SCHEME OF EXAMINATION

RULES & REGULATIONS

AND

SYLLABUS

(for Academic Session 2024-2025)

B.Sc. Chemistry

First Semester Examination, December 2024
Second Semester Examination, June 2025

as per

National Education Policy (NEP)-2020 &
Choice Based Credit System (CBCS)

Faculty of Science

UNIVERSITY OF KOTA

MBS Marg, KOTA (Rajasthan)-324 005

INDIA

INDEX

Bachelor of Science (B.Sc.): Biology Group

Subject Combination: Botany, Chemistry, Zoology (BCZ)

Semester Scheme of Examination

Year / Semester	Number, Code and Nomenclature of Paper				Duration of Examination	Teaching (Hrs./Week) and Credits			Distribution of Maximum Marks			Minimum Pass Marks	
	Number of Paper	Code of Paper	Code for Examination	Nomenclature of Paper		Lecture (L)	Practical (P)	Credit (C)	Internal Assess.	Sem. Assess.	Total Marks	Internal Assess.	Sem. Assess.
1st Year I Semester	1.1	GHIN-101-T	15001	General Hindi	1.5 Hrs.	2	--	2	--	50	50	--	20
	1.2	CHE-132-T	15503	Chemistry-I	3 Hrs.	4	--	4	30	70	100	12	28
	1.3	CHE-132-P	15504	Chemistry Practical-I	6 Hrs.	--	4	2	--	50	50	--	25
	1.4	BOT-133-T	15505	Botany-I	3 Hrs.	4	--	4	30	70	100	12	28
	1.5	BOT-133-P	15506	Botany Practical-I	6 Hrs.	--	4	2	--	50	50	--	25
	1.6	ZOO-134-T	15507	Zoology-I	3 Hrs.	4	--	4	30	70	100	12	28
	1.7	ZOO-134-P	15508	Zoology Practical-I	6 Hrs.	--	4	2	--	50	50	--	25
				Total (I Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
1st Year II Semester	2.1	GENG-102-T	15002	General English	1.5 Hrs.	2	--	2	--	50	50	--	20
	2.2	CHE-232-T	15523	Chemistry-II	3 Hrs.	4	--	4	30	70	100	12	28
	2.3	CHE-232-P	15524	Chemistry Practical-II	6 Hrs.	--	4	2	--	50	50	--	25
	2.4	BOT-233-T	15525	Botany-II	3 Hrs.	4	--	4	30	70	100	12	28
	2.5	BOT-233-P	15526	Botany Practical-II	6 Hrs.	--	4	2	--	50	50	--	25
	2.6	ZOO-234-T	15527	Zoology-II	3 Hrs.	4	--	4	30	70	100	12	28
	2.7	ZOO-234-P	15538	Zoology Practical-II	6 Hrs.	--	4	2	--	50	50	--	25
				Total (II Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
				Total (I and II Semesters)	**57.0 Hrs.**	**28**	**24**	**40**	**180**	**820**	**1000**	**72**	**358**
2nd Year III Semester	3.1	GEC------	-----	Environmental Studies	1.5 Hrs.	2	--	2	--	50	50	--	20
	3.2	CHE----T	-----	Chemistry-III	3 Hrs.	4	--	4	30	70	100	12	28
	3.3	CHE----P	-----	Chemistry Practical-III	6 Hrs.	--	4	2	--	50	50	--	25
	3.4	BOT----T	-----	Botany-III	3 Hrs.	4	--	4	30	70	100	12	28
	3.5	BOT----P	-----	Botany Practical-III	6 Hrs.	--	4	2	--	50	50	--	25
	3.6	ZOO----T	-----	Zoology-III	3 Hrs.	4	--	4	30	70	100	12	28
	3.7	ZOO----P	-----	Zoology Practical-III	6 Hrs.	--	4	2	--	50	50	--	25
				Total (III Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
2nd Year IV Semester	4.1	GEC------	-----	Elementary Computer Applications	1.5 Hrs.	2	--	2	--	50	50	--	20
	4.2	CHE----T	-----	Chemistry-IV	3 Hrs.	4	--	4	30	70	100	12	28
	4.3	CHE----P	-----	Chemistry Practical-IV	6 Hrs.	--	4	2	--	50	50	--	25
	4.4	BOT----T	-----	Botany-IV	3 Hrs.	4	--	4	30	70	100	12	28
	4.5	BOT----P	-----	Botany Practical-IV	6 Hrs.	--	4	2	--	50	50	--	25
	4.6	ZOO----T	-----	Zoology-IV	3 Hrs.	4	--	4	30	70	100	12	28
	4.7	ZOO----P	-----	Zoology Practical-IV	6 Hrs.	--	4	2	--	50	50	--	25
				Total (IV Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
				Total (III and IV Semesters)	**57.0 Hrs.**	**28**	**24**	**40**	**180**	**820**	**1000**	**72**	**358**

Year / Semester	Number, Code and Nomenclature of Paper				Duration of Examination	Teaching (Hrs./Week) and Credits			Distribution of Maximum Marks			Minimum Pass Marks	
	Number of Paper	Code of Paper	Exam. Code	Nomenclature of Paper		Lecture (L)	Practical (P)	Credit (C)	Internal Assess.	Sem. Assess.	Total	Internal Assess.	Sem. Assess.
3rd Year V Semester	5.1(a)	BOT-------	-----	Botany-V(a): Elective	3 Hrs.	4	--	4	30	70	100	12	28
	5.1(b)	BOT-------	-----	Botany-V(b): Elective									
	5.1(c)	BOT-------	-----	Botany-V(c): Elective									
	5.2(a)	BOT-------	-----	Botany Practical-V(a)	6 Hrs.	--	4	2	--	50	50	--	25
	5.2(b)	BOT-------	-----	Botany Practical-V(b)									
	5.2(c)	BOT-------	-----	Botany Practical-V(c)									
	5.3(a)	CHE ---- T(a)	-----	Chemistry-V(a): Inorganic Chemistry	3 Hrs.	4	--	4	30	70	100	12	28
	5.3(b)	CHE ---- T(b)	-----	Chemistry-V(b): Organic Chemistry									
	5.3(c)	CHE ---- T(c)	-----	Chemistry-V(c): Physical Chemistry									
	5.4(a)	CHE ---- P(a)	-----	Chemistry Practical-V(a): Inorganic Chemistry Practical	6 Hrs.	--	4	2	--	50	50	--	25
	5.4(b)	CHE ---- P(b)	-----	Chemistry Practical-V(b): Organic Chemistry Practical									
	5.4(c)	CHE ---- P(c)	-----	Chemistry Practical-V(c): Physical Chemistry Practical									
	5.5(a)	ZOO------	-----	Zoology-V(a): Elective	3 Hrs.	4	--	4	30	70	100	12	28
	5.5(b)	ZOO------	-----	Zoology-V(b): Elective									
	5.5(c)	ZOO------	-----	Zoology-V(c): Elective									
	5.6(a)	ZOO------	-----	Zoology Practical-V(a)	6 Hrs.	--	4	2	--	50	50	--	25
	5.6(b)	ZOO------	-----	Zoology Practical-V(b)									
	5.6(c)	ZOO------	-----	Zoology Practical-V(c)									
	5.7	VAC------	-----	Value Added Course	1.5 Hrs.	2	--	2	--	50	50	--	20
	Total (V Semester)				**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
3rd Year VI Semester	6.1(a)	BOT-------	-----	Botany-VI(a): Elective	3 Hrs.	4	--	4	30	70	100	12	28
	6.1(b)	BOT-------	-----	Botany-VI(b): Elective									
	6.1(c)	BOT-------	-----	Botany-VI(c): Elective									
	6.2(a)	BOT-------	-----	Botany Practical-VI(a)	6 Hrs.	--	4	2	--	50	50	--	25
	6.2(b)	BOT-------	-----	Botany Practical-VI(b)									
	6.2(c)	BOT-------	-----	Botany Practical-VI(c)									
	6.3(a)	CHE ---- T(a)	-----	Chemistry-VI(a): Inorganic Chemistry	3 Hrs.	4	--	4	30	70	100	12	28
	6.3(b)	CHE ---- T(b)	-----	Chemistry-VI(b): Organic Chemistry									
	6.3(c)	CHE ---- T(c)	-----	Chemistry-VI(c): Physical Chemistry									
	6.4(a)	CHE ---- P(a)	-----	Chemistry Practical-VI(a): Inorganic Chemistry Practical	6 Hrs.	--	4	2	--	50	50	--	25
	6.4(b)	CHE ---- P(b)	-----	Chemistry Practical-VI(b): Organic Chemistry Practical									
	6.4(c)	CHE ---- P(c)	-----	Chemistry Practical-VI(c): Physical Chemistry Practical									
	6.5(a)	ZOO------	-----	Zoology-VI(a): Elective	3 Hrs.	4	--	4	30	70	100	12	28
	6.5(b)	ZOO------	-----	Zoology-VI(b): Elective									
	6.5(c)	ZOO------	-----	Zoology-VI(c): Elective									
	6.6(a)	ZOO------	-----	Zoology Practical-VI(a)	6 Hrs.	--	4	2	--	50	50	--	25
	6.6(b)	ZOO------	-----	Zoology Practical-VI(b)									
	6.6(c)	ZOO------	-----	Zoology Practical-VI(c)									
	6.7	SEC------	-----	Skill Enhancement Course	1.5 Hrs.	2	--	2	--	50	50	--	20
	Total (VI Semester)				**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
Total (V and VI Semesters)					**57.0 Hrs.**	**28**	**24**	**40**	**180**	**820**	**1000**	**72**	**358**
Grand Total of Three-Year B.Sc. Degree Programme (I to VI Semesters)					**171.0 Hrs.**	**84**	**72**	**120**	**540**	**2460**	**3000**	**216**	**1074**

