Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus
Bachelor of Science (Chemistry)

Submitted by

Board of Studies,

Bachelor of Science (Chemistry)

FYUGP-Scheme I-VIII Semester

Bachelor of Science (Honors/Research)

(Chemistry - Major)

Four Year (Eight Semester Degree Course)

Teaching and Examination Scheme

B.Sc. Sem-I (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Inorganic Chemistry-1 (Atomic structure, bonding and main group elements)	BCH1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Inorganic Chemistry-1 (Atomic structure, bonding and main group elements)	BCH1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Organic Chemistry-1 (Fundamentals, stereochemistry and hydrocarbons)	BCH1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Organic Chemistry-1 (Fundamentals, stereochemistry and hydrocarbons)	BCH1P02	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO1T01	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO1T02	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Soap, detergent and disinfectant Technology	BVS1P01	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS1P02	-	-	4	2	-	-	-	-	50	50	50
9	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Environmental Sci.	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**150**	**250**	

B.Sc. Sem-II (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Organic Chemistry-2 (Functional group chemistry)	BCH2T03	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Organic Chemistry-2 (Functional group chemistry)	BCH2P03			2	1	-	-	-	-	25	25	25
3	DSC	Physical Chemistry-1 (Thermodynamics, gaseous and liquid states)	BCH2T04	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Physical Chemistry-1 (Thermodynamics, gaseous and liquid states)	BCH2P04			2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO2T03	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO2T04	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Drug synthesis and analysis	BVS2P03	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS2P04	-	-	4	2	-	-	-	-	50	50	50
9	AEC	Second Language	BAE2T02	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Indian Astronomy	BIK2T02	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC2P02	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**150**	**250**	

Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship ORContinue with Major and Minor

B.Sc. Sem-III (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Physical Chemistry-2 (Surface chemistry, phase equilibria, electrochemistry and kinetics)	BCH3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Physical Chemistry-2 (Surface chemistry, phase equilibria, electrochemistry and kinetics)	BCH3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Inorganic Chemistry-2 (Bonding, transition elements and solutions)	BCH3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Inorganic Chemistry-2 (Bonding, transition elements and solutions)	BCH3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO3T05	2	-	-	2	3	80	20	40	-	-	-
10	VSC	Refer VSC Basket	BVS3P05	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Second Language	BAE3T03	2	-	-	2	3	50	50	40	-	-	-
12	FP	Field Project	BFP3P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC3P03	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**200**	**300**	

B.Sc. Sem-IV (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Inorganic Chemistry-3 (Coordination chemistry, Redox reactions and Inorganic Polymers)	BCH4T07	2	-	-	2	3	80	20	40			
2	DSC	Inorganic Chemistry-3 (Coordination chemistry, Redox reactions and Inorganic Polymers)	BCH4P07	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Organic Chemistry-3 (Nitrogen compounds, Heterocyclics and organometallics)	BCH4T08	2	-	-	2	3	80	20	40			
4	DSC	Organic Chemistry-3 (Nitrogen compounds, Heterocyclics and organometallics)	BCH4P08	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)		2	-	-	2	3	80	20	40			
6	Minor	Minor 3 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)		2	-	-	2	3	80	20	40			
8	Minor	Minor 4 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO4T06	2	-	-	2	3	80	20	40	-	-	-
10	SEC	Refer SEC Basket	BVS4T06	-	-	4	2	-	-	-	-	50	50	50
11	AEC	English Compulsory	BAE4T03	2	-	-	2	3	50	50	40	-	-	-
12	CEP	Community Service	BCM4P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC4P04	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**200**	**300**	

Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship ORContinue with Major and Minor

B.Sc. Sem-V (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Organic Chemistry-4 (NMR, Enolates and Natural products)	BCH5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Organic Chemistry-4 (NMR, Enolates and Natural products)	BCH5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Physical Chemistry-3 (Solid state, Surface Chemistry, Spectroscopy and Quantum mechanics)	BCH5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Physical Chemistry-3 (Solid state, Surface Chemistry, Spectroscopy and Quantum mechanics)	BCH5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Inorganic Chemistry-4 (Complexes and Organometallics)	BCH5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Inorganic Chemistry-4 (Complexes and Organometallics)	BCH5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 1	BCH5T12	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 1	BCH5P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
13	VSC	Refer VSC Basket	BVS5P07	-	-	4	2	-	-	-	-	50	50	50
14	CEP	Community Service	BCM5P02	-	-	2	1	-	-	-	-	25	25	25
Total				**13**	**-**	**18**	**22**	**-**	**520**	**130**	**--**	**225**	**225**	**-**

B.Sc. Sem-VI (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Physical Chemistry-4 (Electrochemistry, Quantum Chemistry and Characterization)	BCH6T13	2	-	-	2	3	80	20	40	-	-	-
	DSC	Physical Chemistry-4 (Electrochemistry, Quantum Chemistry and Characterization)	BCH6P13	-	-	2	1	-	-	-	-	25	25	25
2	DSC	Inorganic Chemistry-5 (Bioinorganic Chemistry)	BCH6T14	2	-	-	2	3	80	20	40	-	-	-
	DSC	Inorganic Chemistry-5 (Bioinorganic Chemistry)	BCH6P14	-	-	2	1	-	-	-	-	-	50	25
3	DSC	Organic Chemistry-5 (Molecules of life)	BCH6T15	2	-	-	2	3	80	20	40	-	-	-
	DSC	Organic Chemistry-5 (Molecules of life)	BCH6P15	-	-	2	1	-	-	-	-	25	25	25
4	DSE	Elective 2	BCH6T16	3	-	-	3	3	120	30	60	-	-	-
	DSE	Elective 2	BCH6P16	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 7 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
	Minor	Minor 7 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
6	VSC	Refer VSC Basket	BVS6P08	-	-	4	2	-	-	-	-	50	50	50
7	OJT	Internship (Related to DSC)	BOJ6P01	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	22	**22**		**440**	**110**		**275**	**275**	

Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor

B.Sc. Sem-VII (Honors) (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Advanced Inorganic Chemistry-1	BCH7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Advanced Inorganic Chemistry-1	BCH7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Advanced Organic Chemistry-1	BCH7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Advanced Organic Chemistry-1	BCH7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Advanced Physical Chemistry-1	BCH7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Advanced Physical Chemistry-1	BCH7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Advanced Analytical Chemistry-1	BCH7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Advanced Analytical Chemistry-1	BCH7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 3	BCH7T21	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 3	BCH7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BCH7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BCH7P22	-	-	4	2	-	-	-	-	50	50	50
Total				13	-	14	**20**		**520**	**130**		**175**	**175**	

B.Sc. Sem-VIII (Honors) (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Advanced Inorganic Chemistry-2	BCH8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Advanced Inorganic Chemistry-2	BCH8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Advanced Organic Chemistry-2	BCH8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Advanced Organic Chemistry-2	BCH8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Advanced Physical Chemistry-2	BCH8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Advanced Physical Chemistry-2	BCH8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Advanced Analytical Chemistry-2	BCH8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Advanced Analytical Chemistry-2	BCH8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 4	BCH8T27	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 4	BCH8P27	-	-	2	1	-	-	-	-	25	25	25
11	OJT	Apprenticeship (Related to DSC)	BOJ8P02	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	18	**20**		**440**	**110**		**225**	**225**	

Four Year UG Honours Degree in Major and Minor with 160-176 credits

B.Sc. Sem-VII (Research) (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Advanced Inorganic Chemistry-1	BCH7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Advanced Inorganic Chemistry-1	BCH7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Advanced Organic Chemistry-1	BCH7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Advanced Organic Chemistry-1	BCH7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Advanced Physical Chemistry-1	BCH7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Advanced Physical Chemistry-1	BCH7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 3	BCH7T20R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 3	BCH7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BCH7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BCH7P21R	-	-	4	2	-	-	-	-	50	50	50
11	RP	Research Project/ Dissertation (Core)	BRP7P01	-	-	6	3	-	-	-	-	75	75	75
Total				11	-	18	**20**		**440**	**110**		**225**	**225**	

'R' in the subject code indicates 'Research'.

B.Sc. Sem-VIII (Research) (Chemistry - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Advanced Inorganic Chemistry-2	BCH8T22R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Advanced Inorganic Chemistry-2	BCH8P22R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Advanced Organic Chemistry-2	BCH8T23R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Advanced Organic Chemistry-2	BCH8P23R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Advanced Physical Chemistry-2	BCH8T24R	2	-		2	3	80	20	40	-	-	-
6	DSC	Advanced Physical Chemistry-2	BCH8P24R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 4	BCH8T25R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 4	BCH8P25R	-	-	2	1	-	-	-	-	-	50	25
9	RP	Research Project / Dissertation (Core)	BRP8P02	-	-	14	7 (4+2+1)	-	-	-	-	175	175	175
Total				09	-	22	**20**		**360**	**90**		**275**	**275**	

R' in the subject code indicates 'Research'

Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits

Total Credits:

1. Three Year UG Degree Program: 132
2. Four Year UG Degree Program: 172

Abbreviations: Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

VSC Basket (Chemistry)

Semester	Course Category	Name of Course	BoS	Course Code
I	**VSC**	Soap, detergent and disinfectant Technology	Chemistry	**BVS1P01**
II	**VSC**	Drug synthesis and analysis	Chemistry	**BVS2P03**
III	**VSC**	Soil sampling and analysis	Chemistry	**BVS3P05**
V	**VSC**	Vocational IT skills	Chemistry	**BVS5P07**
VI	**VSC**	Oil and Fats technology	Chemistry	**BVS6P08**

Basket for <u>ELECTIVE</u> (DSE) Category Courses (Chemistry)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	A. Basic Analytical Chemistry	BCH5T12
		B. Industrial Chemistry	
VI	Elective 2	A. Instrumental Methods of Analysis	BCH6T16
		B. Chemistry of dyes and drugs	
VII (Honors)	Elective 3	A. Environmental Chemistry	BCH7T21
		B. Chemistry of natural products	
VIII (Honors)	Elective 4	A. Polymer Chemistry	BCH8T27
		B. Organometallic and bioinorganic Chemistry	
VII (Research)	Elective 3	A. Environmental Chemistry	BCH7T20R
		B. Natural product chemistry	
VIII (Research)	Elective 4	A. Polymer Chemistry	BCH7T25R
		B. Organometallic and bioinorganic Chemistry	

B.Sc. Chemistry (Honours/ Research)

A four-year eight semester degree program

1. Introduction to B.Sc. (Honours/ Research) Chemistry

The Choice Based Credit System (CBCS) provides an opportunity to a student to choose courses from the syllabus comprising Core, Elective, Generic and Skill-based vocational courses. It offers a flexibility of programme structure while ensuring that the student gets a strong foundation in the subject and gains in-depth knowledge. The learning outcome based curriculum framework (LOCF) will provide students with a clear purpose to focus their learning efforts and enable them to make a well judged choice regarding the course they wish to study. This will suit the present day needs of students in terms of securing their paths towards higher studies or employment.

Programme Duration and Design: The B.Sc. (Hons/Res) Chemistry course is a eight semester course spread over four academic years. The teaching – learning process involves theory and practical classes and will be student-centred. Apart from the conventional chalk and talk method, power point presentations, audio–video tools, class discussions, simulations and virtual labs (wherever possible) will be used. Students will be encouraged to carry out short term projects and participate in industrial and institutional visits, seminars and workshops. Assessment will be based on continuous internal evaluation (CIE) and semester end examination (SEE). Each theory paper will be of 100 marks out of which 20% marks are for internal assessment while a practical paper will be of 50 marks comprising 50% internal assessment.

