept of equilibrium, equilibrium constant and to calculate free energy change from it. 2. To provide detailed concepts in Electrochemistry, theories for strong and weak electrolytes and to implant the concept of Ionic and electrolytic conductance 3. To provide concept of different orders and to calculate the corresponding rates of reaction. 4. To teach the surface phenomenon including monolayer and multilayer adsorption. 5. To provide the concept of particle size, coagulation, flocculation and micelle formation. 6. To provide detailed knowledge about electrolytic conductance, chemical kinetics, surface chemistry, colloids and colloidal solution.
6	Course Outcomes	CO1: The application of electrochemical series in daily life and the theoretical basis of calculation of different thermodynamic parameters using EMF technique CO2: Difference between ionic and electrolytic conductance and learn the conductance of strong and weak electrolytes. CO3: Prepare the rate law equations for complex molecular reactions CO4: Understand the essential phenomenon's of surface chemistry and utilise them for processes such as minimising corrosion. CO5: Apply the concepts to daily life applications such as soap action and surface active agents CO6: Develop detailed knowledge to critically analyze electrolytic conductance, chemical kinetics, surface chemistry, colloids and colloidal solution.
7	Course Description	The course emphasis on the various electrolytic and electrochemical process at bulk and interfaces, the kinetic aspects of differential order reactions, the chemical process which occur at surfaces and associated rates, the synthesis and relevance of colloids.
8	Outline syllabus	
	Unit 1	**Electrolytic Conductance – I**

	A	Conduction in electrolyte solutions, Arrhenius theory of electrolytic dissociation.		
	B	Conductivity, equivalent and molar conductivity, variation with dilution.		
	C	Kohlrausch law. Debye-Hückel-Onsager equation, Walden's rules.		
	Unit 2	**Electrolytic Conductance – II**		
	A	Ionic mobilities, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods.		
	B	Grotthus conductance, 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		
	C	(iv) conductometric titrations and (v) hydrolysis constants of salts.		
	Unit 3	**Chemical Kinetics**		
	A	Molecularity and order, Integrated rate law and halflife expression for Zero order reaction,		
	B	First order reactions, Second order reactions, Third order reactions (with equal concentration) , Pseudounimolecular reactions, Concept of activation energy, Arrhenius equation.		
	C	Theories of Reaction Rates: Collision theory and Activated Complex, Comparison of the two theories (qualitative treatment only).		
	Unit 4	**Surface Chemistry**		
	A	Physical adsorption, chemisorption, Applications of Adsorption		
	B	Factors influencing adsorption, Freundlich adsorption isotherm and Langmuir adsorption isotherm		
	C	Introduction to BET theory of multilayer adsorption.		
	Unit 5	**Colloids**		
	A	Classification, preparation, structure and stability of Colloids; Tyndall effect, The electrical double layer; Zeta potential; Coagulation of colloidal solution; Hardy-Shulze rule;		
	B	Flocculation value; Electro kinetic properties; Electrophoresis; Electro-osmosis; Protective colloids; Gold number;		
	C	Emulsion; Oil in water (o/w) emulsion and water in oil (w/o) emulsion; Gels, Micelles: Critical micelle concentration		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. D. A. Mc Quarrie and J. D. Simon, "Physical Chemistry. A Molecular Approach" University Science Books, Sausalito 1997. 2. P.W. Atkins and Julio de Paula, "Physical Chemistry", 8th Ed., W. H. Freeman Publication, 2006. 3. G.M. Barrow, "Physical Chemistry" Tata McGraw-Hill Education, 2008. 4. Puri, Sharma and Pathania, "Principles of Physical Chemistry" Vishal Publishing Co. 5. Bahl Arun, Bahl B.S. and J.D Tuli, "Essentials of Physical Chemistry", S.Chand & Co. 6. KL Kapoor , "Textbook of Physical Chemistry" Volume 3, Macmillan Publishers 7. Physical Chemistry by N. B. Singh; S. S. Das and A. K. Singh. 8. K. J. Laidler and J. H. Meiser, "Physical Chemistry" 3rd ed. Houghton Mifflin Company, Boston 1999.		

2.1 Organic Chemistry-III (BCH 302)

School: SBSR		**Batch : 2019-22**
Program: B.Sc.		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: 5**
1	Course Code	**BCH302**
2	Course Title	**ORGANIC CHEMISTRY-III (C)**
3	Credits	4.0
4	Contact Hours (L-T-P)	(3-1-0)
	Course Status	Compulsory
5	Course Objective	1. Cultivate an appreciation of the role of organic chemistry in everyday life and in biological systems. Particular emphasis will be placed upon identification and core properties of oxygen, sulfur and nitrogen organic functional group chemistry. 2. Understand name reactions and their mechanisms of oxygen, sulfur and nitrogen organic functional groups. 3. Discuss the physical and chemical properties and main reactions of oxygen containing carbonyl group compounds. 4. Identify mono/di carboxylic group, discuss physical properties and characteristic reactions of carboxylic acids. To illustrate synthesis of an ester using Fischer esterification. 5. Discuss the structure and reactivity of nitrogen-containing organic compounds. 6. Create fundamental and critical analysis about carbonyl compounds, carboxylic acids and their derivatives, sulphur containing functional groups, nitrogen containing functional groups and heterocyclic compounds.
6	Course Outcomes	CO1: Employ the chemical reactions of all above functional groups to propose multistep syntheses of a wide variety of organic compounds. CO2: Learn nucleophilic reactions of carbonyl compounds. CO3: Compare the structures, functions, and key chemical reactions of the principal groups of carbonyl compounds, carboxylic acids, thiols, amines, nitrile, isonitriles and sulphonic acids. CO4: Applications of carbonyl compounds, carboxylic acids, thiols, amines, nitrile, isonitriles and sulphonic acids. CO5: Contrast structure and properties of heterocyclic compounds pyrrole, furan, thiophene and pyridine. CO6: Develop understanding and critical thinking about carbonyl

		compounds, carboxylic acids and their derivatives, sulphur containing functional groups, nitrogen containing functional groups and heterocyclic compounds.
7	Course Description	Organic Chemistry-III includes chemistry of carbonyl compounds, carboxylic acids and their derivatives, sulphur and nitrogen containing functional groups and heterocyclic compounds. It provides details knowledge of synthesis, structure and chemical properties. It gives detailed understanding of various mechanism of transformation of substrate into the product. It also discusses the synthesis, reaction and mechanism of substitution reaction of Furan, Pyrrole, Thiophene, Pyridine.
8	Outline syllabus	
	Unit 1	**Carbonyl Compounds**
	A	Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism. Mechanisms of Aldol and Benzoin condensation,
	B	Knoevenagel condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions
	C	Oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition.
	Unit 2	**Carboxylic Acids and their Derivatives**
	A	Preparation, physical properties and reactions of monocarboxylic acid, Preparation and reactions of acid chlorides, anhydrides, esters and amides, Acetoacetic ester: keto-enol tautomerism, preparation by Claisen condensation, Acid hydrolysis and ketonic hydrolysis
	B	Comparative study of nucleophilic sustitution at acyl group - Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions
	C	Hofmann-bromamide degradation and Curtius rearrangement. Preparation of Dicarboxylic acid (succinic acid and adipic acid), Typical reactions of dicarboxylic acids.
	Unit 3	**Sulphur containing functional groups**
	A	Preparation and reactions of thiols, thioethers, Structure & preparation sulphonic acids
	B	Physical & Chemical properties. Derivatives of sulphonic acids.
	C	Uses: Benzene Sulphonamide, Saccharin.
	Unit 4	**Nitrogen Containing Functional Groups**
	A	Preparation and important reactions of nitro compounds, nitriles and isonitriles, Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis
	B	Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive, Curtius & Schimidt, methylation, Hofmann-elimination reaction
	C	Distinction between 1°, 2°and 3°amines with Hinsberg reagent and

		nitrous acid. Diazonium Salts: Preparation and their synthetic applications.		
	Unit 5	**Heterocyclic Compounds**		
	A	Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom		
	B	Synthesis, reactions and mechanism of substitution reactions of: Furan		
	C	Synthesis, reactions and mechanism of substitution reactions of: Pyrrole, Thiophene, Pyridine.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Organic Chemistry by Solomon & Fryhle. 1. Advanced Organic Chemistry by Bahl and Bahl. 2. Organic Chemistry by Morrison and Boyd. 3. Organic Chemistr, Vol.I by Finar. 4. Heterocyclic Chemistry by Joule & Mills.		

2.1 INORGANIC CHEMISTRY-III (BCH 303)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc		**Current Academic Year: 2019**
Branch: Chemistry		**Semester:5th**
1	Course Code	BCH-303
2	Course Title	Inorganic Chemistry-III
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory
5	Course Objective	1. To provide the knowledge about characteristic properties of d block elements 2. To illustrate the knowledge about characteristic properties of f block elements 3. Make it comprehended various metallurgical processes 4. To administer the knowledge of the Bioinorganic Chemistry 5. To provide an introduction to metalloenzymes. 6. To gain insight about various advanced topics in inorganic chemistry
6	Course Outcomes	Students will be able to: CO1: Explain the spectral and magnetic properties of d block elements CO2 :gain insight about characteristic properties of f block elements CO3:explain the metallurgical process CO4 : predict the importance of metal ion in biology CO5: Understand structure and function of metalloenzymes CO6 :Know about the chemistry of d and f-block elements, metallurgy, bioinorganic chemistry and chemistry of metalloenzymes.
7	Course Description	This course describes the chemistry of d and f block elements as well as metallurgy.This course satisfies the requirement of B.Sc chemistry honors' programme.
8	Outline syllabus	
	Unit 1	**d-block elements**
	A	Characteristic properties of 3d elements: ionic radii; oxidation states; complexation tendency
	B	magnetic behavior, catalytic properties and electronic spectral properties. Spectrophotometric estimation of metal ions.
	C	Stability of various oxidation states and e.m.f. (Latimer diagrams).

		Comparison of 3d elements with 4d & 5d elements.		
	Unit 2	**f-block elements**		
	A	Comparative study of lanthanide and actinide elements with respect to electronic configuration; atomic and ionic radii; oxidation state and complex formation		
	B	Lanthanide and actinide contraction;		
	C	Occurrence and principles of separation of lanthanides and actinides.		
	Unit 3	**Metallurgy**		
	A	Chief mode of occurrence of metal based on standard electrode potential. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent.		
	B	Method of purification of metals; Electrolytic Kroll process, Van Arkel-de Boer process		
	C	Mond's process; electrolytic reduction		
	Unit 4	**Bioinorganic Chemistry**		
	A	Inorganic elements in biological systems; trace and essential elements, cells, biometals & common oxidation states; biological ligands		
	B	Metal binding sites in biological systems, toxicity of mercury; cadmium; lead; beryllium; selenium and arsenic;		
	C	Biological defence mechanisms; chelation therapy; metals used for diagnosis and chemotherapy; platinum complexes as anticancer drugs.		
	Unit 5	**Metalloenzymes**		
	A	Carbonate bicarbonate buffering system and Hydrolytic enzymes: carbonic anhydrase, carboxy peptidase, urase. Catalase,		
	B	Superoxide dismutase; Coenzymes; Molybdenum enzyme; Interchangeability of zinc and cobalt in enzymes;		
	C	Vitamin B_{12} and B_{12} coenzymes; Biomineralization and siderophores; ferritin and transferrins.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	**References** 1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991. 2. Malik, Tuli, Madan, *Inorganic Chemistry*		
	Other References	1. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970 2. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th Ed., Oxford University Press, 2014. 3. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962. 5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.		

2.1 Chemistry in Action (BCH 305)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc.		**Current Academic Year: 2019**
Branch: Chemistry		**Semester: V**
1	Course Code	BCH-305
2	Course Title	Chemistry in Action
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Elective
5	Course Objective	1. To familiarize students with different aspects of pharmaceutics, Drug design strategies, Common drugs and their mode of action: Penicillin (Antibiotic), Paracetamol (NSAID). 2. To increase the understanding of processes involved in the synthesis, effects, uses, consequences of insecticide use of Organochlorines, Organophosphates, Anilides based pesticides and insecticides. 3. To help students attain the firm knowledge of Food additives, Antioxidants, Chelating agents; Colouring agents; Curing agents, Flavoring Agents, Fragrances, emulsifiers, Low calorie sweeteners, Nutrient supplements & thickeners. 4. To discuss the classification, Oxygen balance, Properties, Chemical reactions, manufacture of important explosives like TNT, PETN, RDX. 5. To inculcate the knowledge of precautions need to be taken during storage of explosives. 6. To provide the knowledge and critical thinking about polymers, pharmaceuticals, pesticides and insecticides, food industry and explosives.
6	Course Outcomes	CO1:Know the basics of polymer chemistry. CO2: Learn different aspects of pharmaceutics, common drugs and their mode of action. CO3: Understand the processes involved in the synthesis, effects, uses, consequences of insecticides and pesticides. CO4: Attain the firm knowledge of Food additives, Antioxidants, Chelating agents; Colouring agents; Curing agents, Flavoring Agents, Fragrances, emulsifiers, Low calorie sweeteners, Nutrient supplements & thickeners. CO5: Understand the classification, Oxygen balance, Properties, Chemical reactions, manufacture of important explosives like TNT, PETN, RDX and their storage. CO6: Develop critical thinking about polymers, pharmaceuticals, pesticides and insecticides, food industry and explosives.

7	Course Description	Chemistry in Action deals with polymers, pharmaceuticals, pesticides and insecticide, food industry and explosives. Polymers deals with introduction, different techniques of polymerization, vulcanization, biodegradable and conducting polymers. Pharmaceuticals provides detailed knowledge of drug design strategies, steps involved in drug discovery, design and development. Pesticides and insecticides synthetic approach for DDT, Gammexene, Malathion, Parathion and anilides. Food industry deals with Food additives; Antioxidants; Chelating agents; Colouring agents; Curing agents, Flavoring Agents, Fragrances and emulsifiers. Explosive encompasses oxygen balance, manufacture of high explosives, blasting fuses and smokeless powders.
8	Outline syllabus	
	Unit 1	**Polymers**
	A	Introduction and classification, Number average and weight average molecular weight, Degree of polymerization. Polymerisation reactions - Addition and condensation, Mechanism of cationic polymerisation
	B	Anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; thermosetting (phenol-formaldehyde, Polyurethanes), thermoplastics (PVC, polythene)
	C	Synthetic fibres (acrylic, polyamido, polyester) and Rubbers – natural and synthetic: Buna-S; Vulcanization; Biodegradable and conducting polymers with examples.
	Unit 2	**Pharmaceuticals**
	A	Introduction, Drug design strategies: Drug distribution, Acid-base properties
	B	Computer Aided Drug Design, Steps involved in drug discovery, design & development.
	C	Common drugs and their mode of action: Penicillin (Antibiotic), Paracetamol (NSAID).
	Unit 3	**Pesticides & Insecticides**
	A	General introduction to pesticides (natural and synthetic), benefits and adverse effects
	B	Synthesis and technical manufacture and uses of representative pesticides
	C	Inecticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Anilides (Alachlor and Butachlor).
	Unit 4	**Food Industry**
	A	Food additives; Antioxidants; Chelating agents; Colouring agents; Curing agents
	B	Flavoring Agents , Fragrances, emulsifiers. Low calorie sweeteners; pH control agents
	C	Preservatives; Stabilizers and other additives; Nutrient supplements & thickeners.
	Unit 5	**Explosives**
	A	Introduction, Classification, Oxygen balance, Properties, Chemical

		reactions		
	B	Manufacture of important explosives: Trinitrotoluene (TNT), Nitroglycerine (NG), Pentaerythrial tetranitrate (PETN)		
	C	Cyclomethylene trinitroamine (RDX) blasting fuses, smokeless powder, black powder, Precaution during storage of explosives		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. F. W. Billmayer; Text Book of Polymer Science; 3rd edition; John Wiley and sons; New York; 2002. 2. Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, NewYork, 1978 3. Food Science (5th Edn.) by Potter & Hotchkiss, CBS Publishers & Distributors. 2. Food process Technology by Fellows (Woodhead Publishing Ltd). The Chemistry of Food Additives and Preservatives by Titus A. M. Msagati. 4. Jain & Jain, 'Engineering Chemistry', Dhanapat Rai Publishing house.		