Bachelor of Science (B.Sc.): Mathematics Group

Subject Combination: Physics, Chemistry, Mathematics (PCM)

Semester Scheme of Examination

Year / Semester	Number, Code and Nomenclature of Paper				Duration of Examination	Teaching (Hrs./Week) and Credits			Distribution of Maximum Marks			Minimum Pass Marks	
	Number of Paper	Code of Paper	Code for Examination	Nomenclature of Paper		Lecture (L)	Practical (P)	Credit (C)	Internal Assess.	Sem. Assess.	Total Marks	Internal Assess.	Sem. Assess.
1st Year I Semester	1.1	GHIN-101-T	15001	General Hindi	1.5 Hrs.	2	--	2	--	50	50	--	20
	1.2	PHY-131-T	15501	Physics-I	3 Hrs.	4	--	4	30	70	100	12	28
	1.3	PHY-131-P	15502	Physics Practical-I	6 Hrs.	--	4	2	--	50	50	--	25
	1.4	CHE-132-T	15503	Chemistry-I	3 Hrs.	4	--	4	30	70	100	12	28
	1.5	CHE-132-P	15504	Chemistry Practical-I	6 Hrs.	--	4	2	--	50	50	--	25
	1.6	MAT-137-T	15511	Mathematics-I	3 Hrs.	4	--	4	30	70	100	12	28
	1.7	MAT-137-P	15512	Mathematics Practical-I	6 Hrs.	--	4	2	--	50	50	--	25
				Total (I Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
1st Year II Semester	2.1	GENG-102-T	15002	General English	1.5 Hrs.	2	--	2	--	50	50	--	20
	2.2	PHY-231-T	15521	Physics-II	3 Hrs.	4	--	4	30	70	100	12	28
	2.3	PHY-231-P	15522	Physics Practical-II	6 Hrs.	--	4	2	--	50	50	--	25
	2.4	CHE-232-T	15523	Chemistry-II	3 Hrs.	4	--	4	30	70	100	12	28
	2.5	CHE-232-P	15524	Chemistry Practical-II	6 Hrs.	--	4	2	--	50	50	--	25
	2.6	MAT-237-T	15531	Mathematics-II	3 Hrs.	4	--	4	30	70	100	12	28
	2.7	MAT-237-P	15532	Mathematics Practical-II	6 Hrs.	--	4	2	--	50	50	--	25
				Total (II Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
				Total (I and II Semesters)	**57.0 Hrs.**	**28**	**24**	**40**	**180**	**820**	**1000**	**72**	**358**
2nd Year III Semester	3.1	PHY-------	-----	Physics-III	3 Hrs.	4	--	4	30	70	100	12	28
	3.2	PHY-------	-----	Physics Practical-III	6 Hrs.	--	4	2	--	50	50	--	25
	3.3	CHE ---- T	-----	Chemistry-III	3 Hrs.	4	--	4	30	70	100	12	28
	3.4	CHE ---- P	-----	Chemistry Practical-III	6 Hrs.	--	4	2	--	50	50	--	25
	3.5	MAT------	-----	Mathematics-III	3 Hrs.	4	--	4	30	70	100	12	28
	3.6	MAT------	-----	Mathematics Practical-III	6 Hrs.	--	4	2	--	50	50	--	25
	3.7	GEC------	-----	Environmental Studies	1.5 Hrs.	2	--	2	--	50	50	--	20
				Total (III Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
2nd Year IV Semester	4.1	PHY-------	-----	Physics-IV	3 Hrs.	4	--	4	30	70	100	12	28
	4.2	PHY-------	-----	Physics Practical-IV	6 Hrs.	--	4	2	--	50	50	--	25
	4.3	CHE ---- T	-----	Chemistry-IV	3 Hrs.	4	--	4	30	70	100	12	28
	4.4	CHE ---- P	-----	Chemistry Practical-IV	6 Hrs.	--	4	2	--	50	50	--	25
	4.5	MAT------	-----	Mathematics-IV	3 Hrs.	4	--	4	30	70	100	12	28
	4.6	MAT------	-----	Mathematics Practical-IV	6 Hrs.	--	4	2	--	50	50	--	25
	4.7	GEC------	-----	Elementary Computer Applications	1.5 Hrs.	2	--	2	--	50	50	--	20
				Total (IV Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
				Total (III and IV Semesters)	**57.0 Hrs.**	**28**	**24**	**40**	**180**	**820**	**1000**	**72**	**358**

Year / Semester	Number, Code and Nomenclature of Paper				Duration of Examination	Teaching (Hrs./Week) and Credits			Distribution of Maximum Marks			Minimum Pass Marks	
	Number of Paper	Code of Paper	Exam. Code	Nomenclature of Paper		Lecture (L)	Practical (P)	Credit (C)	Internal Assess.	Sem. Assess.	Total	Internal Assess.	Sem. Assess.
3rd Year V Semester	5.1(a)	PHY-------	-----	Physics-V(a): Elective	3 Hrs.	4	--	4	30	70	100	12	28
	5.1(b)	PHY-------	-----	Physics-V(b): Elective									
	5.1(c)	PHY-------	-----	Physics-V(c): Elective									
	5.2(a)	PHY-------	-----	Physics Practical-V(a): Elective	6 Hrs.	--	4	2	--	50	50	--	25
	5.2(b)	PHY-------	-----	Physics Practical-V(b): Elective									
	5.2(c)	PHY-------	-----	Physics Practical-V(c): Elective									
	5.3(a)	CHE ---- T(a)	-----	Chemistry-V(a): Inorganic Chemistry	3 Hrs.	4	--	4	30	70	100	12	28
	5.3(b)	CHE ---- T(b)	-----	Chemistry-V(b): Organic Chemistry									
	5.3(c)	CHE ---- T(c)	-----	Chemistry-V(c): Physical Chemistry									
	5.4(a)	CHE ---- P(a)	-----	Chemistry Practical-V(a): Inorganic Chemistry Practical	6 Hrs.	--	4	2	--	50	50	--	25
	5.4(b)	CHE ---- P(b)	-----	Chemistry Practical-V(b): Organic Chemistry Practical									
	5.4(c)	CHE ---- P(c)	-----	Chemistry Practical-V(c): Physical Chemistry Practical									
	5.5(a)	MAT------	-----	Mathematics-V(a): Elective	3 Hrs.	4	--	4	30	70	100	12	28
	5.5(b)	MAT------	-----	Mathematics-V(b): Elective									
	5.5(c)	MAT------	-----	Mathematics-V(c): Elective									
	5.6(a)	MAT------	-----	Mathematics Practical-V(a):	6 Hrs.	--	4	2	--	50	50	--	25
	5.6(b)	MAT------	-----	Mathematics Practical-V(b):									
	5.6(c)	MAT------	-----	Mathematics Practical-V(c):									
	5.7	VAC------	-----	Value Added Course	1.5 Hrs.	2	--	2	--	50	50	--	20
				Total (V Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
3rd Year VI Semester	6.1(a)	PHY-------	-----	Physics-VI(a): Elective	3 Hrs.	4	--	4	30	70	100	12	28
	6.1(b)	PHY-------	-----	Physics-VI(b): Elective									
	6.1(c)	PHY-------	-----	Physics-VI(c): Elective									
	6.2(a)	PHY-------	-----	Physics Practical-VI(a): Elective	6 Hrs.	--	4	2	--	50	50	--	25
	6.2(b)	PHY-------	-----	Physics Practical-VI(b): Elective									
	6.2(c)	PHY-------	-----	Physics Practical-VI(c): Elective									
	6.3(a)	CHE ---- T(a)	-----	Chemistry-VI(a): Inorganic Chemistry	3 Hrs.	4	--	4	30	70	100	12	28
	6.3(b)	CHE ---- T(b)	-----	Chemistry-VI(b): Organic Chemistry									
	6.3(c)	CHE ---- T(c)	-----	Chemistry-VI(c): Physical Chemistry									
	6.4(a)	CHE ---- P(a)	-----	Chemistry Practical-VI(a): Inorganic Chemistry Practical	6 Hrs.	--	4	2	--	50	50	--	25
	6.4(b)	CHE ---- P(b)	-----	Chemistry Practical-VI(b): Organic Chemistry Practical									
	6.4(c)	CHE ---- P(c)	-----	Chemistry Practical-VI(c): Physical Chemistry Practical									
	6.5(a)	MAT------	-----	Mathematics-VI(a): Elective	3 Hrs.	4	--	4	30	70	100	12	28
	6.5(b)	MAT------	-----	Mathematics-VI(b): Elective									
	6.5(c)	MAT------	-----	Mathematics-VI(c): Elective									
	6.6(a)	MAT------	-----	Mathematics Practical-VI(a): Elective	6 Hrs.	--	4	2	--	50	50	--	25
	6.6(b)	MAT------	-----	Mathematics Practical-VI(b): Elective									
	6.6(c)	MAT------	-----	Mathematics Practical-VI(c): Elective									
	6.7	SEC------	-----	Skill Enhancement Course	1.5 Hrs.	2	--	2	--	50	50	--	20
				Total (VI Semester)	**28.5 Hrs.**	**14**	**12**	**20**	**90**	**410**	**500**	**36**	**179**
				Total (V and VI Semesters)	**57.0 Hrs.**	**28**	**24**	**40**	**180**	**820**	**1000**	**72**	**358**
				Grand Total of Three-Year B.Sc. Degree Programme (I to VI Semesters)	**171.0 Hrs.**	**84**	**72**	**120**	**540**	**2460**	**3000**	**216**	**1074**