2. Learning Outcome-based Curriculum Framework in BSc (Hons/ Res) Chemistry

The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. (Hons/ Res) degree in Chemistry provides a broad structural framework that can accommodate the current curricular needs as well as gives sufficient flexibility to include changes in content that assume importance as the frontiers of science grow. The inherent flexibility in framework allows design of course basket in tune with individual preferences. The basic uniformity in core course design ensures smooth movement across universities in the country.

Nature and Extent: The B.Sc. (Hons/Res) Chemistry programme covers a wide range of basic and applied courses as well as courses of interdisciplinary nature.

Aims of the Programme: The core courses offered in the programme aim to build a strong conceptual chemical knowledge base in the student, the contents of electives and skill enhancement courses help them explore their fitness and suitability to pursue studies in these areas.

3. Programme Specific Outcomes (PSOs) in B.Sc. (Hons/Res) Chemistry

The B.Sc.(Hons/Res) programme in Chemistry is designed to develop in students in depth knowledge of the core concepts and principles that are central to the understanding of this core science discipline. Undergraduates pursuing this programme of study go through laboratory work that specifically develops their quantitative and qualitative skills, provides opportunities for critical thinking and team work, and exposes them to techniques useful for applied areas of scientific study.

1. ***Knowledge: Width and depth*****:** Students acquire theoretical knowledge and understanding of the fundamental concepts, principles and processes in main branches of chemistry, namely, organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry and biochemistry. In depth understanding is the outcome of transactional effectiveness and treatment of specialized course contents. Width results from the choice of electives that students are offered.

2. ***Laboratory Skills: Quantitative, analytical and instrument based*:** A much valued learning outcome of this programme is the laboratory skills that students develop during the course. Quantitative techniques gained through hands on methods opens choice of joining the industrial laboratory work force early on. The programme also provides ample training in handling basic chemical laboratory instruments and their use in analytical and biochemical determinations. Undergraduates on completion of this programme can cross branches to join analytical, pharmaceutical, material testing and biochemical labs besides standard chemical laboratories.
3. ***Communication*:** Communication is a highly desirable attribute to possess. Opportunities to enhance students' ability to write methodical, logical and precise reports are inherent to the structure of the programme. Techniques that effectively communicate scientific chemical content to large audiences are acquired through oral and poster presentations and regular laboratory report writing.
4. ***Capacity Enhancement*:** Modern day scientific environment requires students to possess ability to think independently as well as be able to work productively in groups. This requires some degree of balancing. The chemistry honours programme course is designed to take care of this important aspect of student development through effective teaching learning process.
5. ***Portable Skills*:** Besides communication skills, the programme develops a range of portable or transferable skills in students that they can carry with them to their new work environment after completion of chemistry honours programme. These are problem solving, numeracy and mathematical skills- error analysis, units and conversions, information retrieval skills, IT skills and organizational skills. These are valued across work environments.

4. Structure of the Programme in B.Sc. (Hons/Res) Chemistry

The programme includes Core Courses and Elective Courses. The Discipline Specific Core (DSC) Courses are all compulsory courses. There are three types of Elective Courses – Discipline Specific Elective (DSE), Generic Elective (GE), Vocational/ Skill Enhancement Courses (VS). In addition there are Ability Enhancement Courses (AEC). Field based projects and research projects add to the skill component.

CORE PAPERS/ MINOR PAPERS
B.Sc. Semester – I
BCH1T01
Inorganic Chemistry-1 (Atomic structure, bonding and main group elements)
Theory 2 credits + Practical 1 credit

Course Outcomes

By the end of the course, the students will be able to:

1. *Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic properties.*
2. *Draw the plausible structures and geometries of molecules using VSEPR theory.*
3. *Explain geometries and properties of molecules based on VBT.*
4. *Understand the concept of lattice energy using Born-Haber Cycle.*
5. *Rationalize the metallic properties based on various theories.*
6. *Elaborate structures and properties of common compounds formed by main group elements.*
7. *Identify acidic and basic radicals in simple inorganic salts.*

Unit-I: 7.5 h

(A) Atomic structure: Bohr model**,** Idea of de-Broglie matter Waves, Heisenberg's uncertainty principle. Schrodinger wave equation, significance of ψ and ψ^2, Quantum numbers, Concept of atomic orbital, Radial and angular wave functions and probability distribution curves for *1s, 2s, 2p, 3s, 3p* and *3d* orbitals, shapes of *s, p* and *d* orbitals, Aufbau principle, Bohr-Bury rule, Pauli's exclusion principle and Hund's rule of maximum multiplicity. Principle of extra stability. Electronic Configuration of elements and ions.

(B) Periodic Properties: Atomic and ionic radii, ionization energy, electron affinity and electronegativity-Definition, trends in periodic table. Factors affecting ionization potential. Pauling's, Mulliken's and Allred-Rochow scale of electronegativity. Effective nuclear charge and Slater's rule with some numericals.

Unit-II: 7.5 h

(A) Covalent Bond: Valency Bond Theory, Formation of Hydrogen molecule with potential energy diagram with all improvements, Limitations of VBT, Bond energy, bond length, Bond order, Bond angle. Various types of hybridization and shape of inorganic molecules [BeF_2, BCl_3, CH_4, NH_3, H_2O, PCl_5, SF_6 and IF_7].

VSEPR Theory: Rules/postulates and their applications to various common molecules and ions (NH_3, ClF_3, H_2O, SF_4, H_3O^+, NH_4^+, ICl_2^- etc)

(B) Ionic solids: Close packing in ionic solids [Square, Hexagonal, Cubic, BCC and FCC], Radius ratio rule and its limitations, Ionic structures with respect to NaCl and CsCl, Lattice energy and Born- Haber cycle. Solvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rules.