2.1 Polymer Science (BCH306)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc		**Current Academic Year: 2019**
Branch: Chemistry		**Semester:5th**
1	Course Code	BCH-306
2	Course Title	**POLYMER SCIENCE (E)**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Elective
5	Course Objective	1. Provide students with an opportunity to identify different types of polymers in our surrounding. 2. Introduce students to the practical applications of polymers. 3. Differentiate between natural and man-made polymers. 4. Understand polymerization kinetics and uses of polymers. 5. Calculate molecular weights of polymers. 6. Provide detailed knowledge of introduction to polymer chemistry, chemistry of polymerisation, polymerization techniques, molecular weights of polymers and commercial polymers.
6	Course Outcomes	CO1: Explain the general reaction course and reaction mechanism for step growth polymerization, chain polymerization including radical-, ion- coordination and copolymerization. CO2: Distinguish between homogeneous and heterogeneous polymerization process. CO3: Describe and compare the principles of bulk, solution and interface polymerization. CO4: Calculate the degree of polymerization, average molecular weight, average functionality, gel point, kinetic chain length, copolymerization composition etc. CO5: Analyze the thermal and mechanical properties of polymers, and demonstrate an ability to predict how the molecular weight will affect these properties. CO6: detailed knowledge of introduction to polymer chemistry, chemistry of polymerisation, polymerization techniques, molecular weights of polymers and commercial polymers.
7	Course Description	Polymer Science encompasses polymer chemistry, chemistry of polymerization, polymerization techniques, molecular weights and

		commercial polymers. Introduction deals with preparation, classification, structure, chemical bonding and nomenclature of polymers. Chemistry of polymerization specifically deals with degree of polymerization, chain polymerization, coordination polymerization, polyaddition and ring opening polymerization. Techniques includes bulk, solution, suspension, emulsion, melt and solution polycondensation and molecular weight determination. Commercial polymers discusses various types of commercially available polymers.		
8	Outline syllabus			
	Unit 1	**Introduction to Polymer Chemistry**		
	A	Brief History, Polymer definition, Preparation, Classification, Structure, Chemical bonding		
	B	Molecular forces in Polymers. Nomenclature of Polymers- Common names		
	C	Source-Based names, Structure-Based names, Brand names.		
	Unit 2	**Chemistry of Polymerization**		
	A	Introduction, degree of polymerization, Chain Polymerization: Free radical Polymerization		
	B	Ionic polymerization, Coordination polymerization- Ziegler-Natta catalyst		
	C	Step Polymerization: Polycondensation, Polyaddition polymerization, and Ring Opening polymerization		
	Unit 3	**Polymerization Techniques**		
	A	Bulk polymerisation, Solution polymerization, Suspension polymerization		
	B	Emulsion polymerization, Melt polycondensation, Solution Polycondensation		
	C	Interfacial condensation, electrochemical polymerisation, Salient features of different polymerization techniques		
	Unit 4	**Molecular Weights of Polymers**		
	A	Average Molecular weight, Number Average & Weight Average Molecular weight		
	B	Molecular weight, Practical significance of polymer molecular weights		
	C	Molecular weight determination by End Group Analysis & Viscosity method.		
	Unit 5	**Commercial Polymers**		
	A	Nylon, polyesters (terylene and dacron), rubber, vulcanization of rubber, synthetic rubber		
	B	Buna-N rubber, copolymers of butadiene, PVC, acrylic, teflon, polyethylene and acrylonitrile		
	C	Resins: Phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins, melamine-formaldehyde resins. Synthetic fibre-Aramid.		
	Mode of examination	Theory		
	Weightage	CA	MTE	ETE

	Distribution	30%	20%	50%
	Text book/s*	1. F. W. Billmayer; Text Book of Polymer Science; 3rd edition; John Wiley and sons; New York; 2002. 2. V. R. Gowarikar; N.V.Viswanathan and Jayadev Sreedhav; Polymer Science; Wiley Eastern Limited; Madras 2006. 3. R. J. Young; Introduction to Polymers; Chapman and Hall Ltd.; London; 1999. 4. Gorge Odean–Principles of Polymerisation; 4th editon; Mc.Graw Hill Book Company; New York.2004. 5. M. S. Bhatnagar; "A Text Book of Polymers (chemistry and Technology of polymers); Vol I; II & III; 1st Edn.; S. Chand and Company; Newdelhi; 2007.		

2.1 PHYSICAL CHEMISTRY-IV (BCH 307)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch:Chemistry		**Semester: Vl**
1	Course Code	BCH 307
2	Course Title	**PHYSICAL CHEMISTRY- IV**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To explain the failure of classical mechanical laws and simultaneous emergence of quantum mechanical phenomenon's. 2. To translate the learned quantum mechanical laws into chemistry of conjugated systems 3. To introduce the concept of rotational energy levels and associated transitions and their applications in microwave spectroscopy 4. To discuss the allowed vibronic transitions as according to Jablonski diagram and their radiative applications 5. Introduction to photochemistry and their applications in photochemical reactions 6. To provide detailed knowledge of quantum mechanics and its application, electromagnetic spectrum, approximation, rigid rotor, bond dissociation energy and its determination and photochemistry.
6	Course Outcomes	CO1: Students will be able to understand the basic concepts of quantum mechanics and apply them for mathematical derivations CO 2: Able to understand the basics of the energy quantisation. CO 3: Recognise the allowed and forebidden energy transitions governed by quantum mechanical selection rules. CO 4: able to discuss the physical processes of fluorescence and phosphorescence CO 5: Able to understand Various kinetic processes of photochemical reactions and measurement of quantum yield. CO6: To acquire knowledge to critically think of quantum mechanics and its application, electromagnetic spectrum, approximation, rigid rotor, bond dissociation energy and its determination and photochemistry.
7	Course Description	This course covers the basic information of quantum mechanics, quantisation of energy and various physical and kinetic processes
8	Outline syllabus	
	Unit 1	**Introduction to quantum mechanics**
	A	Failure of classical mechanics, Blackbody radiation, Ultraviolet catastrophe, Planck's radiation law, Photoelectric effect, Concept of quantization

	B	atomic spectra, wave particle duality, uncertainty principle, wave-function and its interpretation, well-behaved function and requirements for an acceptable wave function		
	C	Operator formalism, Hamiltonian (energy) operator, eigen functions and eigen values, expectation values measurement, postulates of quantum mechanics		
	Unit 2	**Application of quantum mechanics**		
	A	Schrodinger equation (time independent),		
	B	particle in box (1D box), energy states		
	C	sketching of wave-function and probability densities for 1D box, degeneracy		
	Unit 3	**Spectroscopy-I**		
	A	Introduction to electromagnetic radiation, regions of the spectrum, Interaction of electromagnetic radiation with molecules and various types of spectra		
	B	Born-Oppenheimer approximation. Rotational spectroscopy of diatomic molecules: rigid rotor model, selection rules,		
	C	spectrum Determination of bond length, effect of isotopic substitution, Jablonski diagram.		
	Unit 4	**Spectroscopy-II**		
	A	Potential energy curves (diatomic molecules), Franck-Condon principle and vibrational structure of electronic spectra.		
	B	Bond dissociation and principle of determination of dissociation energy (ground state).		
	C	Decay of excited states by radiative and non-radiative paths.		
	Unit 5	**Photochemistry-I**		
	A	Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Primary and secondary processes in photochemical reactions Laws of photochemistry: Grotthus-Draper law		
	B	Stark-Einstein law of photochemical equivalence; quantum yield and its measurement for a photochemical process, examples of low and high quantum yields, actinometry.		
	C	Photosensitized reactions, Photostationary state. photochemical equilibrium and the differential rate of photochemical reactions, quenching, Fluorescence and phosphorescence chemiluminescence,		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. KL Kapoor , "Textbook of Physical Chemistry" Volume 4, Macmillan Publishers 2. P.W. Atkins and Julio de Paula, Physical Chemistry, 8th Ed., W. H. Freeman Publication, 2006.		
	Other References	1. Kakkar, R. Atomic & Molecular Spectroscopy: Concepts & Applications, Cambridge University Press (2015). 2. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).		

2.1 ORGANIC CHEMISTRY-IV (BCH 308)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch:Chemistry		**Semester: Vl**
1	Course Code	BCH 308
2	Course Title	**ORGANIC CHEMISTRY-IV**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. Draw the basic structure of carbohydrates, nucleic acids, peptides and lipids. 2. Identify the functional groups in carbohydrates, nucleic acids, peptides/proteins and lipids. 3. Predict the products of chemical reactions of monosaccharidess, amino acids and lipids (acetal/hemiacetal formation or oxidation). 4. To know about soaps and detergents and their properties and applications. 5. Classification, nomenclature and metabolism of drugs. 6. Build a sound foundation about Carbohydrates, amino acids and peptides, oil, fats and lipids, soap and detergents, and drugs.
6	Course Outcomes	CO1: Identify the difference between simple sugars and complex carbohydrates. CO2: Recognize the structure of an amino acid and the peptide bond that connects di-, tri, and polypeptides, list the essential and non-essential amino acids and describe the general strategies for amino acid synthesis. CO3: Compare and contrast saturated, mono-unsaturated, and poly-unsaturated fatty acids. CO4: Describe/recognize soaps and detergents and their mechanism of action. CO5: Familiarize the role of organic chemistry in drugs. Nomenclature, SAR, synthesis and pharmacological activity of some specific drugs. CO6: Provide critical thinking about carbohydrates, amino acids and peptides, oil, fats and lipids, soap and detergents, and drugs.
7	Course Description	Organic Chemistry-IV encompasses carbohydrate, amino acids and peptides, oil, fats and lipids, soap and detergents and drugs. It deals with reducing and nonreducing sugars, confirmations, structural elucidation of sugars, synthesis and structural elucidation of amino acids and peptides. Further it provides detailed knowledge of oil, fats, lipids, soap and detergents. Drugs deal with basic introduction, classification based on therapeutic action, structure – activity relationship and pharmacological activity.

8	Outline syllabus			
	Unit 1	**Carbohydrates**		
	A	Classification, biological importance, Reducing and non-reducing saccharides		
	B	Haworth projections and conformational structures; Interconversions of aldoses and ketoses		
	C	Killiani-Fischer synthesis and Ruff degradation, structure elucidation of fructose and glucose.		
	Unit 2	**Amino acids and Peptides**		
	A	Classification of α-Amino Acids, Synthesis, ionic properties and reactions		
	B	Zwitterions, pKa values, isoelectric point and electrophoresis		
	C	Peptides: determination of their primary structures-end group analysis, methods of peptide synthesis		
	Unit 3	**Oil, Fats & Lipids**		
	A	Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids		
	B	Trans fats, Hydrogenation, Saponification value, Iodine number. Classification, Biological importance of triglycerides and phosphoglycerides and cholesterol		
	C	Lipid membrane, Liposomes and their biological functions and underlying applications.		
	Unit 4	**Soaps and Detergents**		
	A	Soaps: Raw material, chemical reaction, types and cleansing action. Surfactants- emulsion and emulsifying agents		
	B	Wetting and non-wetting, CMC, hydrophobic and hydrophilic nature, amphipathic structures and types		
	C	Detergents- raw materials, detergent builders, additives and cleansing action.		
	Unit 5	**Drugs**		
	A	Introduction, Classification (based on therapeutic action), Nomenclature: Generic name, Brand name, Systematic name, Requirements of an ideal drug		
	B	General aspects of drug action, structure-activity relationship, metabolism of drugs, Chemical structures		
	C	Pharmacological activity, synthesis and uses of some important drugs: Aspirin, Paracetamol, Phenacetin, Chloramphenicol.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 2. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of 3.Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 4.Surfactants in Consumer Products: Theory, Technology and Application edited by Jürgen Falbe. 5.Organic medicinal and pharmaceutical chemistry by Beale & Block.		

2.1INORGANIC CHEMISTRY-IV (BCH 309)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc (Honours)		**Current Academic Year: 2019**
Branch: Chemistry		**Semester:6th**
1	Course Code	BCH-309
2	Course Title	Inorganic Chemistry-IV
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory
5	Course Objective	The main objective of this course is to: 1. Have a full understanding of isomerism in inorganic complexes and their assessment by different bonding theories. 2. Understand the theories behind behavior of complexes. 3. Acquire knowledge about factors affecting stability of complexes. 4. manipulate the catalytic cycle with mechanism studied in the course. 5. apply the knowledge to interpret the magnetic nature of a given compound. 6. Understand the utility of non-aqueous solvents over aqueous solvents.
6	Course Outcomes	CO1. Understanding of the basic concepts of bonding in transition metal complexes. CO2. Able to relate a structure of a complex with its cfse and magnetic moment. CO3 Understanding of the stability of a complex on the basis of various factors. CO4. Evaluate the activity of organometallic complexes as a catalyst. CO5. Explain the action of different non aqueous solvents. CO6.Ability to design an organometallic compound with application as catalyst using non aqueous solvents.
7	Course Description	This course describes the chemistry of organometallic and coordination chemistry with emphasis on catalysis and magnetism. This course satisfies the requirement of B.Sc chemistry honors' programme.
8	Outline syllabus	
	Unit 1	**Coordination chemistry-I**
	A	Werner's theory; nomenclature; stereo-chemistry of coordination numbers 4; 5 and 6. Various types of isomerism in coordination complexes.
	B	Important applications of coordination compounds and chelates.Theories of metal-ligand bonding in transition metal complexes
	C	Sidgwick effective atomic number concept; valence bond theory of

		coordination compounds with specific reference to CN^-, NH_3, OH^-, and limitations.		
	Unit 2	**Coordination chemistry-II**		
	A	Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields. Spectrochemical series. Concept of pairing energies and lattice energy.		
	B	Factors affecting the magnitude of 10 Dq (Δo, Δt).		
	C	Octahedral vs. Tetrahedral coordination, square planar geometry. Energy states and color.		
	Unit 3	**Coordination chemistry-III**		
	A	A brief outline of thermodynamic stability of metal complexes (methods of determination excluded).		
	B	Effect of central ion on stability (ionic size, ionic charge, electronegativity), effect of ligand on stability (size and charge of ligand, basic character, steric effects, chelation and size of the chelate ring)		
	C	magnetism and color of coordination complexes (octahedral, tetrahedral, square planar, high and low spin)		
	Unit 4	**Organometallic Chemistry**		
	A	Introduction- Definition and classification of organometallic compounds on the basis of hapticity and polarity of M-C bond; General characteristics, nomenclature,		
	B	Electron Count, Isolobal concept in organometallic chemistry, 16e and 18e rule and their exception		
	C	Catalytic study using organometallic compounds: Wacker Process, Water gas reaction, Synthetic gasoline, Monsanto acetic acid synthesis.		
	Unit 5	**Non-aqueous solvent**		
	A	Classification and characteristic properties of Non-aqueous solvents		
	B	Types of chemical reactions occurring in liquid ammonia, N_2O_4,		
	C	Types of chemical reactions occurring in liquid sulphur dioxide and anhydrous sulphuric acid.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1.James E. Huheey; Inorganic Chemistry; 4th Edn. (1993); Addison Wesley Pub. Co.; New York. 2. N. N. Greenwood and A. Earnshaw; Chemistry of the Elements; 2nd Edn. (1997); Butterworth Heinemann; London		
	Other References	1. F. A. Cotton and G. Wilkinson Advanced Inorganic Chemistry; 6th Edn. (1999); John-Wiley & Sons; New York. 2. Shriver & Alkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012). 3. Gary L. Miessler and Donald A. Tarr; Inorganic Chemistry; 2nd Edn. (1999); Prentice Hall International Inc.; London. 4. Rajni Garg and Randhir Singh, Inorganic chemistry,Tata McGaw Hill pub.		