University of Kota, Kota

Bachelor of Science (B.Sc.): Mathematics (PCM) and Biology (BCZ) Groups

B.Sc. Chemistry

Semester Scheme of Examination

Year / Semester	Number, Code and Nomenclature of Paper				Duration of Examination	Teaching (Hrs./Week) and Credits			Distribution of Maximum Marks			Minimum Pass Marks	
	Number of Paper	Code of Paper	Exam Code	Nomenclature of Paper		Lecture (L)	Practical (P)	Credits (C)	Internal Assess.	Sem. Assess.	Total Marks	Internal Assess.	Sem. Assess.
1st Year I Semester	1.3	CHE-132-T	15503	Chemistry-I	3 Hrs.	4	--	4	30	70	100	12	28
	1.4	CHE-132-P	15504	Chemistry Practical-I	6 Hrs.	--	4	2	--	50	50	--	25
1st Year II Semester	2.3	CHE-232-T	15523	Chemistry-II	3 Hrs.	4	--	4	30	70	100	12	28
	2.4	CHE-232-P	15524	Chemistry Practical-II	6 Hrs.	--	4	2	--	50	50	--	25
2nd Year III Semester	3.3	CHE ----T	-----	Chemistry-III	3 Hrs.	4	--	4	30	70	100	12	28
	3.4	CHE ---- P	-----	Chemistry Practical-III	6 Hrs.	--	4	2	--	50	50	--	25
2nd Year IV Semester	4.3	CHE ---- T	-----	Chemistry-IV	3 Hrs.	4	--	4	30	70	100	12	28
	4.4	CHE ---- P	-----	Chemistry Practical-IV	6 Hrs.	--	4	2	--	50	50	--	25
3rd Year V Semester	5.3(a)	CHE ---- T(a)	-----	Chemistry-V(a): Inorganic Chemistry	3 Hrs.	4	--	4	30	70	100	12	28
	5.3(b)	CHE ---- T(b)	-----	Chemistry-V(b): Organic Chemistry									
	5.3(c)	CHE ---- T(c)	-----	Chemistry-V(c): Physical Chemistry									
	5.4(a)	CHE ---- P(a)	-----	Chemistry Practical-V(a): Inorganic Chemistry Practical	6 Hrs.	--	4	2	--	50	50	--	25
	5.4(b)	CHE ---- P(b)	-----	Chemistry Practical-V(b): Organic Chemistry Practical									
	5.4(c)	CHE ---- P(c)	-----	Chemistry Practical-V(c): Physical Chemistry Practical									
3rd Year VI Semester	6.3(a)	CHE ---- T(a)	-----	Chemistry-VI(a): Inorganic Chemistry	3 Hrs.	4	--	4	30	70	100	12	28
	6.3(b)	CHE ---- T(b)	-----	Chemistry-VI(b): Organic Chemistry									
	6.3(c)	CHE ---- T(c)	-----	Chemistry-VI(c): Physical Chemistry									
	6.4(a)	CHE ---- P(a)	-----	Chemistry Practical-VI(a): Inorganic Chemistry Practical	6 Hrs.	--	4	2	--	50	50	--	25
	6.4(b)	CHE ---- P(b)	-----	Chemistry Practical-VI(b): Organic Chemistry Practical									
	6.4(c)	CHE ---- P(c)	-----	Chemistry Practical-VI(c): Physical Chemistry Practical									

B.Sc. Chemistry (Biology and Mathematics Groups): Semester Wise Summary of Theory and Practical Contents

Sem	Course Type	Unit	Contents Inorganic Chemistry + Organic Chemistry + Physical Chemistry	Sem	Course Type	Unit	Contents Inorganic Chemistry + Organic Chemistry + Physical Chemistry
I	Discipline Centric Core (DCC) Course	I	Atomic Structure, Electronic Configuration	II	Discipline Centric Core (DCC) Course	I	Ionic Bonding, Metallic Bonding, Weak Interaction Forces
		II	Periodic Table, Periodic Properties			II	Covalent Bonding
		III	Basics of Organic Chemistry			III	Alkanes, Cycloalkanes
		IV	Stereochemistry			IV	Liquid State, Solid State
		V	Gaseous State			V	Chemical Kinetics, Catalysis
		Practical	Laboratory Safety and Working. Inorganic Chemistry: Semimicro Analysis Organic Chemistry: MPs and BPs, Purifications, Stereochemistry, Qualitative Analysis Physical Chemistry: Calibration and use of apparatus, Solution Preparation, Surface Tension, Viscosity			Practical	Inorganic Chemistry: Semimicro Analysis Organic Chemistry: Qualitative Analysis, Paper Chromatography Physical Chemistry: Chemical Kinetics, Volumetric Analysis
Sem	**Course Type**	**Unit**	**Contents Inorganic Chemistry + Organic Chemistry + Physical Chemistry**	**Sem**	**Course Type**	**Unit**	**Contents Inorganic Chemistry + Organic Chemistry + Physical Chemistry**
III	Discipline Centric Core (DCC) Course	I	Chemistry of *s*-Block Elements	IV	Discipline Centric Core (DCC) Course	I	Chemistry of *p*-Block Elements
		II	Alkenes, Dienes, Alkynes			II	Coordination Compounds
		III	Arenes and Aromaticity, Alkyl and Aryl Halides			III	Nitroalkanes and Nitroarenes, Alkyl and Aryl Amines
		IV	Chemical Thermodynamics			IV	Alcohols and Phenols, Ethers and Epoxides
		V	Solutions, Colligative Properties			V	Chemical Equilibrium, Ionic Equilibrium
		Practical	Inorganic Chemistry: Quantitative Analysis, Chromatography Organic Chemistry: Qualitative Analysis, Thin Layer Chromatography Physical Chemistry: Thermochemistry, Transition Temperature			Practical	Inorganic Chemistry: Gravimetric Analysis, Inorganic Preparations Organic Chemistry: Organic Synthesis, Column Chromatography Physical Chemistry: Ionic Equilibrium, Molecular Weight Determination

Sem	Course Type	Unit	Elective: V(a): Inorganic Chemistry	Elective: V(b): Organic Chemistry	Elective: V(c): Physical Chemistry
V	Discipline Specific Elective (DSE) Course	I	Chemistry of *d*-Block Elements, Part-I: • Chemistry of I, II and III Transition Series	Carbonyl Compounds	Phase Equilibrium
		II	Chemistry of *d*-Block Elements, Part-II: • Metal-Ligand Bonding in Transition Metal Complexes • Thermodynamic & Kinetic Aspects of Metal Complexes	Carboxylic Acids & their Derivatives, Organic Synthesis via Enolates	Electrochemistry-I
		III	Chemistry of *d*-Block Elements, Part-III: • Magnetic & Electronic Properties of Transition Metal Complexes	Synthetic Polymers, Synthetic Dyes, Fats and Lipids	Electrochemistry-II
		IV	Chemistry of *f*-Block Elements • Chemistry of Lanthanides, Chemistry of Actinides	Amino Acids, Peptides, Proteins	Surface Chemistry, Micelles
		V	Chemistry of Noble Gases, Inorganic Polymers	Enzymes	Photochemistry
		Practical	Complexometric Titrations, Iodo/Iodimetric Titrations, Acid-Base Titrations, Redox Titrations	Oils and Fats, Amino acids and Proteins, Organic Synthesis	Distribution Law, Phase Equilibrium, Conductometry, Electrochemistry
Sem	**Course Type**	**Unit**	**Elective: VI(a): Inorganic Chemistry**	**Elective: VI(b): Organic Chemistry**	**Elective: VI(c): Physical Chemistry**
VI	Discipline Specific Elective (DSE) Course	I	Acids and Bases, Hard and Soft Acids and Bases, Non-aqueous Solvents, Oxidation-Reduction	Heterocyclic Compounds	Quantum Chemistry-I
		II	Organometallic Compounds-I	Carbohydrates, Nucleic Acids	Quantum Chemistry-II
		III	Organometallic Compounds-II	Ultraviolet Spectroscopy, Infrared Spectroscopy	Principles of Spectroscopy, Rotational Spectroscopy
		IV	Nuclear Chemistry	NMR Spectroscopy	Vibrational Spectroscopy, Raman Spectroscopy
		V	Bioinorganic Chemistry	Mass Spectrometry, Structure Elucidation	Electronic Spectroscopy, Atomic Spectroscopy
		Practical	Instrumentation, Colorimetry, Spectrophotometry, Flame Photometry	Estimation, Carbohydrates, Enzymes, Spectroscopy	Potentiometry, Refractometry & Polarimetry, Adsorption, UV-VIS.

Note: If a student opts any one paper out of Inorganic Chemistry, Organic Chemistry and Physical Chemistry in the V semester then it is mandatory that student will opt the same paper only in the VI semester, it means, if a student opts Inorganic Chemistry in the V semester, then he/she will opt Inorganic Chemistry only in the VI semester or if a student opt Organic Chemistry in the V semester, then he/she will opt Organic Chemistry only in the VI semester or if a student opt Physical Chemistry in the V semester, then he/she will opt Physical Chemistry only in the VI semester.

Rules & Regulations

Course Learning Objectives:

Bachelor of Science (B.Sc.) course with chemistry as a subject is a pioneer model of the University. Objectives of the course is to provide thorough theoretical and experimental knowledge of all the branches of the chemistry including inorganic chemistry, organic chemistry, physical chemistry, environmental chemistry, *etc.* along with communication and presentation skills of the students.