Unit -III: 7.5 h

(A) s- block elements: Electronic configuration, atomic and ionic radii, Ionisation potential, Reducing properties and Metallic Properties. Diagonal Relationships (Li-Mg).

Metallic Bond – Free electron, Valence Bond and Band theory of metallic bond. Properties of conductors, insulators and semiconductors based on Band theory.

Hydrogen bonding - Classification and effect of Hydrogen bonding on viscosity, solubility, melting point and boiling point.

(B) p-block elements: Introduction to p-block elements, comparative study of groups 15, 16 and 17 with respect to atomic and ionic radii, ionisation potential, electron affinity, electronegativity, redox properties, oxidation state. Diagonal relationship (B-Si).

Unit- IV:7.5 h

Hydrides: Comparative study with respect to structure of NH_3, PH_3, AsH_3 and SbH_3. Structure and bonding of diborane, structure of borazine.

Allotropes of Carbon [Graphite, Diamond and Fullerene], **Carbides:** Classification and uses, **Silicates:** classification, **Nitrides of sulphur:** Structure of S_4N_4, **Fluorocarbon** and its uses.

Oxides of Phosphorus: Structure and bonding in P_2O_3 and P_2O_5.

Oxyacids of Phosphorous: Structures of H_3PO_2, H_3PO_3, H_3PO_4, $H_4P_2O_6$ and $H_4P_2O_7$

Peroxyacids of Sulphur: Preparation and structure of Caro's and Marshall's acids.

Interhalogens and Polyhalides: Preparation, properties and structure of Interhalogen compounds. Polyhalides- Classification, Structure of I_3^-, I_5^-, ICl_4^-.

Inorganic Chemistry Practical (1 credit)

A) Introduction to Chemistry Laboratory:

1. Safety rules in laboratory
2. Introduction to nomenclature of glassware and instruments
3. Demonstration of handling pipette, burette, volumetric flask and other common glassware.
4. Pipettable and non-pipettable liquids (aqueous, organic, volatile, viscous, carcinogenic etc)
5. Common mistakes in chemistry laboratory

B) Semimicro Qualitative Analysis: Qualitative analysis of inorganic salt mixture containing two acidic radicals of different group and two basic radicals of same groups.

Note: At least eight mixtures should be analyzed.

Reference books

1. Lee, J.D. (2010),Concise Inorganic Chemistry, Wiley India.
2. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education.
3. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J.(1994),Concepts and Models of Inorganic Chemistry, John Wiley & Sons.
4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010),Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.
5. Wulfsberg, G (2002),Inorganic Chemistry, Viva Books Private Limited.
6. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014),Inorganic Chemistry, 5th Edition, Pearson.
7. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989),Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.
8. Svehla, G. (1996), Vogel's Qualitative Inorganic Analysis, Prentice Hall.

B.Sc. Semester – I
BCH1T02
Organic Chemistry-1 (Fundamentals, stereochemistry and hydrocarbons)
Theory 2 credits + Practical 1 credit

Course Outcomes

On completion of the course, the student will be able to:

1. *Understand and explain the different nature and behaviour of organic compounds based on fundamental concepts learnt.*
2. *Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.*
3. *Learn and identify many organic reaction mechanisms including Free Radical Substitution, Electrophilic Addition and Electrophilic Aromatic Substitution.*
4. *Understand the fundamental concepts of stereochemistry.*
5. *Elaborate various properties of aliphatic and aromatic hydrocarbons.*
6. *Experimentally identify extra element and functional group in the given organic compound.*
7. *Synthesize various organic compounds making use of selective reagents.*

Unit – I: 7.5h

A) Structure and Bonding : Hybridization in case of Methane, Ethane, Ethylene and acetylene, Bond lengths, bond angles and bond energies. Inductive effect, Electromeric effect. Resonance effect. Hyperconjugation definition, examples and application of these effects. Hydrogen bonding in organic compounds (with reference to alcohol, phenols, amines, acids) and **c**onsequences.

B) Mechanism of Organic Reactions : Homolytic and heterolytic bond breaking examples and factors favouring the bond fission. Electrophiles and nucleophiles definition and example both neutral and charged. Types of organic reactions addition, substitution, elimination, rearrangement. Energy consideration. Reactive intermediates carbocations, carbanions, free radicals, carbenes, formation, geometry, stability and reactions given by these intermediates.

Unit - II: 7.5h

A) Stereochemistry of Organic Compounds : Concept of isomerism. Types of isomerism with suitable examples. Optical isomerism-elements of symmetry, molecular chirality, enantiomers, stereogenic centre(lactic acid as example). Optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres (Tartaric acid) diastereomers, mesocompound. Resolution of enantiomers biological and chemical methods. Inversion retention and racemisation. Asymmetric synthesis. Relative and absolute configuration, sequence rules, D and L and R and S system of nomenclature.

B) Geometrical isomerism : *E* and *Z* system of nomenclature, geometric isomerism in alkenes with examples, maleic acid and fumaric acid, 2-butene.

Conformational isomerism : Conformational analysis of ethane, *n*-butane and substituted *n*-butane, conformations of Cyclohexane, axial and equatorial bonds. Newman's projection and sawhorse formulae. Difference between configuration and conformation.

Unit - III: 7.5h

A) Alkanes: IUPAC nomenclature of branched and unbranched alkanes. Alkyl group, Isomerism in alkanes. Methods of formation (Ethane)– Wurtz reaction, Kolbe reaction, decarboxylation of carboxylic acid. Physical properties and chemical reactions of alkanes-halogenation, nitration, sulphonation, isomerization, cyclization, aromatization, pyrolysis and cracking oxidation, L.P.G., Octane number. Mechanism of free radical halogenation of alkane.