2.1BIOLOGICAL CHEMISTRY (BCH 310)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch: Chemistry		**Semester:6**
1	Course Code	BCH 310
2	Course Title	**Biological Chemistry(c)**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1.To introduce the students about the concept of free energy change and the entropy change (randomness and distortedness) taking place inside the various cell organelles of particular cells and tissues of living organism when these cells under goes various biochemical reaction like oxidation reduction, elimination, substitution and re arrangement. 2.To explain the importance of electron carriers, role of various inorganic ions and organic molecules in the various protein and enzyme complex which forms an integral part of cell membranes of all living organisms 3.To elaborate the role of biocatalyst and differentiate it with a chemical catalyst in the mode of action and mechanism. 4.To introduce about the concept of how joining of smaller molecules leads to the requirement of energy and the breakdown of larger molecules in to smaller one leads to release of energy without the loss of those energy in the living cell ie how energy is conserved in the cell 5.To explain the chemistry of signaling of regulating molecules like hormones and their mechanism of action. 6. To provide detailed knowledge of thermodynamics of living world, redox processes in biological systems, bio-catalysts, catabolism and anabolism and chemistry of hormones.
6	Course Outcomes	CO1. Learn the meaning of free energy change, how the release of free energy will make the biochemical reaction spontaneous and will be correlate the second and third law of thermodynamics in a living cell. CO2. Understand the creation of micro and mini voltage and current when an electron flows through the several electron carriers and the role of chemistry and physics in it. CO3. Recogonize the difference between the energy of activation for a catalyst and a biocatalyst and what causes such a huge difference that makes the enzyme work at a much faster rate than a chemical catalyst. CO4. To learn the anabolism and catabolism of several biological organic molecule like carbohydrate(Glucose, Maltose and Starch) , fat (Tri acyl glycerol) and nucleotides CO5. Understand the role of insulin in causing diabetes mellites and other

		chemistry behind the regulation of biochemical reaction. CO6: Develop critical thinking about thermodynamics of living world, redox processes in biological systems, bio-catalysts, catabolism and anabolism and chemistry of hormones.		
7	Course Description	This course covers the information about the various chemical and physical phenomenon inside a living system and how the energy is conserved and utilized		
8	Outline syllabus			
	Unit 1	**Thermodynamics in a living world**		
	A	Biological order and disorder; thermodynamic principles inside cells: Mitochondria; Free energy change ($\Delta G^{/0}$) : Hydrolysis reaction (Glucose-6-phosphate, Glutamine, Maltose),		
	B	Elimination reaction (Malate), rearrangement reaction (Fructose-6-phosphate); ATP as energy currency; ($\Delta G^{/0}$) of ATP hydrolysis;		
	C	High energy rich bio-organic compound; hydrolysis of phosphocreatine in muscle; exergonic and endergonic reaction		
	Unit 2	**Biological oxidation and reduction**		
	A	Redox reactions; reduction potentials; standard reduction potentials; Nernst equation;		
	B	Universal electron carriers (NAD+, NADP+ and FAD, flavoproteins); Mitochondrial electron carriers; Sequences of electron carriers;		
	C	ETC in mitochondria; Functions of ETC complex; Ubiquinone, cytochromes, Iron sulfur proteins		
	Unit 3	**Chemistry of a biocatalyst**		
	A	Enzyme and chemical catalyst; role of enzyme, activation energy lowering; transition state intermediate; enzyme-substrate complex		
	B	Enzyme specific chemical reaction: Oxidoreductase, transferase, hydrolase and isomerase		
	C	Mode of enzyme action: lock and key hypothesis, induced fit hypothesis, Acid base catalysis, covalent catalysis.		
	Unit 4	**Anabolism and Catabolism**		
	A	Principles of anabolism and catabolism. Biochemistry of Glycolysis		
	B	Kreb's cycle, β-oxidation, transamination reaction		
	C	urea cycle, pyrimidine and purine biosynthesis		
	Unit 5	**Hormone chemistry**		
	A	Chemical signaling of hormones -endocrine, paracrine, autocrine,		
	B	Neuroendocrine mechanisms. Classification of Hormones		
	C	Structure of hormones , Steroid and non- steroid hormone		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1.Cox, M.M. and Nelson, D.L. (2008) : Lehninger Principles of Biochemistry, W.H. Freeman		

		and Company, New York, USA 2.Reginald H. Garrett • Charles M. Grisham(2010) : Biochemistry, 4th edition 3.Raven, Johnson, Mason, Losos, Singer: Biology, 9th edition, Mc Graw Hill Publication 4.Reece, Urry, Cain, Wasserman and Minosky, Jackson: Campbell Biology, 10th edition, Pearson Group Publication.
	Other References	1.Sadava, Hillis, Heller and Berenbam : Life the science of biology, 9th edition, W.H Freeman and Company. 2.Donald T Hynie : Biological thermodynamics,2nd edition, Cambridge University Press

2.1 IMPORTANT INORGANIC COMPOUNDS (BCH 311)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc (Honours)		**Current Academic Year: 2019**
Branch:Chemistry		**Semester:6th**
1	Course Code	**BCH311**
2	Course Title	**IMPORTANT INORGANIC COMPOUNDS**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Elective
5	Course Objective	The main objective of this course is to : 1. Explain the technological importance of inorganic pigments. 2. Illustrate the knowledge about inorganic polymers . 3. Acquire thorough proficiency in the types and behaviour of nanomaterials. 4. Understand the action of different types of engineering materials. 5. Acquire knowledge about formulation of ceramics and refractories. 6. Describe technologically important inorganic solids, engineering materials, construction materials, inorganic polymers and nanomaterials and their properties.
6	Course Outcomes	The student will be able to : CO1. Understand the importance of inorganic solid compounds in industry. CO2. Know about chemistry of inorganic materials of industrial importance. CO3. Acquire knowledge about manufacturing and processing of cement. CO4. Have knowledge of inorganic polymers, ceramics and Refractories. CO5. Gain knowledge about synthesis and fabrication of nanomaterials. CO6. Acquire crtitical thinking capabilities about technologically important inorganic solids, engineering materials, construction materials, inorganic polymers and nanomaterials and their properties.
7	Course Description	This course describes the chemistry of engineering materials and nanomaterials with emphasis on polymers.This course satisfies the requirement of B.Sc chemistry honors' programme.
8	Outline syllabus	
	Unit 1	**Inorganic solids of technological importance**
	A	Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments

	B	Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals		
	C	molecular magnets, inorganic liquid crystals		
	Unit 2	**Engineering materials**		
	A	Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels		
	B	Composition, mechanical and fabricating characteristics and applications of copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials		
	C	super alloys thermoplastics, thermosets and composite materials..		
	Unit 3	**Construction Materials**		
	A	Cement: Raw material, composition, manufacturing process and application of Portland cement, Chemistry of setting of cement		
	B	Ceramics and Refractories: Introduction, classification		
	C	Properties, raw materials, manufacturing and applications.		
	Unit 4	**Inorganic Polymers**		
	A	Types of inorganic polymers, comparison with organic polymers		
	B	Synthesis, structural aspects and applications of polysiloxanes and polysilicates		
	C	Synthesis, structural aspects and applications of polyborazines, polyphosphazenes, and polysulphates.		
	Unit 5	**Nanomaterials**		
	A	Definition, macro, micro and nano molecule, Overview of nanostructures and nanomaterials: classification.		
	B	Synthesis and fabrication of nanomaterials: Introduction to Top-down approaches (mechanical process and thermal evaporation) and bottom-up approaches (sol-gel processes).Preparation of gold and silver metallic nanoparticles.		
	C	Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, nanoclusters, nanowires and their applications		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry		
	Other References	1. G. Odian: Principles of Polymerization, John Wiley. 2. F.W. Billmeyer: Text Book of Polymer Science, John Wiley 3. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi. 4. C. P. Poole & F. J.Owens, *Introduction to Nanotechnology* John Wiley & Sons, 2003.		

2.1 INDUSTRIAL INORGANIC CHEMICALS, ENERGY AND ENVIRONMENT (BCH 312)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc (Honours)		**Current Academic Year: 2019**
Branch:Chemistry		**Semester:6th**
1	Course Code	**BCH312**
2	Course Title	**INDUSTRIAL INORGANIC CHEMICALS, ENERGY AND ENVIRONMENT**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Elective
5	Course Objective	The main objective of this course is to : 1. Understand the applications of industrial gases in various areas. 2. Analyze the hazards involved in handling hazardous chemicals like sulphuric acid. 3. Acquire thorough proficiency in the preparation of various types of fertilizers. 4. Describe the basic concept of radioactivity 5. Illustrate uses of radioactive material in energy production. 6. Describe about the various types of pollution and their role in environment damage.
6	Course Outcomes	The student will be able to : CO1. Understand the methods of preparation of different industrial gases. CO2. Administer the knowledge about hazardous chemicals during their applications. CO3. Devise the methods to manage nuclear waste. CO4. Understand the preparation of glass and ceramics. CO5Know about industrial preparation of various types of fertilizers. CO6. Administer the knowledge about the industrial gases, inorganic chemicals for various applications along with various types of fertilizers, nuclear process as a source of energy and environmental issues
7	Course Description	This course describes the chemistry of engineering materials and nanomaterials with emphasis on polymers.This course satisfies the requirement of B.Sc chemistry honors' programme.
8	Outline syllabus	
	Unit 1	
	A	Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen
	B	Large scale production, uses, storage and hazards in handling of the

		following gases:, helium, hydrogen
	C	Large scale production, uses, storage and hazards in handling of the following gases: acetylene, carbon monoxide.
	Unit 2	
	A	Manufacture, application, analysis and hazards in handling the following chemicals: sulphuric acid, caustic soda, common salt, borax
	B	Manufacture, application, analysis and hazards in handling the following chemicals: bleaching powder hydrogen peroxide potash alum, chrome alum and potassium permanganate.
	C	Manufacture, application, analysis and hazards in handling the following chemicals: potash alum, chrome alum and potassium permanganate.
	Unit 3	
	A	Nuclear stability and Nuclear binding energy, Magic Numbers
	B	Types of nuclear reactions with special emphasis on fission, fusion and spallation. Uses of isotopes in tracer techniques. Radio carbon dating,.Coal, petrol and natural gas.
	C	Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution- Disposal of nuclear waste, nuclear disaster and its management.
	Unit 4	
	A	*Glass:* Glassy state and its properties, classification (silicate and non-silicate glasses).
	B	Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, safety glass, borosilicate glass, photosensitive glass.
	C	*Ceramics:* Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications,
	Unit 5	
	A	Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate,

<table>
<tr><td></td><td>B</td><td colspan="3">Different types of fertilizers. Manufacture of the following fertilizers :ammonium phosphates; polyphosphate, superphosphate,</td></tr>
<tr><td></td><td>C</td><td colspan="3">Different types of fertilizers. Manufacture of the following fertilizers: compound and mixed fertilizers, potassium chloride, potassium sulphate</td></tr>
<tr><td></td><td>Mode of examination</td><td colspan="3">Theory</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Weightage Distribution</td><td>CA</td><td>MTE</td><td>ETE</td></tr>
<tr><td>30%</td><td>20%</td><td>50%</td></tr>
<tr><td></td><td>Text book/s*</td><td colspan="3">1. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.</td></tr>
<tr><td></td><td>Other References</td><td colspan="3">1. J. A. Kent: Riegel’s Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
2. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
3. A.Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).
4. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
5. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK</td></tr>
</table>

ELECTIVE COURSES (THEORY)

E1. Syllabus of Introduction to 'C' Programming (CSE115)

School: SET		**Batch : 2019-22**
Program: BSc		**Current Academic Year:2019**
Branch:		**Semester: I**
1	Course Code	CSE115 | Course Name:
2	Course Title	Introduction to 'C' Programming
3	Credits	2
4	Contact Hours (L-T-P)	2-0-0
	Course Status	
5	Course Objective	To understand and demonstrate how to solve logical and scientific problems using programming.
6	Course Outcomes	On successful completion of this module students will be able to: 1. Identify and understand the working of key components of a computer system. 2. Apply and practice logical ability to solve the problems. 3. Generate efficient and schematic solution to the problems.
7	Course Description	To understand and demonstrate how to solve logical and scientific problems using programming.
8	Outline syllabus	
	Unit 1	**Basics of computers**
	A	Introduction to computers: Von- Neumann's Model, Components, Devices.
	B	Data representation in computers(Number,Character).
	C	Introduction to Softwares: System, Application
	Unit 2	**Fundamental of Logic Buildings (Algorithms)**
	A	Problem Solving Aspects: Input, Output, Process(relationships between input and output), Verification, solve real life problems, case study examples.
	B	Type of constructs in algorithm to solve problem: Declaration, assignment, decision and control.
	C	Implementation of Algorithms: Computer Programming Evolution, Translators: Assembler, Compiler, Interpreter
	Unit 3	**Basics of Flowcharts**
	A	Flowchart: Elements, need of input and output.
	B	Identifying and understanding input/output, branching and iterations in flowchart.

	C	Conversion of algorithms in flowchart.		
	Unit 4	**C Language-I**		
	A	Introduction to C programming language: Structure of a C program.		
	B	Compilation and execution of C program. Data types, Variables, Constants, Identifiers and keywords, Operators.		
	C	Types of Statements: Assignment, Control, jumping.		
	Unit 5	**C Language-II**		
	A	Control statements: Decisions, Loops, break, continue		
	B	Nesded Loop		
	C	Arrays: One dimensional Array, Sorting, Searching		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Yashavant Kanetkar, “Let Us C”, BPB.		
	Other References	1. Byron Gottfried, “Programming with C”,TMH. 2.R. G. Dromey, “How to Solve It by Computer”,Pearson.		

E2. Syllabus of Communicative English-1 (ARP101)

Schools:SBSR		**Batch :** 2019-22
		Current Academic Year: 2019
		Semester: 1st (One)
1	Course Code	**ARP101**
2	Course Title	Communicative English-1
3	Credits	2
4	Contact Hours(L-T-P)	1-0-2
5	Course Objective	To minimize the linguistic barriers that emerge invaried socio-linguistic environments through the use of English. Help students to understand different accents and standardise their existing English. Guide the students to hone the basic communication skills - listening, speaking, reading and writing while also uplifting their perception of themselves, giving them self-confidence and building positive attitude.
6	Course Outcomes	CO1 Learn to use correct sentence structure and punctuation as well as different parts of speech. CO2 Learning new words its application and usage in different contexts helpful in building meaning conversations and written drafts.Develop over all comprehension ability, interpret it and describe it in writing. Very useful in real life situations and scenarios. CO2 A recognition of one's self and abilities through language learning and personality development training leading up to greater employability chances. Learn to express oneself through writing while also developing positive perception of self.To be able to speak confidently in English CO3 To empower them to capitalise on strengths, overcome weaknesses, exploit opportunities, and counter threats. To ingrain the spirit of Positive attitude in students through a full length feature film followed by a storyboarding activity. Create a Self Brand, identity and self esteem through various interesting and engaging classroom activity CO4 Exposing students to simulataions and situations wherein students learn to describe people and situations and handle such situations effectively and with ease.Teaching students how to engage in meaningful dialogues and active conversational abilities to navigate through challenging situations in life and make effective conversations. CO12 Learn how to transform adverse beginnings into positive endings – through writing activities like story completion.