Course Learning Outcomes:

Upon successful completion of the course, students will be able to understand basic facts and concepts of chemistry including atomic structure, electronic configuration, chemistry of elements, stereochemistry, organic compounds, matter states, chemical kinetics, catalysis, thermodynamics, solutions, colligative properties, equilibrium, semimicro analysis, qualitative analysis, qualitative analysis, gravimetric analysis, purifications, chromatography, inorganic and organic synthesis, solution preparation, surface tension, viscosity, thermochemistry, *etc*. The students shall be eligible to take admission for higher studies in different branches of the chemical sciences and able to do research in the different areas of chemical sciences or allied fields and shall be placed in different organizations / institutions where skilled chemical science professionals are required.

Course Duration:

The course Bachelor of Science (B.Sc.) Pass Course shall consist of three academic years divided in to the six semesters. B.Sc. (Pass Course) degree shall be awarded to the candidates after successful completion of the six-semester programme of study.

Eligibility for Admission:

- **B.Sc. (Pass Course) Biology Group:**
  A candidate who has passed qualifying examination *i.e.* 10+2 or equivalent examination with Physics, Chemistry and Biology or Physics, Chemistry and Mathematics with Biology as additional subject from any recognized board shall be permitted to take admission in B.Sc. First Semester to award B.Sc. (Pass Course) degree in Biology group from this University.

- **B.Sc. (Pass Course) Mathematics Group:**
  A candidate who has passed qualifying examination *i.e.* 10+2 or equivalent examination with Physics, Chemistry and Mathematics or Physics, Chemistry and Biology with Mathematics as additional subject from any recognized board shall be permitted to take admission in B.Sc. First Semester to award B.Sc. (Pass Course) degree in Mathematics group from this University.

Minimum Marks required in the Qualifying Examination:

- Qualifying examination passed from Rajasthan State or Bonafide Resident of Rajasthan:
  - General Category = 48%.
  - SC/ST/OBC/SBC or MBC = Min. Pass Marks
- Qualifying examination passed from other state than Rajasthan or not a Bonafide Resident of Rajasthan:
  - All Categories = 60%.

Attendance:

Every teaching faculty, handling a course, shall be responsible for the maintenance of Attendance Register for candidates who have registered for the course. The teacher of the course must intimate the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students. Each student should earn 75% attendance in the courses of the particular semester failing which he or she will not be permitted to sit in the End-Semester Examinations. However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons and such exemptions should not under any circumstance be granted for attendance below 65%.

Course Number, Course Code or ID and Nomenclature:

The course code for UG course may be fixed by taking the first three alphabets of the subject, following by the four numerical digits of examination paper code and T/P. T and P correspond to theoretical nature and practical nature of the subject respectively. For example, if the course is B.Sc. Chemistry theory paper, then the course code will be CHE9604T and if the course is B.Sc. Chemistry practical paper, then the course code will be CHE9604P.

Maximum Marks and Credit Points:

Maximum marks of a theory and practical paper shall be decided on the basis of their contact hours / per week. One teaching hour per week shall equal to one credit and carry 25 maximum marks. Therefore, 4 teaching hours/week having 4 credit points shall carry 100 maximum marks for each theory paper/course. While two contact hours per week for a laboratory or practical work shall be equal to one credit point. Therefore, 4 contact hours / week shall equal to 2 credit points and shall carry 50 maximum marks.

Course Structure:

The B.Sc. (Pass Course) course consists of discipline centric core, discipline specific electives along with ability enhancement course, generic elective course, value aided course and skill enhancement course under Choice Based Credit System (CBCS) as per the details of the course structure given below:

S. No.	Nature of Paper / Course	Semesters Wise Papers/Course along with Credits of Theory and Practical Components						Total Credits
		I	II	III	IV	V	VI	
1.	Discipline Centric Core (DCC) Course	Subject-I (4T+2P = 6Cr) Subject-II (4T+2P = 6Cr) Subject-III (4T+2P = 6Cr)	Subject-I (4T+2P = 6Cr) Subject-II (4T+2P = 6Cr) Subject-III (4T+2P = 6Cr)	Subject-I (4T+2P = 6Cr) Subject-II (4T+2P = 6Cr) Subject-III (4T+2P = 6Cr)	Subject-I (4T+2P = 6Cr) Subject-II (4T+2P = 6Cr) Subject-III (4T+2P = 6Cr)	--	--	**24** **24** **24** **…….** **72**
2.	Discipline Specific Elective (DSE) Course	--	--	--	--	Subject-I (4T+2P = 6Cr) Subject-II (4T+2P = 6Cr) Subject-III (4T+2P = 6Cr)	Subject-I (4T+2P = 6Cr) Subject-II (4T+2P = 6Cr) Subject-III (4T+2P = 6Cr)	**12** **12** **12** **…….** **36**
3.	Ability Enhancement Compulsory (AEC) Course	General Hindi / General English (2 Cr)	General English / General Hindi (2 Cr)	--	--	--	--	**04**
4.	Generic Elective Course (GEC)	--	--	Environmental Science (2 Cr)	Elementary Computer Applications (2 Cr)	--	--	**04**

5.	Value Added Course (VAC)	--	--	--	--	Mulya Pravah (2 Cr)	--	**02**
6.	Skill Enhancement Course (SEC)	--	--	--	--	--	Skill Enhancement Course (2 Cr)	**02**
Total Credits		**20**	**20**	**20**	**20**	**20**	**20**	**120**

Teaching Methodologies:

The classroom teaching would be through conventional lectures by using blackboards or use of OHPs or LCDs for power point presentations (PPT). The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill. In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually. For the students of slow learners, special attention would be given.

Assessment Pattern:

The assessment of the students shall be divided into two parts in which first part is continuous or mid-term or internal assessment (30% weightage of the maximum marks) and second part is semester or end-term or external assessment (70% weightage of the maximum marks).

(i) Continuous / Mid-Term / Internal Assessment:

(a) The continuous or mid-term or internal assessment for each theory paper shall be taken by the faculty members in the Department during each semester. Internal assessment part is further divided in two parts of equal weightage of marks as per the details given below:

Continuous Assessment	**Modes of Assessments**		**Max. Marks**
	Collegiate (Regular) Students	**Non-collegiate (Private) Students**	
Cont. Assess-I	Written Examination	Report Writing	20
Cont. Assess-II	Assignment / Project Report / Seminar / Presentation / Quiz / GD / Viva-voce	Viva-voce	10

Note: *In the Continuous/Mid-Term/Internal Assessment-I, written examination shall be of one hour duration for each theory paper and shall be taken according to the academic calendar which will be notified by the Department. Time duration for Continuous/Mid-Term/Internal Assessment-II is not allotted. It will be decided by the faculty member which will be taking second internal assessment.*

(b) For practical papers, there will not be continuous or mid-term or internal assessment. There will be only one external or end-term or semester assessment having 100% weightage of maximum marks.

(c) A student, who remains absent (defaulter) or fails or wants to improve the marks in the continuous or mid-term or internal assessment, may be permitted to appear in the desired paper(s) in same semester and one time only with the permission of the concern Head of the Department. Defaulter/improvement fee of Rupees 250/- per paper shall be taken from such candidates. Duly forwarded application of such student by the Head of the Department, who may permit the such candidates to appear in the continuous or mid-term or internal assessment

after production of satisfactory evidence about the reason of his/her absence in the test(s) and deposition of the defaulter/improvement fee, shall be sent to the concerned teacher to take the continuous or mid-term or internal assessment of such candidates. A record of such candidates shall be kept in the Department.

(d) Regular attendance of the student shall be considered in the internal assessment. Marks (equal to 10% of internal assessment) may be given to the student(s) for regularity who is/are taken classes regularly. If the attendance/regularity factor is similar for all the students, then weightage marks for regularity may be merged in the weightage of second internal assessment (seminar / presentation / assignment / dissertation / quiz / group discussion / viva-voce, *etc.*).

(e) Paper wise consolidated marks for each theory paper and dissertation / seminar (*i.e.* total marks obtained during various modes of internal assessment) obtained by the students (out of the 30% weightage of the maximum marks of each paper) shall be forwarded by the Head of the Department (in two copies) to the Controller of Examinations of the University within a week from the date of last internal assessment test for incorporation in the tabulation register.

(f) The consolidated marks obtained by the students be also made known to them before being communicated by the concerned Head of the Department to the University for final incorporation in the tabulation register. If any discrepancies are discovered or pointed out by the students, the same shall be looked into by the concerned faculty member and corrections made, wherever necessary. The decision of the Head of the Department before the communication of marks to the University shall be final. No corrections shall be made in the internal assessment marks after the declaration of the result by the University.

(g) Consolidated marks of internal assessment obtained out of the 30% weightage of maximum marks of each theory paper which will be communicated to the University shall be in whole number and not in fraction. Marks awarded for the various internal assessments in each paper shall be added up and then round off to the next whole number to avoid any fraction.

(h) All test copies and other material related to the internal assessment shall also be sent to the Controller of Examinations of the University to keep in record as per the University guidelines.

(i) The concerned Head of the Department shall be responsible for proper conduct of internal assessment tests and for communication of the consolidated marks to the University within the prescribed time.

(j) The Head of the Department shall keep a record of the marks and also notify the same to the candidates immediately so that if any candidate is not satisfied with the award in any test or seasonal work, he / she should represent the matter to the higher authority.

(ii) Semester / End-Term / External Assessment:

(a) The semester or end-term or external assessment (70% weightage of the maximum marks) shall be 03 hours duration to each theory paper and 06 hours duration for each practical paper and shall be taken by the University at the end of each semester.