B) Cycloalkanes : Nomenclature, methods of formation of cyclohexane from dihalides, benzene and cyclohexanone, chemical reactions of cyclohexane oxidation, aromatization, chlorination, Baeyer's strain theory and its limitations. Ring strain in small rings cyclopropane and cyclobutane. Theory of strainless rings.

C) Alkenes : Nomenclature of alkenes, methods of formation- dehydrogenation, dehydrohalogenation of alkyl halides, dehydration of alcohol dehalogenation of dihalides. Mechanism of dehydration of alcohol and dehydrohalogenation of Alkyl halides. Saytzeff rule, Hofmann elimination reaction. Chemical reactions of alkenes- hydroboration, oxidation $KMnO_4$, HIO_4, Epoxidation, Ozonolysis, Hydroxylation, Polymerization Substitution in allylic and vinylic position of alkenes. Industrial applications of ethylene and propylene. Markownikoff Rule and peroxide effect. Ionic Mechanism of addition of Br_2 to ethene and HBr to propene. Free radical mechanism of addition of HBr to propene. Stereochemistry of bromine and $KMnO_4$ addition to alkene.

Unit - IV: 7.5h

A) Dienes: Nomenclature and classification of dienes Methods of formation of 1, 3 - butadiene. 1,2 and 1,4 addition reactions of substituted 1,3-butadiene, Diels-Alder reaction.

B) Alkynes: Nomenclature, structure and bonding in Alkynes. Methods of formation of acetylene from - calcium carbide, dehydrohalogenation of dihalides Chemical reaction - hydroboration, oxidation metal ammonia reduction and polymerization. Oxyacetylene flame. Acidity of alkynes.

C) Aromatic Compounds and Aromaticity: Nomenclature of Benzene derivatives, structure of benzene, Molecular formula and Kekule structure. Resonance structure, MO picture, Huckel rule, aromatic ions (cyclopentadienyl anion and cycloheptatrienyl cation). Aromatic electrophillic substitution mechanism with energy profile diagram (eg. nitration and sulphonation).

Organic Chemistry Practical (1 credit)

A) Qualitative Analysis:
1. Element detection (N, S and halogens)
2. Identification of functional groups (-COOH, Phenolic –OH, -CHO, $-NH_2$, $-NO_2$, $-CONH_2$)
3. Melting and Boiling Points

B) Preparations and determination of yield (%) and melting points of products:
1. Hydrolysis : Preparation of Benzoic acid from Benzamide
2. Oxidation: Preparation of Benzoic acid from Benzaldehyde
3. Bromination of Phenol

Reference books

1. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Chandra, R. ; Singh, S.; Singh, A. (2019), Basic Organic Chemistry, Arcler Press.
4. Eliel, E. L.; Wilen, S. H.(1994),Stereochemistry of Organic Compounds; Wiley: London.
5. Singh, S.P.; Prakash, O.,(2017), Reaction Mechanism in organic chemistry, Laxmi
6. Mann, F. G.; Saunders, B. C. (2009), Practical Organic Chemistry, Pearson Education.
7. Ahluwalia, V.K.; Dhingra, S. (2004),Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.
8. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.(2012),Vogel's Textbook of Practical Organic Chemistry, Pearson.
9. Leonard, J.; Lygo, B.; Procter, G. Advanced Practical Organic Chemistry, CRC Press.

B.Sc. Semester – I

Vocational Skill Course (VSC)

BVS1P01: Soap, detergent and disinfectant Technology

Practical 2 credits

Course Outcomes

By the end of this course, students will be able to:

1. *Gain an understanding of the history and influences behind modern soap creation processes and projected trends in the future of soap.*
2. *The analytical approach of this course is to enhance the reasoning and to understand the mechanical part of the industry.*
3. *Learn the most common formulations of soap products by exploring compositions and physical chemistry.*
4. *Understand the different aspects of industrial processes of Manufacturing disinfectants.*
5. *Optimise use of limited resources of harmful chemicals.*
6. *Suggest remedial measures for surfactant quality and threshold quantity improvement.*

List of Experiments

1. Brief History of Soap and Soap-Making Processes, Formulation and Marketing Challenges
2. Sustainable development in cleaning action of disinfectant technology and Innovations in advances and Mechatronic Solutions for Soap Manufacturing Technology from Saponification Systems.
3. Determination of the surface tension of given liquid in the presence of surfactant.
4. Determination of alkali content of soap.
5. Determination of pH of water samples and surfactant (Soap, detergent, Toiletries)
6. Estimation of hardness of water by titration with soap solution.
7. Determination of CMC of various soaps and detergents in market.
8. Comparison of cleansing actions of various commercial soaps and detergents.
9. Preparation of hand sanitizer.
10. Preparation of Soap, Detergents / Surfactants, Cleaners / Cleaning Powder.
11. Preparation of Laundry Care / fabric care / wash.
12. Preparation of Household and Industrial Detergent.
13. Preparation of Liquid Soaps/ Liquid Detergents / Acid Slurry.

Note: Minimum 10 experiments should be performed.

References

1. Ahluwalia,V.K. and Aggarwal,R. Comprehensive Practical Organic Chemistry, Preparation and Quantitative Analysis ,University Press, New Delhi.
2. Sharma, R.K., Sidhwani,I.T., Chaudhari,M.K. (2013),Green Chemistry Experiments: A monograph, I.K. International Publishing House Pvt Ltd. New Delhi.
3. Vermani, O. P.; Narula, A. K. (2004), Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi.
4. https://www.aocs.org/stay-informed/aocs-continuing-education-program/soap-fundamentals?SSO=True#brief-history-of-soap-and-soapmaking-processes
5. Bhatia, S. C. (2004), Chemical Process Industries, Vol. I & II, CBS Publishers, New Delhi.
6. Jain, P. C.; Jain, M. (2013), Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
7. Gopalan, R. Venkappayya, D.; Nagarajan, S. (2004), Engineering Chemistry, Vikas Publications. 5. Sharma, B. K. (1997), Engineering Chemistry, Goel Publishing House, Meerut.