7	Course Description	The course is designed to equip students, who are at a very basic level of language comprehension, to communicate and work with ease in varied workplace environment. The course begins with basic grammar structure and pronunciation patterns, leading up to apprehension of oneself through written and verbal expression as a first step towards greater employability.
8	Outline syllabus – ARP 201	
	Unit A	**Sentence Structure**
	Topic 1	Subject Verb Agreement
	Topic2	Parts of speech
	Topic3	Writing well-formed sentences
	Unit B	**Vocabulary Building & Punctuation**
	Topic 1	Homonyms/ homophones, Synonyms/Antonyms
	Topic2	Punctuation/ Spellings (Prefixes-suffixes/Unjumbled Words)
	Topic3	Conjunctions/Compound Sentences
	Unit C	**Writing Skills**
	Topic 1	Picture Description – Student Group Activity
	Topic2	Positive Thinking - Dead Poets Society-Full-length feature film - Paragraph Writing inculcating the positive attitude of a learner through the movie | SWOT Analysis – Know yourself
	Topic3	Story Completion Exercise –Building positive attitude - The Man from Earth (Watching a Full length Feature Film)
	Unit D	**Speaking Skill**
	Topic 1	Self-introduction/Greeting/Meeting people – Self branding
	Topic2	Describing people and situations - To Sir With Love (Watching a Full length Feature Film)
	Topic3	Dialogues/conversations (Situation based Role Plays)
9	Evaluations	Class Assignments/Free Speech Exercises / JAM Group Presentations/Problem Solving Scenarios/GD/Simulations (60% CA and 40% ETE
10	Texts & References | Library Links	• Blum, M. Rosen. How to Build Better Vocabulary. London: Bloomsbury Publication • Comfort, Jeremy(et.al). Speaking Effectively. Cambridge University Press

Observations:

1. A Single Consolidated Syllabus has now replaced the Previous Functional English Beginners -1 and Functional English Intermediate -1
2. Credits previously allocated to FEN 01 Lab Sessions have been dissolved
3. The Pearson Voice Labs have been completely eliminated

E3. Syllabus of Biomolecules (BBC 102)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch: Biochemistry		**Semester: Term I**
1	Course Code	BBC102
2	Course Title	Biomolecules
3	Credits	4
4	Contact Hours (L-T-P)	3-1-1
	Course Status	Compulsory
5	Course Objective	1. Recognize monosaccharides and their derivatives, understand how monosaccharides cyclize to form two different anomers and how a glycosidic bond links two monosaccharides. 2. Know the overall structure of an amino acid and the structures of the 20 different 'R' groups, understand how peptide bonds link amino acid residues in a polypeptide. 3. Understand that the planar character of the peptide group limits the conformational flexibility of the polypeptide chain, become familiar with the different structures form of protein. 4. Become familiar with the structures and nomenclature of the major classes of lipids,including fatty acids, triacylglycerols, glycerophospholipids, sphingolipids, and steroids. 5. Become familiar with the structures and nomenclature of the eight common nucleotides, understand how nucleotides are linked together to form nucleic acids and become familiar with the structural features of the DNA double helix.
6	Course Outcomes	Having successfully completed this module students will be able to; CO1: discuss chemical and molecular processes take place in and between cells related to carbohydrate, recognize the structure and properties of simple carbohydrates, oligosaccharides and polysaccharides. CO2: write the different structure and learn the function of different amino acids. CO3: understand the different levels of proteins structure and its importance and principles, concepts and facts of the structure and

		their related functions of proteins. CO4: discuss the structure, functions of different lipids and its importance as energy storage, understand of structure properties and biological functions of lipids and biological membranes. CO5: 5.understand why DNA is genetic material, DNA functions, Watson and Crick structure, understand of structure properties and biological roles heterocyclic bases nucleotides and nucleic acids in living organism. CO6: understand structure, function and importance of all macromolecules necessary for human beings.
7	Course Description	This course covers basic structures and functions of carbohydrates, amino acids, proteins, lipids and nucleic acids.
8	**Outline syllabus : Biomolecules**	
	Unit 1	**Carbohydrates and glycobiology**
	A	Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives.
	B	Disaccharides - reducing and non-reducing disaccharides. Polysaccharides – homo and hetero polysaccharides, structural and storage polysaccharides.
	C	Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides).
	Unit 2	**Amino acids**
	A	Structure and classification, physical, chemical and optical properties of amino acids.
	B	Amino acids and their properties - hydrophobic, polar and charged.
	C	Essential and non-essential amino acid.
	Unit 3	**Protein and its structure**
	A	Organization of protein structure into primary, secondary, tertiary and quaternary structures.
	B	fibrous and globular proteins; elementary ideas onprotein denaturation and renaturation
	C	Structure and function of Insulin, glutathione, antidiuretic hormone, hemoglobin and myoglobin .
	Unit 4	**Lipids**
	A	Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes.
	B	Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of

		membrane lipids.		
	C	Plant steroids. Lipids as signals, cofactors and pigments		
	Unit 5	**Nucleic acids**		
	A	Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA.		
	B	Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA.		
	C	Other functions of nucleotides - source of energy, component of coenzymes, second messengers.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Principle of Biochemistry by Nelson and Cox, 3rd edition. 2. Fundamentals of Biochemistry by Voet and Voet, 3rd edition. 3. Biochemistry ByLubertStryer, 5th Edition.		
	Other References	Nil		

E4. FOUNDATION COURSE IN MATHEMATICS (MSM 101)

School: SBSR		**Batch : 2019- 2022**
Program: B.Sc. (H)		**Current Academic Year: 2019**
Branch: Maths, Physics, Chemistry		**Semester: I**
1	Course Code	MSM 101
2	Course Title	FOUNDATION COURSE IN MATHEMATICS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To familiarise the students with basic concepts of matrices, determinants and solving the system of linear equations. 2. To understand the basic concept of sets theory, co-ordinate geometry, complex number and vector algebra.
6	Course Outcomes	CO1: Explain the concept of matrices and solve systems of linear equations and determinants. (K2,K3, K4) CO2: Explain the concept of complex numbers and calculate the nth roots of complex numbers and illustrate the solutions of simple Polynomial equations. (K2, K3, K4) CO3:Memorize the basic of Cartesian coordinate system anduse algebraic techniques to explain intercepts and explore equations of lines on the number plane. (K1, K3, K4) CO4: Describe and differentiate the symmetries from graphs of conic sections. (K1, K2) CO5: Describe and use the concepts of set theory, relation and functions. (K1,K2,K3) CO6: Explain the basic concepts of vector algebra and use to find area of parallelogram and quadrilateral, Vector triple product.(K2,K 3,K4)
7	Course Description	This course is an introduction to the fundamental of Mathematics. The primary objective of the course is to develop the basic understanding of linear algebra, complex number, co-ordinate geometry, sets theory and vector algebra.
8	**Outline syllabus**	**Foundation course in Mathematics**
	Unit 1	**Matrices**
	A	Evaluation of determinants, Properties of determinants,
	B	Matrices: types of matrices, addition, subtraction and multiplication of matrices, symmetric and skew symmetric matrix. Inverse of matrix.
	C	Rank of a matrix, Consistency of system of equations, Characteristic equation, Cayley -Hamilton theorem.
	Unit 2	**Complex Numbers**
	A	Representation of complex number in Argand plane, Modulus and

		argument of complex number		
	B	Algebraic operations, De- Moivre's theorem		
	C	Nth root of complex number, Euler's formula		
	Unit 3	**Co-ordinate geometry**		
	A	Cartesian coordinate system, Distance between two points Equations of line in various forms		
	B	Equation of circle in various forms, Equation of tangent and normal to the circle.		
	C	Equation of ellipse, parabola and hyperbola		
	Unit 4	**Sets Theory**		
	A	Definition of set, types of sets, Union and intersection of sets, Venn diagram, De-Morgan's law.		
	B	Relation and functions.		
	C	Composite function and inverse function.		
	Unit 5	**Vector Algebra**		
	A	Addition and subtraction of vectors and their geometric application.		
	B	Scalar and vector product, their physical application, Projection of vector on another vector, area of triangle.		
	C	Area of parallelogram and quadrilateral, Vector triple product.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Kreyszig, E., "Advanced Engineering Mathematics", John Wiley & Sons Inc. 1. Jain, M.K., and Iyengar, S.R.K., "Advanced Engineering Mathematics", Narosa Publications		
	Other References	1. Thomas, B.G., and Finny R.L., "Calculus and Analytical geometry", Pearson Education Asia, AdisonWisley. 2. Simmons, G.F., "Differential Equations with applications with applications", Tata McGraw-Hill.		

E5. Syllabus of Mechanics and properties of matter (PHB 114)

School: SBSR		Batch: 2019-22
Program: B.Sc.		Current Academic Year: 2019
Branch: Physics		Semester: I
1	Course Code	PHB114
2	Course Title	Mechanics and properties of matter
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To make the students familiar with use of vector algebra to study meachnics. 2. To understand and appreciate the rotational and harmonic motion. 3. To know the elasticity of matter and bending of beams in different situation. 4. To understand the concept surface tension and viscosity.
6	Course Outcomes	After the completion of this course, the student will be able to CO1: understand the concept of motion, work, energy, momemntum and frame of references CO2: appreciate real life applications of rotational mechanics and simple harmonic motion. CO3: use of moment of force and properties of matter to describe the elasticity and beam bending. CO4: understand the cause of capillarity, and surface tension and explain the of real life observations based on it CO5: understand the cause of viscosity and explain the real life observations based on it. CO6: appreciate mechanics with vector algebra and can apply it on real life problems
7	Course description	This course is designed to make students proficient in mechanics, especially rotational mechanics with vector treatment. They also learn about certain properties of matter like elasticity, surface tension and viscosity.
8	Outline Syllabus	
	Unit 1	Motion, Work, Energy and Momentum
	A	Review of Vector Algebra, Concept of work, power and energy; Law of

		conservation of energy; Conservative forces		
	B	Conservation law of momentum; Centre of mass; Collision of bodies		
	C	Centre of mass frame of reference, Laboratory frame of reference		
	Unit 2	Simple Harmonic Motion		
	A	Equation of Simple Harmonic Motion; Energy of a Harmonic Oscillator. Compound Pendulum		
	B	Rigid body-Translational and rotational Motion, angular momentum, torque; Moment of Inertia-Radius of gyration		
	C	Parallel and perpendicular theorems of Moment of Inertia, moment of inertia of disk, sphere, and rectangular lamina		
	Unit 3	Elasticity & Bending of beams		
	A	Hooke's Law, Stress - Strain Diagram - Elastic moduli - Relation between elastic constants		
	B	Poisson's Ratio – Determination of Poisson's ratio; Work done per unit volume in a strain		
	C	Bending of beam; Bending moment, Cantilever		
	Unit 4	Surface Tension		
	A	Surface Tension: Definition and dimensions of surface tension; Excess of pressure over curved surfaces		
	B	Application to spherical and cylindrical drops and bubbles		
	C	Variation of Surface tension with temperature, Jaegar's method		
	Unit 5	Viscosity		
	A	Streamline Flow; Bernoulli's Theorem; Co-efficient of viscosity and its dimensions		
	B	Rate of flow of liquid in a capillary tube - Poiseuilles' formula		
	C	Variation of viscosity of a liquid with temperature		
	Mode of Examination	Theory		
	Weightage Distribution	CA 30%	MTE 20%	ETE 50%
	Text Book/s	1. echanics, D.S.Mathur, S.Chand & Co. (Text Book) 2. Properties of matter, D.S.Mathur, S.Chand & Co.		
	Other References	1. Berkeley Physics Course, Volume I, Mechanics,C. Kittel, W. D. Knight, M. A. Rudderman, A. C. Helmhotz and B. J. Moye; McGraw-Hill 2. Mechanics , H.S.Hans and S.P.Puri, Tata McGraw-Hill (2003) 3. Physics (5th Edn.) - Principles with applications, Douglas C. Giancoli, Prentice Hall. 4. Physics (5th Edn.), John D. Cutnell & Kenneth W. Johnson, John Willey & Sons, Inc.		

E6. Introduction to Life Science (BBC101)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch: Chemistry		**Semester:1**
1	Course Code	BBC 101
2	Course Title	Introduction to life Science
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Elective course (For other disciplines)
5	Course Objective	1. To introduce the students about the concept of biology and how it is used in day to day life 2. To explain the formation of earth and the rise of life thereafter and also to discuss about the abiotic and biotic condition existing about that time 3. To introduce about the classification system adopted in diversity of life 4. To explain the genetics of Mendel's period and it has influence life there after 5. To discuss about the molecular role of genetic variation and the central dogma of life.
6	Course Outcomes	CO1: Learn how biology is used in day to day life. How field of biology is useful in all field of science to provide basic biology knowledge CO2: Elaborate the scientific theory of the formation of earth and how exist evolve after the formation of earth. CO3: Discuss the diversification of life and the classification system involved in this diversification

		CO4: Learn the various law in Mendel's genetics and the role of genetics in agriculture and all other fields and introducing the ethic and reponsibilty of biology in combination with inter disciplinary research to serve the society CO5: Explain the mechanism of genetic variation and the molecular genetics involved in it. CO6: Introduces the information about the early evolution and the diversification of life, patterns of inheritance and the molecular basis of transmission of genetic information.
7	Course Description	This course covers the information about the various early evolution of earth and life after that and how the life has diversified thereafter and lead to various changes in the planet.
8	Outline syllabus	
	Unit 1	**Biological System**
	A	Introduction to concepts of biology;
	B	Themes in the study of biology;
	C	A closer look at the ecosystem and cell; Biology in everyday life
	Unit 2	**Evolutionary history of biological diversity**
	A	Early earth and the origin of life; Major events in the history of life;
	B	Phylogeny and the tree of life;
	C	Concepts of species; Mechanisms of speciation.
	Unit 3	**Classification and diversity**
	A	Classifying the diversity of life
	B	Kingdoms of life, Prokaryotes, Eukaryoyes
	C	Archae, Concepts of taxa
	Unit 4	**Mendelian Genetics**
	A	Patterns of inheritance and question of biology
	B	Mendel's law and genetic variation
	C	phenotype and genotype
	Unit 5	**Modern Genetics**
	A	The molecular basics of genetic information
	B	Flow of genetic information from DNA to RNA

	C	Flow of genetic information from RNA to protein		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Cox, M.M. and Nelson, D.L. (2008) : Lehninger Principles of Biochemistry, W.H. Freeman 2. and Company, New York 3. Reginald H. Garrett • Charles M. Grisham(2010) : Biochemistry, 4th edition 4. Raven, Johnson, Mason, Losos, Singer: Biology, 9th edition, Mc Graw Hill Publication 5. Reece, Urry, Cain, Wasserman and Minosky, Jackson: Campbell Biology, 10th edition, Pearson Group Publication.		
	Other References	1. Sadava, Hillis, Heller and Berenbam : Life the science of biology, 9th edition, W.H Freeman and Company. 2. Donald T Hynie : Biological thermodynamics,2nd edition, Cambridge University Press		

E7. Syllabus of Calculus-I (MSM 105)

School: SBSR		**Batch : 2019- 2022**
Program: B.Sc. (H)		**Current Academic Year: 2019**
Branch: Mathematics		**Semester: II**
1	Course Code	MSM 105
2	Course Title	Calculus-I
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	To make students familiar with the concepts of successive differentiation along with the concepts of partial differentiation, basic integration & multiple integration. A brief of first order ordinary differential equation has been also introduced.
6	Course Outcomes	CO1: Memorize the basic of differentiation & Successive differentiation and solve with Leibnitz's theorem. (K1, K3) CO2: Explain and solve the Taylor's theorem, Maclaurin's theorem of one variable & two variables, Maxima minima for one & two variables, Lagrange's multipliers method and point of inflexion for various functions. (K1, K2, K3) CO3: Describe the Partial differentiation, Homogeneous functions and drive Euler's theorem with applications and apply the concept of Jacobian and its applications. (K1, K2, K3,) CO4: Memorize the basics of Integration with by parts method, partial fraction, Definite integration & its properties and evaluate the Beta and Gamma function. (K1, K3, K6) CO5: Evaluation of double integrals, Change of order of integration, change of variables, Area bounded by the curves, evaluation of triple integrals and its applications. (K1, K6) CO6: Formulate and evaluate first order differential equation. (K2, K5, K6)
7	Course Description	This course is an introduce the concepts of successive differentiation along with the concepts of partial differentiation, basic integration & multiple integration. A brief of formulation and evaluation of first

		order differential equation.
8	Outline syllabus : **Calculus I**	
	Unit 1	**DIFFERENTIATION**
	A	Concepts of limit, continuity and differentiability, differentiation of standard functions, product and quotient rule for differentiation, chain rule
	B	Successive differentiation and its applications, Leibnitz's theorem
	C	Taylor's theorem, Maclaurin's theorem, Maxima-minima, Points of inflexion
	Unit 2	**PARTIAL DIFFERENTIATION**
	A	Partial differentiation, homogeneous functions, Euler's theorem
	B	Jacobian of explicit and implicit functions and its applications, Taylor's expansion in two variables
	C	Maxima-minima in two variables, Lagrange's multipliers method
	Unit 3	**INTEGRATION**
	A	Integration of standard functions, integration by parts, by substitution
	B	Partial fractions, Definite integrals and its properties
	C	Beta and Gamma functions.
	Unit 4	**MULTIPLE INTEGRATION**
	A	Evaluation of double integrals
	B	Change of order of integration, change of variables
	C	Area bounded by the curves, evaluation of triple integrals and its applications
	Unit 5	**ORDINARY DIFFERENTIAL EQUATIONS**
	A	Formation of an ODE , Order and degree of an ODE
	B	First order differential equation and methods of solution including variable separable, homogeneous

	C	Exact differential equations, linear first order ODE, Equation reducible to exact differential equation.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Kreyzig, E., "Advanced Engineering Mathematics", John Willey & Sons.		
	Other References	2. Jain, M.K. and Iyenger, S.R.K., "Advanced Engineering Mathematics", Narosa Publications. 3. Thomas, B.G., and Finny R.L., "Calculus and Analytical Geometry", Pearson education Asia, Adison Wesley. 4. Simmons G.F., "Differential Equations with applications", Tata McGraw Hill.		