(b) The syllabus for each theory paper is divided into five independent units.

Question Paper Pattern:

(A) Continuous / Mid-Term / Internal Assessment:

30% weightage of Maximum Marks (30 Marks out of 100 Maximum Marks).

For Collegiate (Regular) Students

(i) Continuous / Mid-Term / Internal Assessment-I (Max. Marks: 20):

Department of .....
University / College: .....
Address: .....

First Internal Assessment Test 20… - 20….
(Written Examination)

Name of Class/Course :	Max. Marks : 20 Marks
Name of Semester :	Duration of Exam. : 1.00 Hr
No. & Name of Paper :	Date of Exam. :

Q. No. 1. …… 05 Marks
or
……

Q. No. 2. …… 05 Marks
or
……

Q. No. 3. …… 05 Marks
or
……

Q. No. 4. …… 05 Marks
or
……

(ii) Continuous / Mid-Term / Internal Assessment-II (Max. Marks: 10):

Department of .....
University / College: .....
Address .....

Second Internal Assessment Test 20… - 20….
(Seminar / Presentation / Project Report / Quiz / GD / Viva-voce)

Name of Class/Course:	Max. Marks : 10 Marks
Name of Semester :	Mode of Assessment :
No. & Name of Paper:	Date of Assessment :

Format for Compilation of Marks/Awards of Continuous/Mid-Term/Internal Assessment-I & II for Collegiate (Regular) Students

Department of .....
University / College: .....
Address .....

Name of Class/Course: .....
Name of Semester : .....

No. & Name of Paper: .....
Max. Marks : .....

S. No.	Name of Student	Father's Name	Marks Obtained			
			Internal Assessment-I (Written Examination)	Internal Assessment-II (Assignment / Project Report / Seminar / Presentation / Quiz / GD / Viva-voce)	Total Marks (in Figure)	Total Marks (in Words)
1.						

Name & Signature of the Faculty Member

For Non-collegiate (Private) Students

(i) Continuous / Mid-Term / Internal Assessment-I (Max. Marks: 20):

Report Writing

Each private student of UG program will prepare a report on any topic of each course in minimum 1000 words from the prescribed syllabus of the concerned theory paper/course. The student needs to report the Concerned Department / College at the time prescribed by the College/University to submit the report and the College will arrange a Viva-voce on that report. It is proposed that the engaged teacher will be paid at the rate of per answer book per student charges. The examination section will generate an option of bill when the teacher fills the continuous assessment marks on examination portal (same as for external answer book evaluation). The various components of the report may be:

- Name of Course/Class :
- Name of Student :
- Father's/Husband Name :
- Examination Form No. :
- Enrollment No. :
- Name of College (Center) :
- Name of Paper :
- Title of Topic :
- No. of Unit of Topic (as per prescribed syllabus):
- Introduction about the Topic :
- Details/Analysis about the Topic :
- Conclusion of the Topic :
- References :

(ii) Continuous / Mid-Term / Internal Assessment-II (Max. Marks: 10):

Only Viva-voce will be taken by the concerned faculty member at Department level.

Format for Compilation of Marks/Awards of Continuous/Mid-Term/Internal Assessment-I & II for Non-collegiate (Private) Students

Department of .....
University / College: .....
Address .....

Name of Class/Course: .....
Name of Semester : .....
No. & Name of Paper: .....
Max. Marks : .....

S. No.	Name of Student	Father's Name	Marks Obtained			
			Internal Assessment-I (Report Writing)	Internal Assessment-II (Viva voce)	Total Marks (in Figure)	Total Marks (in Words)
1.						

Name & Signature of the Faculty Member

(B) Semester / End-Term / External / Assessment:

70% weightage of Maximum Marks (70 Marks out of 100 Maximum Marks).

Question Paper Pattern for Semester Examination

[Common for Collegiate (Regular) and Non-collegiate (Private) Students]

Duration of Examination: 3 Hours **Max. Marks: 70**

Note: *The syllabus is divided into five independent units and question paper will be divided into following two sections:*

- ***Section-A*** *will carry one compulsory question comprising 10 short answer type questions (answer about in 10-20 words) by taking two questions from each unit with no internal choice. Each short answer type question will have 2 marks and hence Section-A will carry total 20 marks.*
- ***Section-B*** *will carry 50 marks equally divided into five long answer type questions (answer about in 400-500 words) with one question from each unit with internal choice (another question will be given in option or question may be divided in to sub-divisions). Paper setter shall be advised to set one question from each unit along with one option of each question and students are instructed to attempt total five questions by selecting one question from each unit. Each long answer type question will have 10 marks and hence Section-B will carry total 50 marks.*

Section-A

Q. No. 1: Comprising 10 Short Answer Type Questions

Unit-I

(i) …… 02 Marks
(ii) …… 02 Marks

Unit-II

(iii) …… 02 Marks
(iv) …… 02 Marks

Unit-III

(v) …… 02 Marks
(vi) …… 02 Marks

Unit-IV

(vii) …… 02 Marks
(viii) …… 02 Marks

Unit-V

(ix) …… 02 Marks
(x) …… 02 Marks

Section-B

Unit-I

Q. No. 2: …….. 10 Marks

Or

……

Unit-II

Q. No. 3: …….. 10 Marks

Or

……

Unit-III

Q. No. 4: …….. 10 Marks

Or

……

Unit-IV

Q. No. 5: …….. 10 Marks

Or

……

Unit-V

Q. No. 6: …….. 10 Marks

Or

……

Practical Examinations:

Continuous / Mid-Term / Internal Assessment:

Not applicable in Practical Examinations.

Semester / End-Term / External Assessment:

Common for Collegiate (Regular) and Non-collegiate (Private) Students

Duration of Exam: 6 Hours **Maximum Marks: 50**

Distribution of Maximum Marks:

S. No.	Name of Exercise	Marks
1.	Exercise No. 1: ……..	10
2.	Exercise No. 2: ……..	10
3.	Exercise No. 3: ……..	10
4.	Practical Record	10
5.	Viva-voce	10
	Total Marks	**50**

Minimum Pass Marks and Rules regarding Determination of Results:

Each semester shall be regarded as a unit for working out the result of the candidates. The result of each semester examination shall be worked out separately (even if he/she has appeared at the paper of the lower semester along with the papers of higher semester) in accordance with the following conditions:

(a) The candidate shall be declared as pass in a semester examination, if he/she secures at least 40% marks in each theory paper separately in continuous/internal and semester / external examinations and 50% marks in each practical paper/project/dissertation with 40% aggregate marks in that semester.

(b) A candidate declared as fail/absent in one or more papers at any odd semester examination shall be permitted to take admission in the next higher semester (even semester) of the same academic session.

(c) A candidate may be promoted in the next academic session (odd semester), if he/she has cleared collectively at least 50% of the papers of both semesters of previous academic session. The candidate who does not fulfill the above condition will remain

as an ex-student and will re-appear in the due papers' examinations along with next odd/even semester examinations.

(d) If any student who is provisionally admitted in higher odd semester but could not secure prescribed minimum marks in previous semesters will be treated as ex-student and his/her admission fee will be carry forwarded to the next odd semester of forthcoming academic session.

(e) If a candidate, who is declared as pass, wants to improve his/her performance in the theory papers of just previous semester, he/she may re-appear only one time in these theory papers in next odd/even semester examinations.

(f) Candidate shall not be permitted to re-appear or improve the marks obtained in the external examination of practical/dissertation in any condition.

(g) If the number of papers prescribed in a semester examination is an odd number, it shall be increased by one for the purpose of reckoning 50% of the papers for considering the student pass/fail.

(h) A candidate may be given only two additional chances for passing the semester thus maximum tenure for completing for three years undergraduate programme up to five years and so on.

(i) The marks secured in the General Hindi, General English, Computer Applications and Environment Science shall not be counted in awarding the division to a candidate. The candidate shall have to clear the compulsory papers/subjects in the additional three chances and non-appearance or absence in the examination of compulsory papers/subjects shall be counted as chance and shall be declared fail in that examination.

(j) The grace marks scheme shall be applicable as per the University norms.

Classification of Successful Candidates:

(a) Each student shall be awarded a final letter grade at the end of the semester of the particular course. The letter grades and their corresponding grade points are given as:

Percentage of Marks Obtained	Performance	Grade Letter	Grade Point
90.00 – 100.00	Outstanding	O	10
80.00 – 89.99	Excellent	A^+	9
70.00 – 79.99	Very Good	A	8
60.00 – 69.99	Good	B^+	7
50.00 – 59.99	Above Average	B	6
45.00 – 49.99	Average	C	5
40.00 – 45.99	Below Average / Pass	P	4
00.00 – 39.99	Fail	F	0
--	Absent	AB	0
--	Unfair Means	UM	0
--	Withdrawn	W	0

(b) A candidate who remains absent for any semester examination shall be assigned a letter grade AB along with corresponding grade point zero. He/she will have to re-appear for the said examination in due paper/course.

(c) Semester Grade Point Average (SGPA): Performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses by the student during the semester. For example, if a student takes five papers (theory/practical) in a semester with credits C_1, C_2, C_3, C_4 and C_5 and the student's grade points in these courses are P_1, P_2, P_3, P_4 and P_5 respectively, then students' SGPA is calculated as:

$$SGPA = \frac{C_1P_1 + C_2P_2 + C_3P_3 + C_4P_4 + C_5P_5}{C_1 + C_2 + C_3 + C_4 + C_5} = \frac{\sum_{i=1}^{n} C_iP_i}{\sum_{i=1}^{n} C_i}$$

Where:

C_i: Number of credits earned in the i^{th} paper/course of semester for which SGPA is to be calculated.