B.Sc. SEMESTER – I

BVE1T01: ENVIRONMENTAL SCIENCE

COURSE OUTCOMES:

At the end of the course, students shall be able to:

- Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
- Explicate the importance of Environmental Education.
- Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
- Describe the various physical and chemical characteristics and properties of Water and Soil
- Understand the Ecology and its allied branches
- Comprehend about Population and Community Ecology
- Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7.5 Hrs)

A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.
B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.
C. Components of Environment: Atmosphere (Structure and composition),hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7.5 Hrs)

A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.
B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.
C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. Precipitation – Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (7.5 Hrs)

A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.
B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.
C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto-cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (7.5 Hrs)

A. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)
B. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y- shaped). Energy flow and the law of thermodynamics.
C. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr

P.U. Meshram, Allied Publishers, New Delhi.

8. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
9. Animal Ecology and Distribution of Animals: Veer Bala Rastogi , Rastogi Publication, Meerut (U.P).
10. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
11. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
12. Environmental Biology: P.K.G. Nair, Himalaya Publication.
13. Environmental Biology: K.C. Agrawal, Agro Botanical Publisher ,Bikaner,1994

Indian Knowledge System (IKS)

SEM1: VEDIC MATHEMATICS (BIK1T01)

Course Outcomes: This course will enable the students to

1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i)Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum - Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	**8**
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhwajank(ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	**8**
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	**7**
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	**7**
	TOTAL	**30 HRS**

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, MotilalBanarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution ofCivil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5,3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group
8. Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books

B.Sc. Semester – II
BCH2T03
Organic Chemistry-2 (Functional group chemistry)
Theory 2 credits + Practical 1 credit

Course Outcomes

On completion of the course, the student will be able to:

1. *Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups.*
2. *Use the synthetic chemistry learnt in this course to do functional group transformations.*
3. *To propose plausible mechanisms for various reactions.*
4. *Suggest synthesis routes for desired product from initial reactant.*
5. *Identify given organic compound by systematic chemical analysis.*
6. *Synthesize derivatives of given organic compound.*

Unit-I : 7.5h

Orientation : Activating (–OH, $–NH_2$) and deactivating (–Cl, $–NO_2$, –COOH) substituents, their orientation and directive influence on further electrophilic substitution, o/p ratio. Methods of formation and chemical reactions of alkyl benzene (Toluene) and biphenyl.

Alkyl halides : Nomenclature, classification, methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides S_N1 and S_N2 with energy profile diagrams. Factors affecting S_N1 and S_N2 mechanisms.

Polyhalogen compounds : Chloroform and carbon tetrachloride – formation and chemical reactions.

Nuclear and side chain halogen derivatives of benzene: Halobenzene and benzyl halide preparation and reactions.

Unit-II: 7.5h

A) Alcohols : Classification and nomenclature,

Monohydric alcohols : Methods of formation by reduction of aldehydes, ketones using H_2/Ni, hydrolysis of alkyl halides, addition of Grignard reagent to aldehydes and ketones. Reactions of alcohol.

Dihydric alcohols : Methods of formation, chemical reactions of vicinal glycols, oxidative cleavage ($Pb(OAc)_4$ and HIO_4) and Pinacol – pinacolone rearrangement.

Trihydric alcohols : Methods of formation, chemical reactions of glycerol.

B) Phenols : Structure and bonding, Preparation of phenols from cumene, chlorobenzene (Dows and Raschig process) and diazonium salts. Physical properties and acidic character, Resonance stabilization of phenoxide ion, Reactions of phenols, Electrophilic aromatic substitution, acetylation and carboxylation, Claisen rearrangement, Gatterman synthesis reaction Mechanism of (i) Fries Rearrangement, (ii) Reimer-Tiemann reaction.

Unit-III: 7.5h

Aldehydes and ketones : Nomenclature and structure of the carbonyl group, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides and ketones from nitriles. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation, Wittig reaction, Mannich reaction, oxidation of aldehydes (by $KMnO_4$, Tollen's reagent and Fehling solution), Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction with mechanism, MPV, Clemmensen, Wolf-Kishner, $LiAlH_4$ and $NaBH_4$ reductions,

Unit-IV: 7.5h

A) Carboxylic Acids : Nomenclature, structure and bonding, Physical properties, acidity of carboxylic acids, effect of substituents on acid strengths preparation of carboxylic acids(from G.R. and cyanides), Reactions of carboxylic acids, Hell-Volhard-Zelinsky reactions. Reduction of carboxylic acids, Mechanism of decarboxylation. Methods of formation and chemical reactions of unsaturated monocarboxylic acids (crotonic acid and cinnamic acid).

Dicarboxylic acids : Methods of formation and effect of heat and dehydrating agents. (Succinic acid, Phthalic acid).

B) Carboxylic acid derivatives : Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides. Interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, Chemical reactions, Mechanism of esterification and hydrolysis (acidic and basic).

Organic Chemistry Practical (1 credit)

Complete analysis of simple organic compound involving following steps:

1. Preliminary examination
2. Detection of elements
3. Detection of functional group
4. Determination of melting point/ boiling point.
5. Preparation of derivative and its melting point/ boiling point.
6. Performance of specific test, if any.

Note: At least eight compounds should be analyzed.