E8. Syllabus of Bio-Statistics (MTH215)

School: SBSR		**Batch: 2019- 2022**
Program: B. Sc.		**Current Academic Year: 2019**
Branch: Chemistry/Bio-chemistry		**Semester: Even**
1	Course Code.	MTH215
2	Course Title	BIO-STATISTICS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course status	Elective
5	Course Objectives	To make students familiar with the concept of Probability and Statistics with emphasis on some standard probability distributions and sampling distributions.
6	Course Outcomes	CO1:Describe the concept of Statistics and statistical inference and calculate find the measures of central tendency and dispersion of a data. (K1,K2,K3) CO2: Explain the concept of probability and evaluate the probability of various events in a random experiment, theorem on probability, conditional probability. (K2,K4,K5) CO3: Discuss the concept of normal distributions for evaluate relevant probabilities. (K1,K2,K5) CO4: Discuss about confidence interval and evaluate population parameters from the statistics of samples.(K1,K2,K5) CO5: Explain and evaluate statistical hypothesis using large and small samples. (K2,K4,K5) CO6: Describe and evaluate coefficient of correlation, rank correlation and regression lines relating two variables. (K1,K2,K5)
7	Course Description	In this introductory statistics course we will explore the use of statistical methodology in designing, analyzing, interpreting, and presenting biological experiments and observations. We will cover descriptive statistics, probability, and hypothesis testing and statistical inference, correlation and regression techniques.
8	Outline syllabus:	
UNIT 1	**Introduction and descriptive statistics.**	
A	Some basic concepts – sampling and statistical inference	
B	Frequency distribution. Measures of central tendency – mean, median, mode, mean of the combined data.	
C	Dispersion – mean deviation, variance, standard deviation, quartiles.	
UNIT 2	**Probability.**	
A	Objective and subjective views on probability. Random experiment, sample space, events, mutually exclusive events, independent events, axioms of probability, conditional probability.	

B	Calculation of probabilities using addition theorem and conditional probability theorems.			
C	Normal distribution: use of tables to calculate probabilities and also the mean and SD of normal distribution with given probabilities.			
UNIT 3	**Estimation.**			
A	Confidence interval of a population mean.			
B	Use of the t distribution in the estimation of population mean in the small sample cases.			
C	Estimation of proportions.			
UNIT 4	**Testing of hypothesis.**			
A	Testing of hypothesis: single population mean and difference of two population means.			
B	Testing of hypothesis: single population proportion.			
C	Chi – square test – goodness of fit.			
UNIT 5	**Correlation and regression.**			
A	Carl Pearson's Coefficient of correlation.			
B	Rank correlation.			
C	Regression lines.			
	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
		30%	20%	50%
	Text books	1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics".		
	Other references	1. Daniel,WayneW.,"Biostatistics": Basic concept and Methodology for Health Science. 2. Grewal,B.S, "Higher Engineering Mathematics".		

E9. Syllabus of Environmental Science (EVS106)

School: SBSR		**Batch : 2019-2022**
Program: B. Sc		**Current Academic Year: 2019**
Branch: Maths		**Semester: I**
1	Course Code	EVS-106
2	Course Title	Environmental Science
3	Credits	03
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	1. Enable students to learn the concepts, principles and importance of environmental science 2. Provide students an insight of various causes of natural resource depletion and its conservation 3. Provide detailed knowledge of causes, effects and control of different types of environmental pollution and its effect on climate change, global warming and ozone layer depletion. 4. Provide knowledge of different methods of water conservation 5. Provide and enrich the students about social issues such as R&R, population and sustainability.
6	Course Outcomes	CO1.Understand the principles and scope of environmental science and natural resource management and conservation CO2. Study about pollution causes, effects and control CO3. Effect of global warming and ozone layer depletion CO4. Study the methods of water conservation CO5. Understand sustainable development, resettlement and rehabilitation, impact of population explosion on environment CO6.Overall understanding of the various elements of environment and factors affecting environmental process and its related issues.
7	Course Description	Environmental Science emphasises on various factors as 1. Importance and scope of environmental science 2. Natural resource conservation 3. Pollution causes, effects and control methods 4. Social issues associated with environment
8	Outline syllabus	
	Unit 1	**General Introduction**
	A	Definition, principles and scope of environmental science
	B	Land resources, Forest Resources
	C	Water Resources ,Energy Resources
	Unit 2	**Environmental Pollution (Cause, effects and control measures)**
	A	Air pollution
	B	Water Pollution

	C	Soil and Noise pollution		
	Unit 3	**Climate Change and its impact**		
	A	Concept of Global Warming and greenhouse effect		
	B	Ozone layer Depletion and its consequences		
	C	Climate change and its effect on ecosystem, Kyoto protocol and IPCC concerns on changing climate		
	Unit 4	**Water Conservation**		
	A	Need of Water Conservation		
	B	Rain Water Harvesting		
	C	Watershed management		
	Unit 5	**Social Issues and the Environment**		
	A	Concept of sustainable development		
	B	Resettlement and rehabilitation of people; its problems and concerns, Case studies		
	C	Population explosion and its consequences		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	**1.** Joseph, Benny, "Environmental Studies", Tata Mcgraw-Hill.		
	Other References			

E10. Syllabus of Optics (PHB115)

School: SBSR		**Batch : 2019-22**
Program: B.Sc.		**Current Academic Year: 2019**
Branch: Physics		**Semester: II**
1	Course Code	PHB-115
2	Course Title	OPTICS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory
5	Course Objective	This course provides the knowledge of fundamental concepts of optics and understanding of wave and optics phenomena, with emphasis on everyday effect.
6	Course Outcomes	CO1: Apply the laws and concepts of geometrical optics to find cardinal points and solve a variety of numerical problems. CO2: Understand the concepts and phenomena of wave optics and analyze the intensity variation of light due to interference. CO3: Understand the concepts of diffraction and analyze the intensity variation of light due to single slit, double slits and N-slits diffraction. CO4: Understand mean of resolution and working of telescope and microscope. CO5: Understand optical phenomena in terms of electromagnetic wave properties including polarization of light and its applications. CO6: Apply conceptual understanding and mathematical methods to solve the problems.
7	Course Description	This course provides students with an understanding of optical phenomena based on the wave description of light. The geometrical optics and principles of polarization, interference and diffraction and optical devices that use these properties of light will be described.
8	Outline syllabus	
	Unit 1	**Geometrical Optics**
	A	Cardinal Points of an Optical System (six points), Newton's formula
	B	Nodal slide, Coaxial Lens System(equivalent focal length and cardinal points)
	C	Huygens Eyepiece, Ramsden Eyepiece and their cardinal points
	Unit 2	**Interference**
	A	Introduction, Coherent sources, Concept of spatial and temporal coherence, Interference of light

	B	Division of wave front: Young's Double slit experiment and Fresnel's bi-prism		
	C	Division of amplitude: Interference in thin films, wedge shaped films, Newton's rings.		
	Unit 3	**Diffraction**		
	A	Introduction, Fresnel and Fraunhoffer diffraction,		
	B	Fraunhoffer diffraction due to single slit, double slit		
	C	n slits diffraction, Plane diffraction grating		
	Unit 4	**Resolving power**		
	A	Resolving power, Rayleigh criteria		
	B	Resolving power of diffraction grating		
	C	Resolving power of microscope, telescope		
	Unit 5	**Polarization**		
	A	Phenomenon of polarization, Production of polarized light by reflection, refraction, Brewster's law, Malus law,		
	B	Nicol prism, Polarization by double refraction Retardation plates (Quarter and half wave plates), production and analysis of circularly and elliptically polarized light		
	C	Optical activity and Fresnel's theory of optical rotation, specific rotation, polarimeter		
	Mode of examination	Class test (10), assignments (10) and presentation (10)		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Optics by Brijlal and Subrahmanyam 2. Optics by Vasudeva		
	Other References	1. Optics by A. K.Ghatak 2. Principles of Optics, B.K. Mathur, New Global Printing Press, Kanpur 3. Fundamentals of Optics - F.A. Jenkins and H.E. White ((McGraw Hill) 4. Principles of Optics, M. Born and E. Wolf, Sixth Edition, Pergamon Press, Oxford		

E11. Cell Biology (BBC104)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch: Biochemistry		**Semester: Term II**
1	Course Code	BBC104
2	Course Title	Cell Biology
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	**1.** To introduce the students about the basic understanding of unit of life. 2. To discuss about concepts of prokaryotic and eukaryotic cell and its organization. 3. To make the student understand about nucleus and various nuclear components and their chemical and structural organization 4. To make the students aware of the plasma membrane and importance of it being semipermeable and the transport mechanism involved across the membrane. 5. To study the cell division and the process of cell to cell interactions
6	Course Outcomes	CO1: Understand the minute facts about cell and the overall structural and organization. CO2: Correlate the role of various cell organelles and nuclear components involved. CO3: Understand the role of various cell organelles CO4: Explain the transport of biomolecules across the membrane in detail and thereby help them to carry over the facts in doing research CO5: Understand the cell division and various cell to cell interactions involving tight and gap junctions CO6: Understand the importance, organization and basic functions of cell and apply the concepts to enhance research understanding and presentation skills
7	Course Description	This course describe the importance and better understanding of unit of life-Cell and its organization
8	Outline syllabus	
	Unit 1	**Cell**
	A	Cell as a basic unit of living systems- cell theory,
	B	structure, function, and biosynthesis of cellular organelles

	C	Differences between prokaryotic and eukaryotic cells and animal and plant cells		
	Unit 2	**Cell organelle**		
	A	Ribosomes, Golgi apparatus,		
	B	endoplasmic reticulum, lysosomes, mitochondria,		
	C	chloroplasts, peroxisomes		
	Unit 3	**Nucleus and nuclear components**		
	A	Ultra structure of nucleus and its components,		
	B	structural organisation, centromeres, telomeres, euchromatin and heterochromatin,		
	C	polytene and lampbrush chromosomes		
	Unit 4	**Plasma Membrane**		
	A	Structure and function of plasma membrane		
	B	Transport across membranes		
	C	Active and passive transport, ion channel		
	Unit 5	**Cell cycle and Cell-to Cell Interaction**		
	A	Cell division- Mitosis and meiosis		
	B	cytoskeleton, cell movements and		
	C	Cell-cell interactions, tight & gap junctions		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Cooper G.M., and Hausman R.E., The Cell: A Molecular Approach, 5th Edition. Sinauer Associates (2009). 2. Karp G., Cell and Molecular Biology: Concepts and Experiments, 6th Edition. Wiley (2009).		
	Other Ref	-		

E12. Molecular Biology-I :Gene Organization, Replication and Repair(BBC202)

School: SBSR		**Batch : 2019-2022**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch: Biochemistry		**Semester: Term III**
1	Course Code	BBC202
2	Course Title	**Molecular Biology- I: Gene Organization, Replication and Repair**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understand that a DNA helix can have the A, B, or Z conformation. Understand that DNA replication mechanism in Prokaryotes and Eukaryotes. 2. Explain why DNA polymerase requires a template and a primer and summarize the functions of the following proteins in *E. coli* DNA replication: DNA polymerase I, DNA polymerase III, DnaA, helicase, SSB, primase, the sliding clamp, clamp loader, DNA ligase, Tus, and topoisomerase. 3. Understand that DNA is susceptible to damage from a variety of sources and mutagenicity, which is related to carcinogenicity, can be tested.
6	Course Outcomes	Having successfully completed this module students will be able to; **CO1:** understand the basic chemical structure of DNA, how ds-DNA converts into ss-DNA, vice versa and what factors affect these function. CO2: differentiate organization of genes among viruses, bacteria, animals and plants, understand how histones protein are associated with DNA and its packing. CO3: know DNA polymerase requires a template and primers to synthesize DNA and that double-stranded DNA is replicated semi-

		discontinuously by experiment proof. CO4: explain how DNA topology and chromatin structure affects the processes of DNA replication, repair, and transcription. CO5: discuss mechanisms by which DNA can be damaged and describe the molecular mechanisms by which protein complexes repair or bypass different forms of DNA damage. CO6: 6. interpretate how DNA is organized in different species, function of different proteins/enzymes responsible for DNA replication and factors associated with DNA repair
7	Course Description	This course covers the Gene Organization, DNA Replication and Repair
8	Outline syllabus	
	Unit 1	**Structure of DNA**
	A	DNA structure, features of the double helix
	B	Various forms of DNA
	C	Denaturation and reassociation of DNA.
	Unit 2	**Genes and genomic organization**
	A	Genome sequence and chromosome diversity
	B	Definition of a gene, organization of genes in viruses, bacteria, animals and plants
	C	Nucleosome structure and packaging of DNA into higher order structures.
	Unit 3	**Replication of DNA**
	A	DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication.
	B	Stages of replication of *E. coli* chromosome, replication in eukaryotes. Comparison of replication in prokaryotes and eukaryotes.
	C	Inhibitors of DNA replication and applications in medicine, topoisomerase inhibitors and their application in medicine.
	Unit 4	**Recombination of DNA and Molecular basis of mutations**
	A	Homologous recombination, proteins and enzymes in recombination, site-specific recombination, serine and tyrosine recombinases
	B	Biological roles of site-specific recombination. Importance of mutations in

		evolution of species.		
	C	Types of mutations - transition, transversions, frame shift mutations, mutations induced by chemicals, radiation, transposable elements, Ames test		
	Unit 5	**Various modes of DNA repair**		
	A	Replication errors and mismatch repair system, repair of DNA damage		
	B	direct repair, base excision repair, nucleotide excision repair,		
	C	recombination repair, translesion DNA synthesis		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Principle of Biochemistry by Nelson and Cox, fourth edition. 2. Fundamentals of Biochemistry by Voet and Voet, Third edition. 3. Biochemistry ByLubertStryer, Fifth Edition. 4. Principles of Genetics (2010) 5th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons Asia.		
	Other References	1. Harper's Biochemistry		