P_i: Grade point earned in i^{th} paper/course.

i = 1, 2, 3, 4, ……..n : Represents the number of papers/courses in which a student has appeared in End of Semester Evaluation (EoSE).

The SGPA is calculated, as per example given below, up to two decimal points:

Paper/Course	**Credit (C)**	**Grade Letter**	**Grade Point (P)**	**Credit Point (CP)**	**SGPA**
Physics-I	4	A	8	4 x 8 = 32	ΣCP
Physics Practical-I	2	B^+	7	2 x 7 = 14	$= \frac{}{\Sigma C}$
Chemistry-I	4	A	8	4 x 8 = 32	
Chemistry Practical-I	2	B^+	7	2 x 7 = 14	$\frac{146}{20}$
Mathematics-I	4	A	8	4 x 8 = 32	$= \frac{}{20}$
Mathematics Practical-I	2	B	6	2 x 6 = 12	
General Hindi	2	C	5	2 x 5 = 10	
Total	**20**	**--**	**--**	**146**	= **7.30**

It should be noted that, the SGPA for any semester shall take into consideration the F and AB grade awarded in that semester. For example, if a student has a F or AB grade in paper/course 4, the SGPA shall then be computed as:

$$SGPA = \frac{C_1P_1 + C_2P_2 + C_3P_3 + C_4 \text{ x ZERO} + C_5P_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

(d) Cumulative Grade Point Average (CGPA): The CGPA is calculated with the SGPA of all the semesters up to two decimal points and is indicated in final grade report card / final transcript showing the grades of all the semesters and their papers/courses. The CGPA shall reflect the failed status in case of F grade(s), till the paper(s)/course(s) is/are passed. When the paper(s)/course(s) is/are passed by obtaining a pass grade on subsequent examination(s), the CGPA shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$CGPA = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4 + C_5S_5 + C_6S_6}{C_1 + C_2 + C_3 + C_4 + C_5 + C_6} = \frac{\sum_{i=1}^{n} C_iS_i}{\sum_{i=1}^{n} C_i}$$

Where:

C_1, C_2, C_3, … is the total number of credits for I, II, III, …. Semesters and S_1, S_2, S_3, … is the SGPA of I, II, III, …. Semesters.

The CGPA is calculated, as per example given below, up to two decimal points:

Semester	**Credit (C)**	**SGPA**	**C x SGPA (CS)**	**CGPA**
Semester-I	20	7.30	20 x 7.30 = 146.0	ΣCS = -------- ΣC
Semester-II	20	7.69	20 x 7.69 = 153.8	
Semester-III	20	7.23	20 x 7.23 = 144.6	
Semester-IV	20	7.86	20 x 7.86 = 157.2	925.80 = ------- 120
Semester-V	20	8.12	20 x 8.12 = 162.4	
Semester-VI	20	8.09	20 x 8.09 = 161.8	
Total	**120**	**--**	**925.80**	= **7.71**

(e) The classification of successful candidates after last semester examination shall be as under:

Description of Marks Obtained	**Division / Result**	**CGPA**
• 75% and above marks in a paper with Distinction	First Class with Distinction	CGPA 7.50 and above
• A candidate who has secured aggregate 60% and above marks	First Class/Division	CGPA 6.00 to 7.49
• A candidate who has secured aggregate 50% and above but less than 60% marks	Second Class/Division	CGPA 5.00 to 5.99
• A candidate who has secured aggregate 40% and above but less than 50% marks	Pass	CGPA 4.00 to 4.99
• A candidate who has secured aggregate below to the 40% marks	Fail	CGPA below 4.00

..... x ..... x ..... x .....

Syllabus

B.Sc. (Pass Course) Biology and Mathematics Groups

First Semester Examination

Paper-1.3: CHE-132-T (15503)
Chemistry-I

Contact Hours / Week	: 4 Hours / Week	Total Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

The syllabus is divided into five independent units and question paper will be divided into following two sections:

Section-A *will carry one compulsory question comprising 10 short answer type questions (answer about in 10-20 words) by taking two questions from each unit with no internal choice. Each short answer type question will have 2 marks and hence Section-A will carry total 20 marks.*

Section-B *will carry 50 marks equally divided into five long answer type questions (answer about in 400-500 words) with one question from each unit with internal choice (another question will be given in option or question may be divided in to sub-divisions). Paper setter shall be advised to set one question from each unit along with one option of each question and students are instructed to attempt total five questions by selecting one question from each unit. Each long answer type question will have 10 marks and hence Section-B will carry total 50 marks.*

Unit-I **Atomic Structure:**

Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle, Hydrogen atom spectra, time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations (only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number and magnetic spin quantum number.

Electronic Configurations:

Rules for filling electrons in various orbitals, Aufbau principle, Pauli's exclusion principles, Hund's rule of maximum multiplicity, stability of half-filled and completely filled orbitals, electronic configurations of the elements according to their position in the periods of periodic table, concept of exchange energy, relative energies of atomic orbitals, anomalous electronic configurations, effective nuclear charge.

Unit-II **Periodic Table:**

Mendeleev's periodic law, Mendeleev's periodic table, Mosley's periodic law, modern periodic law, long form of periodic table or modern periodic table, periodicity of property and magnetic numbers. Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in the periodic table.

Periodic Properties:

Atomic radii, ionic and crystal radii, covalent radii, factors affecting and variation of radii, determination of ionic radii, ionization enthalpy, successive ionization

enthalpies and factors affecting of ionization energy, applications of ionization enthalpy. Electron affinity, factors affecting and variation of electron affinity. Electronegativity, Pauling's, Mulliken's, Allred Rachow's and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio, electrode potentials and oxidation states.

Unit-III Basics of Organic Chemistry

Organic Compounds:

Classification and nomenclature, hybridization, shapes of molecules, influence of hybridization on bond properties, inclusion compounds, clathrates, charge transfer complexes.

Electronic Displacements:

Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; dipole moment; hydrogen bonding; organic acids and bases and their relative strengths.

Organic Reactive Intermediates:

Homolytic and Heterolytic fission with suitable examples, representation of various types of arrows used in chemical reactions, formal charges; electrophiles and nucleophiles; nucleophilicity and basicity; types, shape and their relative stability of Carbocations, Carbanions, Free radicals, Carbenes, Benzynes, Nitrenes.

Organic Reactions and their Mechanism:

Introduction, types, mechanisms of addition, elimination and substitution reactions.

Methods of Determination of Reaction Mechanism:

Product analysis, intermediates, isotope effects, kinetic and stereochemical studies.

Unit-IV Stereochemistry:

Concept of isomerism, types of isomerism.

Optical isomerism: Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration: Sequence rules, D & L and R & S systems of nomenclature.

Geometric Isomerism: Determination of configuration of geometric isomers, E & Z systems of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational Isomerism: Conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and sawhorse formulae, Fischer and Flying wedge formulae. Difference between configuration and conformation.

Unit-V Gaseous State:

Behaviour of Ideal Gases:

Kinetic molecular model of gases, Postulates and derivation of the kinetic gas equation, gas laws, collision frequency, collision diameter, mean free path and viscosity of gases including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η, variation of viscosity with temperature and pressure. Maxwell distribution and its

use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Behaviour of Real Gases:
Deviations from ideal gas behaviour, compressibility factor and its variation with pressure for different gases. Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Paper-1.4: CHE-132-P (15504)
Chemistry Practical-I

Contact Hours / Week : 4 Hours / Week
Duration of Examination : 6 Hours
Maximum Marks : 50 Marks
Semester Assessment : 50 Marks

Distribution of Marks:

S. No.	Name of Exercise	Marks
1.	Exercise No. 1: Inorganic Chemistry	10
2.	Exercise No. 2: Organic Chemistry	10
3.	Exercise No. 3: Physical Chemistry	10
4.	Practical Record	10
5.	Viva-voce	10
	Total Marks	**50**

Introduction to Laboratory Safety and Working:

- Safe working in chemical laboratories.
- Experiments and recording of results.
- Good laboratories practices (GLPs).
- Standard operating procedures (SOPs).
- Hazards in chemical laboratories.
- Introduction of working with lab ware.
- Proper uses of solvents and reagents.

Inorganic Chemistry:

Qualitative Semimicro Analysis:
Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

- Anions: CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_2^-, NO_3^-, SO_4^{2-}, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-},
- Cations: NH_4^+, Ag^+, Hg^+, Pb^{2+}, Hg^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, $Sn^{2+/4+}$, $As^{3+/5+}$, $Sb^{3+/5+}$, Fe^{3+}, Al^{3+}, Cr^{3+}, Mn^{2+}, Co^{2+}, Zn^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}.

Mixtures should preferably contain one interfering anion or insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or combination of anions *e.g.* CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^-, NO_3^- and I^-.