Reference books

1. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Janice Smith, Organic Chemistry, 7th Edition, McGraw Hill with solution manual
4. Bruice, P. Y. Organic Chemistry, 6th Edition, Pearson Education with solution manual
5. Francis A. Carey, Robert M. Giuliano Organic Chemistry, 8th Edition McGraw Hill with solution manual
6. Marc Loudon, Jim Parise 7th Edition, W. H. Freeman with solution manual
7. David Klein Organic Chemistry, John Wiley & Sons Inc with solution manual
8. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I. K. International.
9. Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016),Organic Chemistry, 12th Edition, Wiley.
10. Chandra, R. ; Singh, S.; Singh, A. (2019), Organic reactions and their nomenclature, Arcler Press.
11. Mann, F. G.; Saunders, B. C. (2009),Practical Organic Chemistry, Pearson Education.
12. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.(2012),Vogel's Textbook of Practical Organic Chemistry, Pearson.
13. Ahluwalia, V.K.; Aggarwal, R.(2004),Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press.

B.Sc. Semester – II
BCH2T04
Physical Chemistry-1 (Thermodynamics, gaseous and liquid states)
Theory 2 credits + Practical 1 credit

Course Outcomes

By the end of the course, students will be able to:

1. *Solve fundamental mathematical function based problems in chemistry.*
2. *Understand the three laws of thermodynamics, concept of State and Path functions, extensive and intensive properties.*
3. *Derive the expressions of ΔU, ΔH, ΔS, ΔG, ΔA for ideal gases under different conditions.*
4. *Evaluate thermodynamics of various physical and chemical processes.*
5. *Analyse and explain properties of ideal gas, real gas and liquids.*
6. *Evaluate thermodynamic constants through calorimetric studies.*
7. *Use various properties of liquids for determination of their concentration and composition.*

Unit-I : 7.5h

Mathematical concepts and Introduction to Thermodynamics

(A) Mathematical concepts for Chemists: Logarithmic relations, Curve sketching, Linear graphs calculation of slopes, Differentiation of functions like kx, e^x, x^n, sin x, log x, etc., Maxima and Minima, Partial differentiation, Integration of useful/relevant functions, Permutations and combinations (introductory), Factorials, Concept of units with reference to C.G.S. and S.I. units, Inter-conversion of units.

(B) Introduction to Thermodynamics: Definitions of some common thermodynamic terms: system, surrounding, etc. Types of system (closed, open and isolated), Homogeneous and heterogeneous systems, intensive and extensive properties, thermodynamic processes (isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible) State function and path functions and their differentiation, concept of heat and work.

Unit-II: 7.5h

Fundamentals of Thermodynamics and Thermochemistry

(A) Statements of first law of thermodynamics, definition of internal energy and enthalpy, heat capacity, heat capacity at constant volume and at constant pressure, Joule-Thomson experiment, Joule-Thomson coefficient and inversion temperature, calculations of w, q , E and H for expansion of gases for isothermal and adiabatic conditions for reversible process.

(B)Thermochemistry : Standard states, standard enthalpy of formation, enthalpy of combustion, enthalpy of solution, enthalpy of dilution, enthalpy of neutralization, enthalpy of ionization, Hess's law of constant heat of summation and its applications, Heat of reaction, relation between heat of reaction at constant volume and constant pressure. Average bond energy, bond dissociation energy and its calculations from thermochemical data. Numerical problems.

Unit- III: 7.5h

Gaseous State

(A) Postulates of kinetic theory of gases, derivation of kinetic gas equation, deduction of various gas laws from kinetic gas equation (Boyle's law, Charle's law, Avogadro's law, Grahams law, Daltons law. Qualitative discussion of the Maxwell- Boltzmann distribution of molecular velocities. Effect of temperature on molecular velocities. Different types of molecular velocities (most probable, R.M.S. and average and expressions for them), their inter relationships. Definitions of collision diameter, collision number, mean free path.

(B) Ideal gas and real gases, behavior of real gases, deviations from ideal behavior, explanation of the terms - Compressibility factors and Boyle temperature. Causes of deviation from ideal behaviors. Vander Waal's equation of state, explanation of behaviour of real gases on the basis of van der Waal equation. Andrew's

experiment on critical phenomenon of CO_2. Continuity of states. The isotherms of Van der Waals equation, Relation between critical constants and Van der Waals constants. Reduced equation of state and law of corresponding states. Numerical problems.

Unit- IV: 7.5h

Liquid State

(A) Intermolecular forces, structure of liquids (a qualitative description), structural differences between solids, liquids and gases, liquid crystals, Classification, structure of Nematic and Cholesteric phases, Thermography, liquid crystal display and seven segment cell.

(B) Properties of liquid :

i) Surface tension : Explanation, methods of determination, Capillary rise method and drop number method, Parachor value and its application.

ii) Viscosity : Explanation, coefficient of viscosity, Effect of temperature on Viscosity, relative viscosity, specific viscosity and intrinsic viscosity and reduced viscosity. Method of determination by Ostwald viscometer.

iii) Refractive index : specific refraction, molar refractions and chemical constitution. Method of determination by Abbe's Refractometer. Numerical problems.

Physical Chemistry Practical (1 credit)

1. To determine the heat of solution of potassium nitrate calorimetrically
2. To determine heat of ionization of acetic acid calorimetrically.
3. To determine solubility of benzoic acid at different temperatures and hence to determine heat of solution of benzoic acid.
4. Determination of relative viscosity of unknown liquid by Ostwald viscometer.
5. To determine the percentage composition of given binary mixture (Ethanol-water) by viscosity method.
6. Determination of surface tension of a given liquid by drop number method (Stalagmometer method)
7. To compare cleansing power of two samples of detergent.
8. To determine parachor value of $-CH_2$ group by surface tension method.
9. To determine refractive index, specific and molar refraction of given liquid by Abbe's refractometer.

Note: At least eight experiments should be performed.