E13. Introduction to Microbiology (BBC203)

School: SBSR		**Batch : 2019-2020**
Program: B.Sc. (Honours)		**Current Academic Year: 2019**
Branch:Biochemistry		**Semester: Term III**
1	Course Code	BBC203
2	Course Title	INTRODUCTION TO MICROBIOLOGY
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Discipline Specific Elective
5	Course Objective	1. To introduce students to basic concepts in microbiology. 2. To elaborate the mode of reproduction, growth curve and the mechanism of gene transfer in bacteria 3. To understand the harmful bacteria and the role of beneficial bacteria in human welfare. 4. To study the application of various microbes in medical, beverage, agriculture, food and dairy industry
6	Course Outcomes	CO1: Understand the history, basic concepts of microbial biochemistry with reference to bacteria and its classification. CO2: Introduce the concept of germination, sporulation, growth, growth curve and various factors affecting it. CO3: Understand the types of bacterial , as DNA reproduction, transposable elements and significance of plasmids as vector, in gene therapy etc and exploit the knowledge in research avenues. CO4: Understand the industrial applications of microorganism in human welfare , This will increase their exposure and help them to go for interdisciplinary research. CO5: This will give an idea to exploit microorganism and improve their industrial prospects of food, beverages, agriculture and dairy research CO6: Understand the history, ultra structure of microbes with special reference to bacteria nd its role in human welfare, reproduction and its applications in food industry, medical, beverage, agriculture and dairy industry and research.
7	Course Description	This course covers the basic introduction to microbes and its role in human welfare. Also various applications of microorganisms in food industry, medical, beverage, agriculture and dairy industry
8	Outline syllabus	
	Unit 1	**Introduction to Microbes**
	A	History of microbiology, five kingdom classification, Prokaryotic & Eukaryotic cell

	B	Ultra structure of bacteria,Nutritional Classification of bacteria, Gram positive and Gram negative bacteria		
	C	Cyanobacteria; Archaea; Mycoplasma, PPLO		
	Unit 2	**Baterial Sporulation and Growth**		
	A	Sporulation in Bacteria, endospore and its types, Spore germination, generation time		
	B	Diauxi, continous, synchronus and asynchronus growth of bacteria		
	C	Growth curve; Growth inhibitory substances (Temperature, acidity, alkalinity temperature, etc), measurement of bacterial growth (Direct and indirect method)		
	Unit 3	**Bacterial Reproduction**		
	A	Modes of reproduction, ,Mechanisms of gene transfer in bacteria		
	B	Transposable genetic elements, Types of transposition (cut-and-paste, replicative and retrotransposons)		
	C	Plasmids: Types, function and applications		
	Unit 4	**Bacteria and Human Welfare**		
	A	Beneficial and harmful bacteria; Soil microflora-like bacteria, fungi actinomycetes, algae, protozoa and viruses		
	B	Role of microbes in weathering of minerals and soils formation, components of soil		
	C	Biofertilizers BGA, Rhizobia, Biopesticides, Mycorriza.		
	Unit 5	**Applied Microbiology**		
	A	Important microorganisms in Food industry; preservation		
	B	Microbial production of food (Indian food, fermented meat, preparation of bread, fermented protein, single cell protein)		
	C	Applications in medical, beverage, agricultural and dairy industry		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	CO203.1
		30%	20%	CO203.2
	Text book/s*	1. Tortora G.J., Funke B.R., and Case C.L., Microbiology: An Introduction, 11th Edition. Benjamin Cummings (2012). 2. Willey J., Sherwood L., and Woolverton C., Prescott's Microbiology, 8th Edition. McGraw Hill (2010).		
	Other References	1. Microbiology (5th Edition) by Michael pelczar		

E14. Syllabus of Calculus- II (MSM 204)

School: SBSR		**Batch : 2019- 2022**
Program: B. Sc. (H)		**Current Academic Year: 2019**
Branch: Mathematics		**Semester: III**
1	Course Code	MSM 204
2	**Course Title**	**Calculus- II**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	To make students familiar with the advancement of calculus. The concept of Laplace transform, Fourier series, Vector differentiation & Vector Integration along with the brief of Z-transform has been introduced.
6	Course Outcomes	CO1: Explain and illustrate the concepts of vector differentiability of function along with its applications. (K2, K3, K4) CO2: Describe the properties of divergence and curl; evaluate irrotational and solenoidal vector fields. (K1, K2, K3, K5) CO3: Describe line integral, surface integral, and volume integral, explain its application and Gauss divergence theorem, Stoke's theorem and Green's theorem. (K2, K3, K4) CO4: Describe Laplace Transform of some standard functions & Inverse Laplace transform & explain its application and solve linear differential equations. (K2, K3, K4) CO5: Describe the Fourier Series and evaluate the expansion of functions in terms of Fourier series. (K2, K3, K6) CO6: Describe and analyze the basic concepts of Z-transform and it's application. (K1,K2, K4)
7	Course Description	This course is an initiate the advancement of calculus. The primary objective of the course is to develop the basic understanding of the concept of Laplace transform, Fourier series, Vector differentiation & Vector Integration along with the brief introduction of Z-transform.

8	Outline syllabus : **Calculus-II**	
	Unit 1	**Vector Differentiation:**
	A	Vector and scalar fields, gradient, level surfaces, normal to a surface,
	B	directional derivative, angle between two surfaces, definitions of divergence and curl,
	C	Properties of divergence and curl, irrotational and solenoidal vector fields.
	Unit 2	**Vector Integration:**
	A	Line integral, surface integral,
	B	Volume integral, applications of Gauss divergence theorem (Without proof),
	C	Stoke's theorem (Without proof) and Green's theorem (Without proof).
	Unit 3	**LAPLACE TRANSFORMATION**
	A	Laplace transform of some standard functions, theorems and properties on Laplace transforms
	B	Inverse Laplace transformation
	C	Convolution theorem and application to solve simple linear differential equations
	Unit 4	**FOURIER SERIES**
	A	Periodic function, Fourier series of period 2pi
	B	Change of interval
	C	Even and odd functions, Half range sine and cosine series
	Unit 5	**Z Transform:**
	A	Definition of Z transform, examples of Z transform,
	B	properties of Z transform, Inverse Z transform, Convolution theorem,
	C	Application to solve simple difference equations.

	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Kreysig, E., ”Advanced Engineering mathematics”, John Willey & Sons		
	Other References	2. Jain, M.K. and Iyenger, S.R.K., “Advanced Engineering mathematics”, Narosa Publications. 3. Thomas, B.G., and Finny R.L., “Calculus and Analytical geometry”, Pearson Education Asia, Adison Wisley.		

E15. Syllabus of Solid State Physics (PHB 218)

School: SBSR		**Batch : 2019-22**
Program: B.Sc.		**Current Academic Year: 2019**
Branch: Physics		**Semester: III**
1	Course Code	PHB-218
2	Course Title	Solid State Physics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory
5	Course Objective	This course provides an opportunity to develop knowledge and understanding of the key principles and applications of physics of solids including theoretical description of crystal and electronic structure, lattice dynamics and optical properties of different materials (metals, semiconductors, dielectrics, magnetic materials and superconductors)
6	Course Outcomes	CO1: Demonstrate knowledge for crystal structures of solids, different physical mechanisms involved in crystal binding and lattice dynamics. CO2: Understand the theory of X-ray diffraction, use the lattice structure of crystalline materials both in real space and in reciprocal space (k-space) and be able to transform between these two spaces. CO3: Knowledge of fundamental principles of conductor, semiconductors, and insulators on the basics of band theory and be able to estimate the charge carrier mobility and density. CO4: Explain atomistic mechanism of thermal properties of solids. CO5: Explain the physical principles for different types of electric and magnetic phenomena in solid materials (like e.g. dielectricity, superconductivity, paramagnetism, diamagnetism, ferromagnetism etc). CO6: Apply physics principles and mathematical methods in solid state physics to explain crystal structure and various physical, electrical, thermal and magnetic properties of materials.
7	Course Description	This course provides the basic understanding of crystal structure, symmetry, electrical, thermal, dielectric and magnetic properties of materials and their technological applications.
8	Outline syllabus	
	Unit 1	**Crystal Structure and Bonding**
	A	Bonding in solids- ionic, covalent, metallic, Van der Waals and hydrogen bonding.
	B	Crystalline and amorphous solids, Crystal Lattice, Unit Cell, Miller Indices and Miller Planes, Bravais lattice

	C	Simple crystal structure (SC, BCC, FCC), Atomic packing fractions for Simple cubic(SC), BCC and FCC		
	Unit 2	**Reciprocal lattice**		
	A	X-rays Diffraction, Bragg law, Laue method, Rotating–crystal method		
	B	Scattering from lattice, Diffraction conditions		
	C	Reciprocal lattice, Ewald construction.		
	Unit 3	**Electrical properties of solids**		
	A	Electrical conductivity, classification of solids; conductors, semiconductors and insulators		
	B	intrinsic and extrinsic semiconductors, electrons and holes		
	C	Hall Effect		
	Unit 4	**Thermal properties of Solids**		
	A	Lattice vibration and phonons, vibrational modes of a 1-D lattice		
	B	Lattice heat capacity, Classical theory of specific heat		
	C	Thermal Conductivity, Thermoelectricity: Seebeck Effect and Peltier Effect.		
	Unit 5	**Dielectric and magnetic properties**		
	A	Dielectrics, dielectric polarization, polar and nonpolar dielectrics, relation between electric field and polarization.		
	B	Classification of magnetic materials: diamagnetism, paramagnetism, ferromagnetism, Magnetic Susceptibility, Curie law, Hysteresis Curve		
	C	Superconductivity, Type-I and type-II superconductors. Meissner effect.		
	Mode of examination	Class test (10) ,Assignments (10) and presentation (10)		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Solid State Physics: S.O. Pillai 2. Introduction to material science: Raghvan		
	Other References	3. Introduction to solid state physics: C. Kittel 4. Solid State Physics: A. J. Dekker		

2.2 Syllabus of Chemistry Lab-I (BCH 151)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 1**	
1	Course number	**BCH-151**	
2	Course Title	**Chemistry Lab-I**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	To learn methods for quantitative estimation of different chemical species by various volumetric methods and to understand calorimetric formula, heat capacity of calorimeter, water equivalent of calorimeter and enthalpy.	
6	Course Outcomes	1. Able to prepare primary standard and secondary standard solutions. 2. Understand the importance of pH and pH meter. 3. Explain the cause of change in thermal energy of a system during any physical or chemical change. 4. Correlate the change in thermal energy with the heat lost or gained by the system. 5. Distinguish between heat capacity and water equivalent of calorimeter. 6. Able to understand the colligative properties. 7. Able to understand the concept Kinematic viscosity.	
7	Outline syllabus:		
7.01	BCH151.01	Task 1	To prepare a standard solution of sodium carbonate (Na_2CO_3) and use it to standardise a given solution of HCl.
7.02	BCH151.02	Task 2	To determine the strength of given HCl solution by titrating it against 0.1 N Na_2CO_3 solution pH metrically.
7.03	BCH 151.03	Task 3	To determine the heat capacity of the calorimeter.
7.04	BCH 151.04	Task 4	To determine the enthalpy of neutralization of NaOH and HCl.
7.05	BCH 151.05	Task 5	To determine the enthalpy of hydration of anhydrous copper sulphate.
7.06	BCH 151.06	Task 6	Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
7.07	BCH 151.07	Task 7	Study the variation of viscosity of sucrose solution with the concentration of solute using Ostwald viscometer.

7.08	BCH 151.08	Task 8	To demonstrate the colligative property of elevation in boiling point.
7.09	BCH 151.09	Task 9	To demonstrate the colligative property of depression in freezing point.
7.10	BCH 151.10	Task 10	To demonstrate the phenomenon of osmosis using semi permeable membrane.
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quizzes	None	
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks	
8.15	Presentations	None	
8.16	Any other	None	
8.2	MTE	None	
8.3	End-term examination: None		
9	**References**		
9.1	Text book	O.P. Pandey, D.N. Bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	1. Eastman. E.D. and Rollefson, G.K. *Physical Chemistry* 1947 ed. McGraw-Hill p307. 2. Pauling, Linus: *General Chemistry* 1970 ed. Dover Publications pp459-460. 3. Moore, Walter J. *Physical Chemistry* 1962 ed. Prentice Hall p132.	

2.2 Syllabus of Chemistry Lab-II (BCH 152)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 1**	
1	Course number	**BCH-152**	
2	Course Title	**Chemistry Lab-II**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	• To learn methods for, purification and qualitative analysis of organic compounds • To execute independently purification techniques to organic compounds like filtration, recrystallization, sublimation and distillation. • To perform the qualitative test on unknown organic compounds i.e preliminary tests, tests for extra elements. • To understand the basic concept of quantitative analysis for organic compounds • To understand the concept of organic acid and perform the acid base titration to calculate their solubility in solvents at room temperature.	
6	Course Outcomes	Students are able to • Understand the methods of separation and purification • Understand the Qualitative analysis of organic compounds • Prepare solutions of different strength and standardize them • Execute the volumetric analysis experiments for organic compounds	
7	Outline syllabus:		
7.01	**BCH-152**.01	Task 1	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization using: Water solvent (Phthalic acid, Benzoic acid), Determination of the melting points of above compounds and report the yields of pure compounds.
7.02	**BCH-152**.02	Task 2	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization using Alcohol (naphthalene), Determination of the melting points of above compounds and report the yields of pure compounds.
7.03	**BCH-152**.03	Task 3	To check the solubility of organic compounds and

			Filtration/Purification of organic compounds by recrystallization Alcohol-Water (Aspirin from tablet), Determination of the melting points of above compounds and report the yields of pure compounds.
7.04	**BCH-152**.04	Task 4	To perform the purification of crude naphthalene by sublimation method and calculate the percentage yield and M.P..
7.05	**BCH-152**.05	Task 5	Purification of organic compounds(Water + acetone) by simple distillation.
7.06	**BCH-152**.06	Task 6	Elimination reaction of 2-pentanol
7.07	**BCH-152**.07	Task 7	Cycloaddition reaction of Cyclopentadiene and maleic anhydride
7.08	**BCH-152**.08	Task 8	To To Analyze the presence of extra elements (N, S, halogens) other than C, H, &O in the given organic compound.
7.09	**BCH-152**.09	Task 9	To To Analyze the presence of extra elements (N, S, halogens) other than C, H, &O in the given organic compound.
7.10	**BCH-152**.10	Task 10	To determine the solubility of given organic acid(oxalic acid
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quizzes	None	
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks	
8.15	Presentations	None	
8.16	Any other	None	
8.2	MTE	None	
8.3	End-term examination: None		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

2.2 Syllabus of Chemistry Lab-III (BCH 251)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 3**	
	Course number	**BCH-251**	
2	Course Title	**Chemistry Lab-III**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	1. To learn the methods for calibration of laboratory glass wares used in experiments. 2. To understand the method of solutions of different normality and Molarity. 3. To understand the process of standardization of a given solution. 4. To understand the concept of redox titration and the reactions involved 5. To perform the qualitative analysis of inorganic compounds. 6. To identify cations and anions in a given mixture. 7. To execute independently the determination of flash point of a given oil. 8. To determine the calorific value of any given material by bomb calorimeter.	
6	Course Outcomes	Students will be able to 1. Calibrate the burette and pipette used to get the results with zero error. 2. Prepare the solutions of any given normality and strength. 3. Understand the estimation of mixture of salts. 4. Standardise NaOH with oxalic acid. 5. Understand the reactions involved in redox titrations. 6. Measure the calorific value of any given fuel. 7. Understand the process of determination of flash point and fire point.	
7	**Outline syllabus:**		
7.01	BCH **251**.01	Task 1	To calibrate the lab apparatus and preparation of solutions of different Molarity/Normality of titrants.