Organic Chemistry:

Determination of Melting Points and Boiling Points:

- Determination of melting points:
  - Naphthalene 80-82ºC, Benzoic acid 121.5-122ºC, Urea 132.5-133ºC, Succinic Acid 184.5-185ºC, Cinnamic acid 132.5-133ºC, Salicylic acid 157.5-158ºC, Acetanilide 113.5-114ºC, *m*-Dinitrobenzene 90ºC, *p*-Dichlorobenzene 52ºC, Aspirin 135ºC.
- Determination of boiling points:
  - Ethanol 78ºC, Cyclohexane 81.4ºC, Toluene 110.6ºC, Benzene 80ºC
- Determination of mixed melting points:
  - Urea-Cinnamic acid mixture of various compositions (1:4,1:1,4:1)

Purification of Organic Compounds:

- Distillation:
  - Simple distillation of ethanol-water using water condenser
  - Distillation of nitrobenzene and aniline using air condenser
  - Steam Distillation:
- Sublimation (Simple and vacuum)
  - Camphor, Naphthalene, phthalic acid and Succinic acid.
- Crystallization
  - Concept of induction of crystallization.
  - Phthalic acid from hot water (using fluted filter paper and stemless funnel).
  - Acetanilide from boiling water.
  - Naphthalene from Ethanol.
  - Benzoic acid from water.
- Decolorization and crystallization using charcoal
  - Decolorization of brown sugar (sucrose) with animal charcoal using gravity filtration.
  - Crystallization and decolorization of impure naphthalene (100g of naphthalene mixed with 0.3g. of Congo Red using l.0g decolorizing carbon) from ethanol.

Stereochemical Study of Organic Compounds via Models

- R and S configuration of optical isomers.
- E and Z configuration of geometrical isomers.
- Conformational analysis of cyclohexanes and substituted cyclohexanes.

Qualitative Analysis:

Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, ester, carbohydrates, amine, amide, nitro, anilide, glucose, fructose, *etc*.) in simple organic compounds.

Physical Chemistry:

Solution Preparation and Standardization:

- Preparation of solutions in terms of molarity, molality, formality, normality, w/w, w/v, v/v, percent, mole ratio, partial pressure and presentation of concentration in g/L, percent, ppt, ppm, ppb.
- Standardization of solutions.

Surface Tension:

- Determination of the surface tension of a liquid or a dilute solution by (i) drop number (ii) drop weight method.
- Study of the variation of surface tension of a detergent solution with concentration.

Viscosity:

- Determination of co-efficient of viscosity of an unknown aqueous solution
- Determination of the relative and absolute viscosity of a liquid or dilute solution.
- Study of the variation of viscosity of an aqueous solution with concentration of solute.

Suggested Books for Theory Papers:

Inorganic Chemistry:

- *Basic Inorganic Chemistry: F. A. Cotton and G. Wilkinson, Wiley Eastern*
- *Chemistry of the Elements, N.N. Greenwood and A. Earnshaw*
- *Shriver & Atkins' Inorganic Chemistry*
- *Concise Inorganic Chemistry: J. D. Lee, ELBS*
- *Theoretical Inorganic Chemistry, ACS Publications. M.C. Day and J. Selbin*
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- *Biological Inorganic Chemistry-An Introduction-Robert R. Crichton*
- *The Organometallic Chemistry of Transition Metals, 4e-Robert H Crabtree*
- *Organometallic Chemistry, Mehrotra and Singh. New Age International Publishers, 2ndEdn.*
- *Basic Organometallic Chemistry, 2ndEdn., Gupta B. D. and Elias A. J., University Press.*

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- *Organic Chemistry, Graham Solomons, John Wiley & Sons, Inc.*
- *Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.*
- *Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.*
- *Organic Chemistry (Volume 1), I.L. Finar, Dorling Kindersley (India) Pvt. Ltd.*
- *Organic Chemistry (Volume 2): Stereochemistry and the Chemistry of Natural Products, I.L. Finar, Dorling Kindersley (India) Pvt. Ltd.*
- *Organic Chemistry, Vol. I, II & III. Jag Mohan, R. Chand & Company*
- *Organic Chemistry, (Vol. I, II & III. S. M. Mukherji, S. P. Singh and R. P. Kapoor*
- *Stereochemistry of Carbon Compounds, Ernest L. Eliel, Tata McGraw Hill.*
- *Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.*
- *Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.*
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- *A Text Book of Organic Chemistry: B. S. Bahl and Arun Bahl*
- *A Text Book of Organic Chemistry: P. L. Soni & H.M. Chawla*
- *A Text Book of Organic Chemistry: (Vol. I & II) O. P. Agarwal*
- *Organic Synthesis: Jagadamba Singh and L.D.S. Yadav*
- *Principles of Organic Synthesis-Norman & Coxon*
- *Heterocyclic Chemistry at a Glance 2e by Joule & Mills Blackwell*
- *Heterocyclic Chemistry by RK Bansal*
- *Heterocyclic Chemistry Volume I and II by RR Gupta*
- *Fundamentals of Biochemistry 5e Voet & Voet*
- *Lehninger Principles of Biochemistry 4e Nelson & Cox*
- *Harper's Illustrated Biochemistry. XXVIII edition. Murray, Granner, Mayes and Rodwell. Lange Medical Books/ McGraw-Hill.*
- *Elementary Organic Spectroscopy, 5th Edition, Y R Sharma, S. Chand & Company.*
- *Organic Spectroscopy and Applications, Jag Mohan, Narosa Publishers*

- *Organic Spectroscopy, Kemp, W. Palgrave*

Physical Chemistry:

- *Atkins' Physical Chemistry, Oxford University Press*
- *Principles of Physical Chemistry: Prutton and Marron*
- *Elements of Physical Chemistry: Lewis Glasstone*
- *Principles of Physical Chemistry: B. R. Puri and L. R. Sharma*
- *A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand*
- *A Text Book of Physical Chemistry by K. L. Kapoor*
- *Modern Electrochemistry 2A-Fundamentals of Electrodics-Bockris, Reddy & Gamboa*
- *Introductory Quantum Chemistry, Chandra, A. K., Tata McGraw-Hill.*
- *Fundamentals of Quantum Chemistry, 2nd Ed. House, J. E., Elsevier*
- *Quantum Chemistry, Lowe, J. P. & Peterson, K. Academic Press.*
- *Fundamentals of Molecular Spectroscopy, 4th Ed. Banwell & McCash. Tata McGraw-Hill: New Delhi.*
- *Atomic & Molecular Spectroscopy, Kakkar, R. Cambridge University Press*
- *Fundamentals of Photochemistry, Rohatagi Mukherjee. Wiley Eastern Ltd.*

Analytical Chemistry:

- *Principles of Instrumental Analysis, Skoog, Holler and Nieman, Thomson Asia Pvt. Ltd. Singapore.*
- *Analytical Chemistry Vol-I Qualitative Analysis-Treadwell & Hall*
- *Analytical Chemistry Vol-II Quantitative Analysis-Treadwell & Hall*
- *Chemical Analysis-Modern Instrumentation Methods and Techniques, 2e-Francis Rouessac*
- *Handbook of Instrumental Techniques for Analytical Chemistry-Frank Settle*

Suggested Books for Practical Papers:

Inorganic Chemistry

- *Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis*
- *Vogel's Textbook of Quantitative Analysis, Bassett, Denney, Jeffery and Mendham*
- *Qualitative Analysis by Welcher and Hahn.*
- *Practical Chemistry: Giri Bajpai and Pandey, S. Chand & Co. Ltd., New Delhi.*

Organic Chemistry:

- *Vogel's Textbook of Practical Organic Chemistry, Tatchell, John Wiley.*
- *Macro scale and Micro scale Organic Experiments, K.L. Williamson, D.C. Health*
- *Practical Organic Chemistry, 5th Ed., Furniss, Hannaford, Smith, Tatchell. Pearson.*
- *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Ahluwalia & Aggarwal, University Press.*
- *Comprehensive Practical Organic Chemistry: Qualitative Analysis, Ahluwalia, & Dhingra, S., University Press.*
- *Laboratory Hand Book of Chromatographic & Allied Methods, Mikes, & Chalmes, Elles Harwood Ltd. London*

Physical Chemistry

- *Practical Physical Chemistry, James and Prichard, Longman.*
- *Findley's Practical Physical Chemistry, Levitt, Longman.*
- *Experimental Physical Chemistry, Das and Behera, Tata McGraw Hill.*
- *Experimental Physical Chemistry, Athawale & Mathur, New Age International: New Delhi.*
- *Senior Practical Physical Chemistry, Khosla, Garg, and Gulati. R. Chand & Co.: New Delhi*
- *Experiments in Physical Chemistry 8th Ed.; Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. McGraw-Hill: New York*
- *Experimental Physical Chemistry 3rdEd.; Halpern, A.M. & McBane, G. C. W.H. Freeman & Co.: New York.*
- *Experimental Physical Chemistry, J. N. Gurtu, R. Kapoor.*

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Syllabus

B.Sc. (Pass Course) Biology and Mathematics Groups

Second Semester Examination

Paper-2.3: CHE-232-T (15523)
Chemistry-II

Contact Hours / Week	: 4 Hours / Week	Total Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

The syllabus is divided into five independent units and question paper will be divided into following two sections:

Section-A *will carry one compulsory question comprising 10 short answer type questions (answer about in 10-20 words) by taking two questions from each unit with no internal choice. Each short answer type question will have 2 marks and hence Section-A will carry total 20 marks.*

Section-B *will carry 50 marks equally divided into five long answer type questions (answer about in 400-500 words) with one question from each unit with internal choice (another question will be given in option or question may be divided in to sub-divisions). Paper setter shall be advised to set one question from each unit along with one option of each question and students are instructed to attempt total five questions by selecting one question from each unit. Each long answer type question will have 10 marks and hence Section-B will carry total 50 marks.*

Unit-I **Ionic Bonding:**

General characteristics, energy considerations, inert pair effect, radius ratio rule and its limitations, lattice energy and their importance in the context of stability and solubility of ionic compounds, Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy, Madelung constant, Born-Haber cycle and its applications, solvation energy.

Metallic Bonding:

Qualitative idea of valence bond and band theories, semiconductors and insulators.