Reference books

1. Peter, A.; Paula, J. de. (2011), Physical Chemistry, 9th Edition, Oxford University Press.
2. Castellan, G. W. (2004), Physical Chemistry, 4th Edition, Narosa.
3. Kapoor, K.L.(2015), A Textbook of Physical Chemistry, Vol 2, 6th Edition, McGraw Hill Education.
4. Kapoor, K.L.(2013), A Textbook of Physical Chemistry, Vol 3, 3rd Edition, McGraw Hill Education.
5. McQuarrie, D. A.; Simon, J. D. (2004),Molecular Thermodynamics, Viva Books Pvt. Ltd. Levine, I.N.(2010),Physical Chemistry, Tata Mc Graw Hill.
6. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A.; Will, S.(2011),Commonly asked Questions in Thermodynamics. CRC Press.
7. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015),Senior Practical Physical Chemistry, R. Chand & Co, New Delhi.
8. Kapoor, K.L. (2019),A Textbook of Physical Chemistry, Vol.7, 1st Edition, McGraw Hill Education.
9. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P.(2003),Experiments in Physical Chemistry, 8th Edition, McGraw-Hill, New York.

B.Sc. Semester – II
Vocational Skill Course (VSC)
BVS2P03: Drug synthesis and analysis
Practical 2 credits

Course Outcomes

By the end of this course, students will be able to:

1. *A foundational understanding of the principles and concepts of medicinal chemistry, including drug design and development.*
2. *Gaining practical experience in common laboratory techniques used in medicinal chemistry, such as synthesis and purification.*
3. *Ability to design and perform experiments to test the effectiveness of potential drug candidates, including assays.*
4. *Develop an understanding of the Physico-Chemical properties of drugs through fundamentals of volumetric analytical skills.*

List of Experiments

(A) Synthesis of pharmaceuticals

- 1. Paracetamol from p-nitro phenol
- 2. Benzocaine from p-nitro benzoic acid
- 3. Acetanilide from aniline
- 4. Diphenylhydantoin from Benzoin.
- 5. Diclofenac sodium from aniline.
- 6. Aspirin from Salicylic acid.
- 7. Methyl Salicylate from Salicylic Acid.

(B) Estimation of pharmaceuticals

- 1. Estimation of vitamin B_{12} in commercial tablet.
- 2. Estimation of vitamin C in commercial tablet.
- 3. Estimation of alkali in antacid tablet.
- 4. Estimation of paracetamol in commercial tablet.
- 5. Estimation of aspirin in commercial tablet.
- 6. Estimation of Ibuprofen.
- 7. Estimation of Fe in hematinic tablet.

Note: Minimum 10 experiments should be performed.

References:

1. Patrick, G. (2017), Introduction to Medicinal Chemistry, Oxford University Press.
2. Singh H.; Kapoor V.K. (1996), Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan.
3. Foye, W.O.; Lemke, T. L.; William, D.A. (1995),Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd.
4. Kjonaas, R.A.; Williams, P.E.; Counce, D.A.; Crawley, L.R. Synthesis of Ibuprofen. J. Chem. Educ., 2011, 88 (6), pp 825–828 DOI: 10.1021/ed100892p.
5. Marsh, D.G.; Jacobs, D.L.; Veening, H. Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry. J. Chem. Educ., 1973, 50 (9), p 626. DOI: 10.1021/ed050p626
6. Kar, Ashutosh (2005),Textbook of Medicinal Chemistry, New Age International.
7. Eric Marsault and Mark L. Peterson (2017), Practical Medicinal Chemistry with Macrocycles, Wiley.
8. D. Sriram and P. Yogeswari (2010), Medicinal Chemistry, Pearson.

SEM 2 : CONSTITUION OF INDIA (BVE2T02)

Syllabus

UNIT – I:

- Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II

- Preamble – Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity

- Salient Features of the Constitution of India

UNIT – III

- General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV

Introduction of the Constitutional Institutions and Authorities;

- Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
- State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
- Higher Judiciary (Supreme Court of India and High Courts)

Indian Knowledge System (IKS)

SEM2: INDIAN ASTRONOMY (BIK2T02)

Course Outcomes: This course will enable the students to understand that

1. It is possible to create a map of the intellectual growth of a culture usingastronomy as a probe.
2. The growth of Indian astronomy occurs in distinct stages analogous to phasetransitions of the evolution of cultures
3. Indian Astronomy therefore provides an excellent window to the pastdramatic transitions.

UNITS	TOPICS	HOURS
Unit 1	Astronomy in Prehistoric Era, Astronomy in Vedic Era, Vedang Jyotish, Astronomical References In Religious Scriptures, Astronomies of the West	**8**
Unit 2	Arya Bhatta, Panch Siddhantika of Varahamihira, Surya Siddhanta Varahamihira to Bhaskar Acharya-II, Siddhant Shiromani of Bhaskar Acharya-II, Bhaskar Acharya-II to Jai Singh, Jai Singh and his Observatories.	**8**
Unit 3	After Jai Singh, Interaction with the Astronomies of the World, Modern Era Astronomy , Our Universe, Cosmology	**7**
Unit 4	Panchang Horoscope and Astrology , Siddhantas, Karnas and Koshtakas, Observational Instruments of Indian Astronomy	**7**
	TOTAL	**30 HRS**

Reference Books:

1. The Story Of Astronomy In India, Chander Mohan, Pothi.com
2. Indian Astronomy: An Introduction. Front Cover · S. Balachandra Rao.Universities Press, 2000
3. Astronomy in India: A Historical Perspective, Thanu Padmanabhan,Springer Science & Business Media
4. Hindu Astronomy, W. Brennand, Alpha Editions
5. Origin and Growth of Astronomy in India, https://www.tifr.res.in/~archaeo/FOP/FOP%20pdf%20of%20ppt/Vahia%20Origin%20of%20Astronomy.pdf