7.02	BCH **251**.02	Task 2	To standardization of NaOH with standard Oxalic acid
7.03	BCH **251**.03	Task 3	To estimate the carbonate and hydroxide present together in mixture.
7.04	BCH **251**.04	Task 4	To estimate of Fe(II) and oxalic acid using standardized KMnO4 solution.
7.05	**BCH-251**.05	Task 5-8	**Semi-micro qualitative analysis using H2S of mixtures** - not more than two ionic species (one anion and one cation and excluding insoluble salts) out of the following: Cations : NH4+, Pb2+, Ag+, Bi3+, Cu2+, Cd2+, Sn2+, Fe3+, Al3+, Co2+, Cr3+, Ni2+, Mn2+, Zn2+,Ba2+, Sr2+, Ca2+, K+ Anions : CO32– , S2–, SO2–, S2O32–, NO3–, CH3COO–, Cl–, Br–, I–, NO3–,SO42-, PO43-, BO33-,C2O42-, F- (Spot tests should be carried out wherever feasible**)**
7.06	BCH **251**.05	Task 9	To detect flash point and fire point of a lubricant.
7.07	BCH **251**.07	Task 10	To determine the calorific value of a fuel using Bomb Calorimeter.
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.2	Attendance	None	
8.3	Homework	Yes	
8.4	Quizzes	Yes	
8.5	Labs	Evaluation of work done on each lab turn in the lab, notebook and feedback from oral quiz about the work done that day, punctuality, interaction. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 60 marks	
8.6	Presentations	None	
8.7	Any other	None	
8.8	MTE	None	
8.9	End-term examination: Yes, 40 marks		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

2.2 Syllabus of Chemistry Lab-IV (BCH 252)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 4**	
1	Course number	**BCH-252**	
2	Course Title	**Chemistry Lab-IV**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	**The main objective of this course is :** 1. To learn about various types of titrations like neutralization titration, precipitation titration etc. 2. To execute redox titration including iodometric titration. 3. To understand the utility of internal and external indicators 4. To perform the qualitative functional test on unknown organic compounds. 5. To learn the synthesis, characterization and purification organic compounds 6. To prepare and execute reactions of Grignard's reagent.	
6	Course Outcomes	**Students will be able to** 1. Perform various types of titration 2. Standardise Sodium Thiosulphate solution iodometrically. 3. Understand the difference of internal and external indicators 4. To perform the qualitative functional test on unknown organic compounds. 5. Synthesize, Characterize and purify organic compounds 6. To prepare and execute reactions of Grignard's reagent.	
7	Outline syllabus:		
7.01	**BCH-252**.01	Task 1	**Redox titration :** Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.
7.02	**BCH-252**.02	Task 2	**Iodometric Titration :**Estimation of Cu(II) concentration of a given solution using sodium thiosulphate solution.
7.02	**BCH-252**.03	Task 3	**Neutralization Titration** :Estimation of oxalic acid and sodium oxalate in a given mixture.
7.03	**BCH-252**.04	Task 4	**Redox Titration** :Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.
7.04	**BCH-252**.05	Task 5	**Neutralization Titration: Estimation** of amount of bicarbonate and carbonate in the given sample of water.
7.05	**BCH-252**.06	Task 7	**Precipitation titration:** Determination of chloride content by

			precipitation titration.
7.06	**BCH-252**.07	Task 8	To check the presence of functional group/s in the given organic compounds.
7.07	**BCH-252**.08	Task 9	To check and identify the primary, secondary, tertiary alcohol and phenol out of the 4 given unknown compounds.
7.08	**BCH-252**.09	Task 10	To check the percentage yield and melting point of the synthesized phenyl benzoate from phenol.
7.09	**BCH-252**.10	Task 11	To check the percentage yield and melting point of the synthesized *m*-dinitrobenzene from nitrobenzene.
7.10	**BCH-252**.11	Task 12	To prepare the Grignard's reagent from benzyl bromide and use it to prepare tertiary alcohol (triphenyl methanol).
	BCH-252.12	Task 11	Purification of organic compounds (Water + acetone) by simple distillation.
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.2	Attendance	None	
8.3	Homework	Yes	
8.4	Quizzes	Yes	
8.5	Labs	Evaluation of work done on each lab turn in the lab, notebook and feedback from oral quiz about the work done that day, punctuality, interaction. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 60 marks	
8.6	Presentations	None	
8.7	Any other	None	
8.8	MTE	None	
8.9	End-term examination: Yes, 40 marks		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

2.2 Syllabus of Chemistry Lab-V (BCH 253)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 4**	
1	Course number	**BCH 253**	
2	Course Title	**Chemistry Lab-V**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	• To study the experimental properties of buffer solutions using pH Meter • To construct the phase diagrams of varied systems and investigate the solubility limits and critical solution temperature. • To study the electronic structre properties of inorganic computer and validating the Lambert Beer's law. • To study the kinetics process with reference to absorbance standards.	
6	Course Outcomes	After the completion of course, students will be able 1. To prepare the varied buffer solutions and compare the effect of acid/base addition. 2. To determine the dissociation strength of weak acids. 3. To draw the phase diagram for binary system and realize the concept of eutectic point. 4. To study the electronic structure of organic and inorganic compounds using UV-vis studies. 5. Study the kinetic process using electronic structure variation.	
7	Outline syllabus:		
7.01	**BCH253**.01	Task 1	Preparation of buffer solutions: (1) Sodium acetate-acetic acid, Measurement of the pH of buffer solutions and comparison of the values with theoretical values. Study the effect on pH of addition of HCl/NaOH to buffer solutions.
7.02	**BCH253**.02	Task 2	Preparation of buffer solutions: Ammonium chloride-ammonium hydroxide, Measurement of the pH of buffer solutions and comparison of the values with theoretical Values. Study the effect on pH of addition of HCl/NaOH to buffer solutions.
7.03	BCH253.03	Task-3	Determination of dissociation constant of a weak acid via pH meter.
7.04	BCH253.04	Task 4	Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
7.05	BCH253.05	Task 5	Determination of the critical solution temperature and composition of the phenol-water system and study of the effect of impurities on it.

7.06	BCH253.06	Task 6	Verify Lambert-Beer's law and determine the concentration of CuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration
7.07	BCH253.07	Task 7	Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.
7.08	BCH253.08	Task 8	Determine the dissociation constant of an indicator (phenolphthalein).
7.09	BCH253.09	Task 9	Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
7.10	BCH253.10	Task 10	Interpret the structure of organic compounds by analysing their IR/UV-vis/NMR spectra
8	Course Evaluation		
8.1	Course work: 100% marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quizzes	None	
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks	
8.15	Presentations	None	
8.16	Any other	None	
8.2	MTE	None	
8.3	End-term examination: None		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

2.2 Syllabus of Chemistry Lab-VI (BCH 351)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 5**	
1	Course number	**BCH-351**	
2	Course Title	**Chemistry Lab-VI**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	**The main objective of this course is :** 1. To learn qualitative analysis of acidic and basic radicals 2. To illustrate the estimation of metal ion gravimetrically. 3. To illustrate the estimation of metal ion complexometrically. 4. To teach the synthesis of common inorganic compounds 5. To learn the qualitative analysis of organic compounds. 6. To distinguish different types of amines. 7. To learn organic synthesis.	
6	Course Outcomes	**Students will be able to** 1.Detect various acidic and basic radical present in a salt mixture 2.Estimate Ni(II) in a mixture gravimetrically 3.Estimate Zn(II) ion in a sample complexometrically 4.Synthesize common inorganic compounds 5. Understand the methods of separation and purification of organic compounds. 6. Distinguish aliphatic and aromatic amines. 7. Understand different types of organic synthesis.	
7	Outline syllabus:		
7.01	**BCH-351**.01	Task 1	Estimation of Nickel (II) using Dimethylglyoxime (DMG) gravimetrically.
7.02	**BCH-351**.02	Task 2	Estimation of Zn^{2+} by complexometric titrations using EDTA.
7.03	**BCH-351**.03	Task 3	Synthesis of common inorganic compounds
7.04	**BCH-351**.04	Task 4	Analysis of unknown salt mixture for acidic radical
7.05	**BCH-351**.05	Task 5	Analysis of unknown salt mixture for basic radical
7.06	**BCH-351**.06	Task 6	To analyze the presence of functional group/s in the

			given organic compounds.
7.07	**BCH-351**.07	Task 7	To identify primary, secondary, tertiary amines
7.08	**BCH-351**.08	Task 8	To perform the synthesis of 1-(phenylazo)-2-naphthol from aniline and β-naphthol.
7.09	**BCH-351**.09	Task 9	To perform the synthesis of dibenzalacetone (crossed aldol reaction) and report its yield and melting point.
7.10	**BCH-351**.10	Task 10	To perform the synthesis of benzilic acid from benzil and report its percentage yield and melting point.
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.2	Attendance	None	
8.3	Homework	Yes	
8.4	Quizzes	Yes	
8.5	Labs	Evaluation of work done on each lab turn in the lab, notebook and feedback from oral quiz about the work done that day, punctuality, interaction. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 60 marks	
8.6	Presentations	None	
8.7	Any other	None	
8.8	MTE	None	
8.9	End-term examination: Yes, 40 marks		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

2.2 Syllabus of Chemistry Lab-VII (BCH 352)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 5**	
1	Course number	**BCH-352**	
2	Course Title	**Chemistry Lab-VII**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	1. To learn methods for, purification and qualitative analysis of organic compounds 2. To execute independently purification techniques to organic compounds like filtration, recrystallization, sublimation and distillation. 3. To perform the qualitative test on unknown organic compounds i.e preliminary tests, tests for extra elements. 4. To understand the basic concept of quantitative analysis for organic compounds 5. To understand the concept of organic acid and perform the acid base titration to calculate their solubility in solvents at room temperature.	
6	Course Outcomes	Students are able to 1. Understand the methods of separation and purification 2. Understand the Qualitative analysis of organic compounds 3. Prepare solutions of different strength and standardize them 4. Execute the volumetric analysis experiments for organic compounds	
7	Outline syllabus:		
7.01	**BCH-352**.01	Task 1	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization using: Water solvent (Phthalic acid, Benzoic acid), Determination of the melting points of above compounds and report the yields of pure compounds.
7.02	**BCH-352**.02	Task 2	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization using Alcohol (naphthalene), Determination of the melting points of above compounds and report the yields of pure compounds.
7.03	**BCH-352**.03	Task 3	To check the solubility of organic compounds and

			Filtration/Purification of organic compounds by recrystallization Alcohol-Water (Aspirin from tablet), Determination of the melting points of above compounds and report the yields of pure compounds.
7.04	**BCH-352**.04	Task 4	To perform the purification of crude naphthalene by sublimation method and calculate the percentage yield and M.P..
7.05	**BCH-352**.05	Task 5	Purification of organic compounds(Water + acetone) by simple distillation.
7.06	**BCH-352**.06	Task 6	Elimination reaction of 2-pentanol
7.07	**BCH-352**.07	Task 7	Cycloaddition reaction of Cyclopentadiene and maleic anhydride
7.08	**BCH-352**.08	Task 8	To To Analyze the presence of extra elements (N, S, halogens) other than C, H, &O in the given organic compound.
7.09	**BCH-352**.09	Task 9	To To Analyze the presence of extra elements (N, S, halogens) other than C, H, &O in the given organic compound.
7.10	**BCH-352**.10	Task 10	To determine the solubility of given organic acid(oxalic acid
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quizzes	None	
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks	
8.15	Presentations	None	
8.16	Any other	None	
8.2	MTE	None	
8.3	End-term examination: None		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

2.2 Syllabus of Chemistry Lab-VIII (BCH 354)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 6**	
	Batch	**2019-2022**	
1	Course number	**BCH354**	
2	Course Title	**Chemistry Lab-VIII**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-3	
5	Course Objective	1. To introduce & demonstrate the students with inorganic complex preparations 2. To demonstrate the chemical analysis of inorganic compounds 3. To introduce the method of qualitative analysis of Inorganic cations/anions. 4. To analyze the components of molecules like oil, fat, vitamins etc. 5. Synthesis of drug molecules 6. To inculcate the knowledge of advanced organic and inorganic chemistry	
6	Course Outcomes	Students will be able to 1. Introduce & demonstrate the students with inorganic complex preparations 2. Demonstrate the chemical analysis of inorganic compounds 3. Introduce the method of qualitative analysis of Inorganic cations/anions. 4. Analyze the components of molecules like oil, fat, vitamins etc. 5. Synthesize a drug molecules 6. have the knowledge of advanced organic and inorganic chemistry	
7	Outline syllabus:		
7.01	**BCH-354**.01	Task 1	**Inorganic Preparations:** (1)Tetraamminecopper (II) sulphate, $[Cu(NH_3)4]SO4.H2O$
7.02	**BCH-354**.02	Task 2	(2)Preparation of the following complexes and measurement of their conductivity: Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl2 and LiCl3. a. tetraamminecarbonatocobalt (III) nitrate b. tetraamminecopper (II) sulphate
7.02	**BCH-354**.03	Task 3	Draw calibration curve (absorbance at λ max vs. concentration) for various concentrations of a given coloured compound (Complex of Fe3+ with NH_4SCN) and estimate the concentration of the same in a given unknown solution.
7.03	**BCH-354**.04	Task 4	**Advanced Inorganic chemistry practicals** Synthesis of pigment chrome red.
7.04	**BCH-354**.05	Task 5	Inorganic acidic and basic radicals with interfering ions(2+2).
7.05	**BCH-354**.06	Task 6	Preparation of silver nanoparticles/ synthesis of phosphate fertilizer(option for both electives)

7.06	**BCH-354**.07	Task 7	To determine the iodine value of an oil/fat
7.07	**BCH-354**.08	Task 8	Differentiate between a reducing/ nonreducing sugar (Molish, Pollin, Benadict etc. tests), identify.
7.08	**BCH-354**.09	Task 9	To prepare soap by alkaline hydrolysis (saponification) of cooking oil and test some of the chemical properties and cleansing power of soap relative to detergent.
7.09	**BCH-354**.10	Task 10	Functional group test of all functional groups including amino acids, identify the organic compound and preparation of one derivative.
7.10	**BCH-354**.11	Task 11	Separation of a mixture of two amino acids by ascending and horizontal paper chromatography and Separation of a mixture of two sugars by ascending paper chromatography report the Rf value.
7.11	**BCH-354.12**	Task 12	12Synthesis of aspirin via salicylic acid and acetyl chloride, report the yield and M.P.
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.2	Attendance	None	
8.3	Homework	Yes	
8.4	Quizzes	Yes	
8.5	Labs	Evaluation of work done on each lab turn in the lab, notebook and feedback from oral quiz about the work done that day, punctuality, interaction. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 60 marks	
8.6	Presentations	None	
8.7	Any other	None	
8.8	MTE	None	
8.9	End-term examination: Yes, 40 marks		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

2.2 Syllabus of Chemistry Lab-IX (BCH 355)

School: SBSR		**Batch: 2019-2022**	
Program: BSc. (H)		**Current Academic Year: 2019**	
Branch: Chemistry		**Semester: 6**	
	Batch	**2019-2022**	
1	**Course number**	**BCH355**	
2	**Course Title**	**Chemistry Lab-VI**	
3	**Credits**	**1**	
4	**Contact Hours (L-T-P)**	**0-0-3**	
5	**Course Objective**	1. To introduce & demonstrate the students with chemical analysis of water. 2. To demonstrate the chemical analysis of Bleaching powder. 3. To introduce the method to determine the composition of lime stone. 4. To explain and demonstrate the methods of fertilizer analysis 5. To demonstrate the method to do kinetic study of dissolution. 6. To demonstrate the method to measure pKa and PI value of amino acid. **7.** To demonstrate the method to measure ascorbic acid in fruit juice.	
6	**Course Outcomes**	Students will be able to 1. The sampling and analysis of water 2. To measure the available chlorine in Bleaching powder 3. To check the composition of lime stone 4. To check the quality of fertilizers 5. To check kinetics of dissolution of Mg metal in dil. HCl 6. To identify and separate the amino acid **7.** To apply this knowledge in research, materials, fertilizer, food processing, beverage and textile industry.	
7	**Outline syllabus:**		
7.01	BCH-355.01	Task 1	To determine the amount of dissolved CO_2 in water using acid base titration method.
7.02	BCH-355.02	Task 2	To determine the dissolved O_2 in given sample by Winkler's method.
7.02	BCH-355.03	Task 3	To determine the percentage of available chlorine in bleaching powder.
7.03	BCH-355.04	Task 4	To determine the amount of chloride in given water sample using Mohr's method.
7.04	BCH-355.05	Task 5	To determine the Sulphate content in given water sample by gravimetric analysis.
7.05	BCH-355.06	Task 6	Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.