Weak Chemical Forces:

van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions, repulsive forces, hydrogen bonding (theories of hydrogen bonding, valence bond treatment), effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

Unit-II **Covalent Bonding:**

Covalency and maximum covalency, failure of octet rule, Lewis's structure, valence bond theory (Heitler-London approach) and its limitations, energetics of hybridization, equivalent and non-equivalent hybrid orbitals, Bent's rule, resonance and resonance energy, shapes of simple inorganic molecules and ions,

Molecular orbital theory (MOT), criteria for forming MO from AOs, bonding and anti-bonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, non-bonding combination of orbitals, MO diagrams of diatomic {homonuclear (N_2, O_2, C_2, B_2, F_2) and heteronuclear (CO, NO, HCl)} and polyatomic (BeF_2, CO_2) molecules and their ions, formal charge, Valence Shell Electron Pair Repulsion (VSEPR) theory, determination of shapes of simple molecules and ions containing lone pairs and bond pairs of electrons and by taking

suitable examples of AB_2 (linear), AB_3 (trigonal planar), AB_4 (square planar and tetrahedral), AB_5 (trigonal bipyramidal), AB_6 (octahedral) and AB_7 (pentagonal bipyramidal) types of species.

Comparison of VB and MO approaches, multiple bonding (σ and π bond approach), bond lengths, bond order, bond strength and bond energy.

Covalent character in ionic compounds: polarizing power and polarizability, factors affecting polarizability, Fajan's rules, consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment, percentage ionic character from dipole moment and electronegativity difference.

Unit-III Alkanes:

General methods of preparation (with special reference to Wurtz reaction, Wurtz-Fittig Reactions, Kolbe reactions, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reaction of alkanes. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Cycloalkanes:

General methods of preparations, chemical reactions, Baeyer's strain theory and its limitations, Ring strains in small rings (cyclopropane and cyclobutane), Chair, Boat and Twist boat forms of cyclohexane with energy diagrams, theory of strain less rings. The case of cyclopropane ring: banana bonds, relative stability of mono substituted cycloalkanes.

Unit-IV Liquid State:

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

Solid State:

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in solids. Glasses and liquid crystals.

Unit-V Chemical Kinetics:

Rate of a reaction, molecularity and order of reaction, factors influencing the rate of a reaction, concentration dependence of rates, mathematical characteristic of simple chemical reactions zero order, first order, second order, pseudo-order, half-life and mean life. Radioactive decay as a first order phenomenon. Determination of the order of reaction differential method, experimental methods of the determination of rate laws, kinetics of complex reactions: (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Theories of Chemical Kinetics:

Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory

(equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects (no derivation).

Catalysis:

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Paper-2.4: CHE-232-P (15524)
Chemistry Practical-II

Contact Hours / Week : 4 Hours / Week
Duration of Examination : 6 Hours
Maximum Marks : 50 Marks
Semester Assessment : 50 Marks

Distribution of Marks:

S. No.	Name of Exercise	Marks
1.	Exercise No. 1: Inorganic Chemistry	10
2.	Exercise No. 2: Organic Chemistry	10
3.	Exercise No. 3: Physical Chemistry	10
4.	Practical Record	10
5.	Viva-voce	10
	Total Marks	**50**

Inorganic Chemistry:

Qualitative Semimicro Analysis:

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

- Anions: CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_2^-, NO_3^-, SO_4^{2-}, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-},
- Cations: NH_4^+, Ag^+, Hg^+, Pb^{2+}, Hg^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, $Sn^{2+/4+}$, $As^{3+/5+}$, $Sb^{3+/5+}$, Fe^{3+}, Al^{3+}, Cr^{3+}, Mn^{2+}, Co^{2+}, Zn^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}.

Mixtures should preferably contain one interfering anion or insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or combination of anions *e.g.* CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^-, NO_3^- and I^-.

Organic Chemistry:

Qualitative Analysis:

Systematic qualitative analysis of an organic compounds through monofunctional group analysis (carboxylic, phenolic, aldehydic, ketonic, amide, nitro, amines, *etc.*), determination of melting point and preparation of suitable derivatives.

Paper Chromatography-Ascending and Circular:

Separation of a mixture of organic compounds and reporting of the R_f values:

- Separation of a mixture of phenyl alanine and glycine, alanine and aspartic acid, leucine and glutamic acid, or other combination of amino acids. Spray reagent-Ninhydrin.
- Separation of a mixture of D,L-alanine, glycine and L-leucine using n-butanol: acetic acid : water (4:1:5). Spray reagent-Ninhydrin.
- Separation of monosaccharides-a mixture of D-galactose and D-fructose using n-butanol : acetone : water (4:5:1). Spray reagent- Aniline hydrogen phthalate.

Physical Chemistry:

Chemical Kinetics:

Study the kinetics of the following reactions.

- Initial rate method: Iodide-persulphate reaction
- Integrated rate method:
  - Acid hydrolysis of methyl acetate and/or ethyl acetate with hydrochloric acid.
  - Saponification of ethyl acetate.
  - Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate and/or ethyl acetate

Volumetric Analysis:

- Determination of acetic acid in commercial vinegar using NaOH
- Determination of alkali content in antacid tablet using HCl.
- Estimation of calcium content in chalk as calcium oxalate by permanganatometry.

Suggested Books for Theory Papers:

Inorganic Chemistry:

- *Basic Inorganic Chemistry: F. A. Cotton and G. Wilkinson, Wiley Eastern*
- *Chemistry of the Elements, N.N. Greenwood and A. Earnshaw*
- *Shriver & Atkins' Inorganic Chemistry*
- *Concise Inorganic Chemistry: J. D. Lee, ELBS*
- *Theoretical Inorganic Chemistry, ACS Publications. M.C. Day and J. Selbin*
- *Advanced Inorganic Chemistry, Vol I & II. Satya Prakash, G.D. Tuli, S.K. Basu and R.D. Madan*
- *Principles of Inorganic Chemistry: B. R. Puri and L. R. Sharma*
- *Fundamentals of Inorganic Chemistry, Vol. I, Das, CBS Publications, 2nd Ed.*
- *Bioinorganic Chemistry-Bertini*
- *Biological Inorganic Chemistry-An Introduction-Robert R. Crichton*
- *The Organometallic Chemistry of Transition Metals, 4e-Robert H Crabtree*
- *Organometallic Chemistry, Mehrotra and Singh. New Age International Publishers, 2ndEdn.*
- *Basic Organometallic Chemistry, 2ndEdn., Gupta B. D. and Elias A. J., University Press.*

Organic Chemistry:

- *Organic Chemistry, Claydon, Nick Greeves and Stuart Warren, Oxford University Press*
- *Organic Chemistry, Graham Solomons, John Wiley & Sons, Inc.*
- *Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.*
- *Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.*
- *Organic Chemistry (Volume 1), I.L. Finar, Dorling Kindersley (India) Pvt. Ltd.*
- *Organic Chemistry (Volume 2): Stereochemistry and the Chemistry of Natural Products, I.L. Finar, Dorling Kindersley (India) Pvt. Ltd.*
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- *Fundamentals of Molecular Spectroscopy, 4th Ed. Banwell & McCash. Tata McGraw-Hill: New Delhi.*
- *Atomic & Molecular Spectroscopy, Kakkar, R. Cambridge University Press*
- *Fundamentals of Photochemistry, Rohatagi Mukherjee. Wiley Eastern Ltd.*

Analytical Chemistry:

- *Principles of Instrumental Analysis, Skoog, Holler and Nieman, Thomson Asia Pvt. Ltd. Singapore.*
- *Analytical Chemistry Vol-I Qualitative Analysis-Treadwell & Hall*
- *Analytical Chemistry Vol-II Quantitative Analysis-Treadwell & Hall*
- *Chemical Analysis-Modern Instrumentation Methods and Techniques, 2e-Francis Rouessac*
- *Handbook of Instrumental Techniques for Analytical Chemistry-Frank Settle*

Suggested Books for Practical Papers:

Inorganic Chemistry

- *Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis*
- *Vogel's Textbook of Quantitative Analysis, Bassett, Denney, Jeffery and Mendham*
- *Qualitative Analysis by Welcher and Hahn.*
- *Practical Chemistry: Giri Bajpai and Pandey, S. Chand & Co. Ltd., New Delhi.*

Organic Chemistry:

- *Vogel's Textbook of Practical Organic Chemistry, Tatchell, John Wiley.*
- *Macro scale and Micro scale Organic Experiments, K.L. Williamson, D.C. Health*
- *Practical Organic Chemistry, 5th Ed., Furniss, Hannaford, Smith, Tatchell. Pearson.*
- *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Ahluwalia & Aggarwal, University Press.*
- *Comprehensive Practical Organic Chemistry: Qualitative Analysis, Ahluwalia, & Dhingra, S., University Press.*
- *Laboratory Hand Book of Chromatographic & Allied Methods, Mikes, & Chalmes, Elles Harwood Ltd. London*

Physical Chemistry

- *Practical Physical Chemistry, James and Prichard, Longman.*
- *Findley's Practical Physical Chemistry, Levitt, Longman.*
- *Experimental Physical Chemistry, Das and Behera, Tata McGraw Hill.*
- *Experimental Physical Chemistry, Athawale & Mathur, New Age International: New Delhi.*
- *Senior Practical Physical Chemistry, Khosla, Garg, and Gulati. R. Chand & Co.: New Delhi*
- *Experiments in Physical Chemistry 8th Ed.; Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. McGraw-Hill: New York*
- *Experimental Physical Chemistry 3rdEd.; Halpern, A.M. & McBane, G. C. W.H. Freeman & Co.*
- *Experimental Physical Chemistry, J. N. Gurtu, R. Kapoor.*

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