7.06	BCH-355.07	Task 7	Determination of composition of lime stone (by complexometric titration).
7.07	BCH-355.08	Task 8	Estimation of nitrate contents in the given fertilizer.
7.08	BCH-355.09	Task 9	To determine the kinetics of dissolution of Mg metal in dil. HCl.
7.09	BCH-355.10	Task 10	To determine the titration curve of glycine and to estimate the pKa values of the ionizable groups of amino acid and its PI using the obtained curve.
7.10	BCH-355.11	Task 11	To Determine the amount of ascorbic acid in the given tablet of vitamin C.
8	Course Evaluation		
8.1	Course work: 100% marks		
8.2	Attendance	None	
8.3	Homework	Yes	
8.4	Quizzes	Yes	
8.5	Labs	Evaluation of work done on each lab turn in the lab, notebook and feedback from oral quiz about the work done that day, punctuality, interaction. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 60 marks	
8.6	Presentations	None	
8.7	Any other	None	
8.8	MTE	None	
8.9	End-term examination: Yes, 40 marks		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

E1. Syllabus of Biological Science Lab-I (BBC151)

School: SBSR		**Batch: 2019- 2022**		
Pogram: B.Sc.(H)		**Current Academic Year: 2019**		
Branch: Biochemistry		**Semester: I**		
1	Course Code	BBC151		
2	Course Title	Biological Science Lab-I		
3	Credits	2		
4	Contact Hours (L-T-P)	0-0-2		
	Course Status	Compulsory		
5	Course Objective	1. The goal of this course is to introduce students to the fundamental knowledge of preparation of solutions, buffers. 2. Understand the principles of routine instruments in use. 3. The course will cover the qualitative estimations of biomolecules including carbohydrates, proteins, amino acids 4. Enhance the practical knowledge and result analysis skills		
6	Course Outcomes	After completing the course the students will be- CO1:Able to use lab instruments independently. CO2: Able to prepare stock solutions, buffers etc . CO3: Understand the basics of biomolecules and become familiar with qualitative estimations of carbohydrates. CO4: Able to understand the biochemistry of reactions. CO5: Able to analyse the results and understand the biochemical reactions involved. CO6: Enhance the practical skills		
7	Course Description	The course will give the fundamental knowledge and practical abilities in qualitative estimations of biomolecules.		
8	Outline syllabus			
	Unit 1	**Practical based on lab instruments**		
		Preparation of stock solution, buffer etc		
	Unit 2	**Practical related to** – carbohydrate estimations		
	Unit 3	**Practical related to**--- amino acid estimations.		
	Unit 4	**Practical related to**--- protein estimation		
	Unit 5	**Practical related to**---lipid estimation.		
	Mode of examination	Practical &Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book			

E2. Syllabus of Physics Lab 1 (PHB 151)

School: SBSR		**Batch: 2019-2022**
Program: B.Sc.		**Current Academic Year: 2019**
Branch: Physics		**Semester: I**
1	Course Code	PHB151
2	Course Title	Physics Lab 1
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	To provide students an understanding about fly wheel, compound pendulum. To provide students an understanding of gravity via simple pendulum and compound pendulum setups. To study bending of a beam via stress and strain. To understand the viscous nature of any liquid using Pouselli method.
6	Course Outcomes	CO1: Students will understand simple harmonic motion and its conditions of one dimension. CO2: Students will be able to understand the fly wheel structure and its different applications. CO3: Students will have a clear understanding about depression in a beam via loading it at its one end. CO4: Students will be able to handle travelling microscope, vernier calipers, screw gauge, stop watch also students will gain knowledge of manometer, capillary tube. CO5: Students will learn to measure the height of a building. CO6: Students will learn about modulus of rigidity of a material and moment of inertia also.
7	Course Description	This course deals with the basic concepts of mechanics. Students will be guided to use travelling microscope, vernier calipers, screw gauge, stop watch. This course deals with many different concepts of mechanics via simple experiments.
8	Outline syllabus	
	Unit 1	**Practical's related to gravity**
	a	To measure the acceleration due to gravity using a simple pendulum. And verify the relation. $T = 2\pi\sqrt{\frac{L}{g}}$

	b, c	(i) To determine the acceleration due to gravity (g) by means of a compound pendulum. (ii) To determine radius of gyration about an axis through the center of gravity for the compound pendulum.		
	Unit 2	**Practical related to moment of inertia**		
	a	To determine the moment of inertia of Flywheel about its axis of rotation.		
	b, c	To calculate Moment of inertia of different irregular shapes.		
	Unit 3	**Practical related to coefficient of viscosity of water**		
	a, b, c	To determine the coefficient of viscosity of water by Poiseuille's method.		
	Unit 4	**Practical related to measuring of height of a building**		
	a, b, c	To determine the height of a building by the help of a Sextant.		
	Unit 5	**Practical related to elasticity**		
	a	To determine Young's modulus of a material by the bending of abeam clamped at one end and loaded at one of its end by cantilever method.		
	b, c	To determine the modulus of rigidity of a material of a given wire with an inertia table (torsion pendulum) by dynamical method		
	Mode of examination	Jury+Practical+Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book/s*	1. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing		
	Other References	2. B.Sc. Practical Physics- C L Arora, S. Chand Publishing 3. Basic electronics and linear circuits – N N Bhargava, D C Kulshreshtha, S C Gupta, Tata McGraw-Hill publishing company Ltd.		

E3. Syllabus Biological Science Lab-2 (Practical)

School: SBSR		**Batch: 2019- 2022**
Pogram: B.Sc.(H)		**Current Academic Year: 2019**
Branch: Biochemistry		**Semester: II**
1	Course Code	BBC152
2	Course Title	Biological Science Lab-2
3	Credits	2
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	1. To understand the basic concepts and methods behind Lambert-Beer's Law. 2. To undergo some quantitative estimation of proteins using standard methods 3. To apply some basic principle behind the quality control experiments of lipids(oils and fats) 4. To understand the principle and methods behind the isolation technique of proteins from different sources 5. To quantify unknown carbohydrates form different food sample.
6	Course Outcomes	After the completion of this course students will be able to CO1.Know the importance of Beer Lamberts Law and how to use this graphical notation in different methods CO2 .Understand and analyse the role of standard calibration curve and to how to use it for the estimation of unknown protein concentration from different food samples CO3.Use the same quality control method in determining the acid value of Butter, mustard oil, coconut oil and olive oil CO4. Know the different isolation techniqueand how to apply it in simple research or projects. CO5.Analyze the result and estimate the concentration of Glucose and starch from different food samples CO6. Understand, analyse and corelate the different methods for the quantitative estimation of carbohydrate, proteins and fat and apply them thoroughly in small projects or in research
7	Course Description	The course will give the fundamental knowledge and practical abilities in qualitative estimations of biomolecules.
8	Outline syllabus	
	Unit 1	To demonstrate the working principle of spectrophotometer

		To determine the Lambda maximum of the given solution		
	Unit 2and 5	To prove and verify Beer's lambert's law using different concentrations of $KMnO_4$ and Potassium Dichromate		
		To determine the unknown protein using Folin - Lowry's method		
		To estimate the reducing sugar by nitro salicylic acid (DNS) method		
		To quantify total sugars using anthrone method		
		To determine unknown protein using biuret method.		
	Unit 3	To determine the acid value of mustard oil, coconut oil, olive oil and butter		
		To determine the saponification value of the given oil sample		
	Unit 4	To isolate the crude protein extract from germinating seeds and leaf		
	Mode of examination	Practical &Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book			

E4. Syllabus of Physics Lab 2 (PHB 152)

School: School of Basic Sciences and Research		**Batch: 2019-2022**
Program: B.Sc. (Hons)		**Current Academic Year: 2019**
Branch:Physics		**Semester: II**
1	Course Code	PHB152
2	Course Title	**Physics Lab 2 (Optics and Thermal Physics)**
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	1. To provide students an understanding of prism, Fresnel's biprism, and spectrometer. 2. To provide students an understanding of thermal conductivity. 3. To study the thermocouples and also to have knowledge of Stefan's law. 4. Students will learn about plane transmission grating and Newton's ring method.
6	Course Outcomes	After the completion of this course, CO1: Students will learn about the fundamentals of optics i.e. dispersion, diffraction, interference etc. CO2: Students will understand about bad conductor, good conductor and how to determine their thermal conductivity. CO3: Students will learn about thermocouples and their working. CO4: Students will learn about black body radiation through Stefan's law. They will also learn to determine the wavelength of light through plane diffraction grating and Newton's Ring method. . CO5: Students will gain knowledge of lenses and learn to determine the focal length of lenses. CO6: Students will be able to correlate theory and practical together through the experiments and get the clear understanding of the concepts behind them.
7	Course Description	This course will help students to have basic understanding of basics of Optics, Thermal conductivity and blackbody Radiation. It also helps them to understand the working of spectrometer, Newton's ring, plane diffraction grating and Nodal slides.
8	Outline syllabus	
	Unit 1	
	A B C	1. To determine the dispersive power of a material of the prism and its angle using spectrometer. Also calculate speed of light in the given prism. 2. To determine wavelength of monochromatic light source (λ) by

		Fresnel's biprism		
	Unit 2			
	A B C	**3.** To determine thermal conductivity of a bad conductor in form of a disc using Lee's method. 4. Calculate the thermal conductivity of copper by Searle's method		
	Unit 3			
	A B C	5. To calibrate a thermocouple to determine the temperature of a given object. 6. To verify Stefan's law using radiation method.		
	Unit 4			
	A B C	7. To determine the wavelength of prominent lines of mercury by plane diffraction grating. 8. To determine the wavelength of monochromatic light by Newton's Ring method.		
	Unit 5			
	A B C	9. To determine the focal length of the combination of two lenses separated by a distance with the help of a nodal slide and to verify the formula.		
	Mode of examination	Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book/s*	4. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing 5. B.Sc. Practical Physics- C L Arora, S. Chand Publishing		
	Other References	1. Basic electronics and linear circuits – N N Bhargava, D C Kulshreshtha, S C Gupta, Tata McGraw-Hill publishing company Ltd.		

E6. Syllabus of Physics Lab 3 (PHB 251)

School: School of Basic Sciences and Research		**Batch: 2019-22**
Program: B.Sc. (Hons)		**Current Academic Year: 2019**
Branch: Physics		**Semester: III**
1	Course Code	PHB 251
2	Course Title	Physics Lab 3
3	Credits	2
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
6	Course Outcomes	On successful completion of the course the students will have: CO1: Knowledge of basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope. CO2: Use the concept of semiconductor to calculate the energy band, Hall coefficient and mobility of the semiconducting materials. CO3: Understand how to measure the susceptibility of paramagnetic solution. CO4: Understand how to measure the specific resistance of a wire and verification of Stefan's law. CO5: Knowledge and study of variation of magnetic field and LCR circuits. CO6: Apply the mathematical concepts/equations to obtain quantitative results and ability to conduct, analyze and interpret experiments.
7	Outline Syllabus	
	Unit 1	
	A	1. To familiarize with basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope. 2. To calculate the energy band gap of a semiconductor material using four probe method.
	B	
	C	
	Unit 2	
	A	3. To study Hall's effect and determine the Hall coefficient, carrier density and the mobility of a semiconductor material.
	B	
	C	
	Unit3	
	A	4. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
	B	

	C	5. To determine the specific resistance of the material of a given wire using Carey Foster's bridge.		
	Unit 4			
	A	6. To verify Stefan's law using electrical method.		
	B			
	C			
	Unit 5			
	A	7. To determine the variation of magnetic field along the axis of a current carrying coil and estimate the radius of the coil. 8. To study the characteristics of a series RC Circuit.		
	Mode of Examination	Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text books	6. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing. 7. B.Sc. Practical Physics- C L Arora, S. Chand Publishing.		
	Other References	1. Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co. 2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New		

2.3 Syllabus of Project I/Dissertation I (BCH 359)

Note: This is to be accompanied by a **Project details as per template C** listing the detail of the project which also needs to be uploaded onto LMS.

School: SBSR		**Batch : 2019- 2022**		
Program: B.Sc. (H)		**Current Academic Year: 2019**		
Branch: Chemistry		**Semester: V**		
1	Course Code	BCH 359		
2	Course Title	Project I		
3	Credits	3		
4	Contact Hours (L-T-P)	0-0-3		
	Course Status	Compulsory/Elective		
5	Course Objective	• Deep knowledge of a specific area of specialization. • Develop research skills especially in project writing and oral presentation. • Develop time management skills. • Develop skill to summarize the published work by literature survey • Inculcate Team spirit		
6	Course Outcomes	**CO1:** The course gives an introduction to the concept of research within the subject, as regards approaching a question, collecting and analysing background material and presenting research questions and conclusions. **CO2:**Cultivate a deeper interest in Chemistry and acquire a taste for research. **CO3:**engage in activities that support their professional goals. **CO4:** learn effective project organizational skills.		
7	Course Description	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.		
8	Outline syllabus			
	Unit 1	**Introduction**		
	Unit 2	**Hypothesis**		
	Unit 3	**Case study/Lab work**		
	Unit 4	**Report**		
	Unit 5	**Presentation**		
	Mode of examination	Jury/Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book/s*	-		
	Other References			

2.3 Syllabus of Project II (BCH 360)

Note: This is to be accompanied by a **Project detail as per template C** listing the detail of the project which also needs to be uploaded onto LMS.

School: SBSR		**Batch : 2019- 2022**		
Program: B.Sc.		**Current Academic Year: 2019**		
Branch: Chemistry		**Semester: VI**		
1	Course Code	BCH 360		
2	Course Title	Project II		
3	Credits	3		
4	Contact Hours (L-T-P)	0-0-3		
	Course Status	Compulsory/Elective		
5	Course Objective	• Deep knowledge of a specific area of specialization. • Develop communication skills especially in project writing and oral presentation. • Develop skill to summarize the published work by literature survey • Develop some time management skills.		
6	Course Outcomes	**CO1:** The course gives an introduction to the concept of research within the subject, as regards approaching a question, collecting and analysing background material and presenting research questions and conclusions. **CO2:**Cultivate a deeper interest in Chemistry and acquire a taste for research. **CO3:**engage in activities that support their professional goals. **CO4:** learn effective project organizational skills.		
7	Course Description	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.		
8	Outline syllabus			
	Unit 1	**Introduction**		
	Unit 2	**Hypothesis**		
	Unit 3	**Case study/Lab work**		
	Unit 4	**Report**		
	Unit 5	**Presentation**		
	Mode of examination	Jury/Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book/s*	-		
	Other References			