

***SCHEME OF EXAMINATION  
AND  
SYLLABUS***

***(for Academic Session 2023-2024)***

**B.Sc. Chemistry  
Third & Fourth Semester Examination**

**This syllabus is only for the B.Sc. Course  
running under Semester Scheme  
at the University campus**

**Bachelor of Science (B.Sc.)  
Chemistry**

**Faculty of Science**



**UNIVERSITY OF KOTA**

**MBS Marg, KOTA (Rajasthan)-324 005**

**INDIA**

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

*Subject Combination: Chemistry, Mathematics, Physics (CMP)*

### B.Sc. First and Second Semesters Semester Scheme of Examination

Year / Semester	Number, Code or ID and Nomenclature of Paper			Duration of Exam. (in Hrs.)	Teaching Hrs. / Week & Credit Points			Distribution of Assessment Marks				Total Marks	
	Number of Paper	Code or ID of Paper	Nomenclature of Paper		Teaching Th.	Pr.	Credit Points	Continuous Assessment (20%)		Semester Assessment (80%)			
								Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks
<b>1st Year</b>	Paper-1.1	HIND-111	General Hindi	2	2	-	2	-	-	50	20	50	20
	Paper-1.2	ECA-112	Elementary Computer Applications	2	2	-	2	-	-	50	20	50	20
<b>I Semester</b>	Paper-1.3	CHEM-111	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.4	CHEM-112	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.5	CHEM-113	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.6	CHEM-114	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-1.7	MATH-111	Mathematics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-1.8	MATH-112	Mathematics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-1.9	MATH-113	Mathematics: Paper-III: Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-1.10	PHY-111	Physics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-1.11	PHY-112	Physics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-1.12	PHY-113	Physics: paper-III: Physics Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (I Semester)</b>				<b>39+4</b>	<b>30+4</b>	<b>24+4</b>	<b>90</b>	<b>36</b>	<b>510+100</b>	<b>219+40</b>	<b>600+100</b>	<b>195+40</b>	
<b>1st Year</b>	Paper-2.1	ENG-121	General English	2	2	-	2	-	-	50	20	50	20
	Paper-2.2	EVS-122	Environmental Studies	2	2	-	2	-	-	50	20	50	20
<b>II Semester</b>	Paper-2.3	CHEM-121	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.4	CHEM-122	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.5	CHEM-123	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.6	CHEM-124	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-2.7	MATH-121	Mathematics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-2.8	MATH-122	Mathematics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-2.9	MATH-123	Mathematics: Paper-III: Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-2.10	PHY-121	Physics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-2.11	PHY-122	Physics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-2.12	PHY-123	Physics: paper-III: Physics Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (II Semester)</b>				<b>39+4</b>	<b>30+4</b>	<b>24+4</b>	<b>90</b>	<b>36</b>	<b>510+100</b>	<b>219+40</b>	<b>600+100</b>	<b>195+40</b>	

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

Subject Combination: Chemistry, Mathematics, Physics (CMP)

### B.Sc. Third and Fourth Semesters Semester Scheme of Examination

Year / Semester	Number, Code or ID and Nomenclature of Paper			Duration of Exam. (in Hrs.)	Teaching Hrs. / Week & Credit Points		Distribution of Assessment Marks				Total Marks		
	Number of Paper	Code or ID of Paper	Nomenclature of Paper		Teaching Th.	Pr.	Credit Points	Continuous Assessment (20%)		Semester Assessment (80%)		Max. Marks	Min. Pass Marks
								Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks		
2nd Year III Semester	Paper-3.1	CHEM-231	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.2	CHEM-232	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.3	CHEM-233	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.4	CHEM-234	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-3.5	MATH-231	Mathematics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.6	MATH-232	Mathematics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.7	MATH-233	Mathematics: Paper-III: Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-3.8	PHY-231	Physics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.9	PHY-232	Physics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.10	PHY-233	Physics: paper-III: Physics Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (III Semester)</b>				<b>39</b>	<b>30</b>	<b>24</b>	<b>90</b>	<b>36</b>	<b>510</b>	<b>219</b>	<b>600</b>	<b>195</b>	
2nd Year IV Semester	Paper-4.1	CHEM-241	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.2	CHEM-242	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.3	CHEM-243	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.4	CHEM-244	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-4.5	MATH-241	Mathematics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-4.6	MATH-242	Mathematics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-4.7	MATH-243	Mathematics: Paper-III: Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-4.8	PHY-241	Physics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-4.9	PHY-242	Physics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-4.10	PHY-243	Physics: paper-III: Physics Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (IV Semester)</b>				<b>39</b>	<b>30</b>	<b>24</b>	<b>90</b>	<b>36</b>	<b>510</b>	<b>219</b>	<b>600</b>	<b>195</b>	

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

Subject Combination: Chemistry, Mathematics, Physics (CMP)

### B.Sc. Fifth and Sixth Semesters Semester Scheme of Examination

Year / Semester	Number, Code or ID and Nomenclature of Paper			Duration of Exam. (in Hrs.)	Teaching Hrs. / Week & Credit Points		Distribution of Assessment Marks				Total Marks		
	Number of Paper	Code or ID of Paper	Nomenclature of Paper				Continuous Assessment (20%)		Semester Assessment (80%)		Max. Marks	Min. Pass Marks	
					Teaching Th.	Pr.	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks			
<b>3rd Year</b>	Paper-5.1	CHEM-351	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
<b>V Semester</b>	Paper-5.2	CHEM-352	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-5.3	CHEM-353	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-5.4	CHEM-354	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-5.5	MATH-351	Mathematics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-5.6	MATH-352	Mathematics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-5.7	MATH-353	Mathematics: Paper-III: Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-5.8	PHY-351	Physics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-5.9	PHY-352	Physics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-5.10	PHY-353	Physics: paper-III: Physics Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (V Semester)</b>				<b>36</b>	<b>30</b>	<b>24</b>	<b>90</b>	<b>36</b>	<b>510</b>	<b>219</b>	<b>600</b>	<b>195</b>
<b>3rd Year</b>	Paper-6.1	CHEM-361	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
<b>VI Semester</b>	Paper-6.2	CHEM-362	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-6.3	CHEM-363	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-6.4	CHEM-364	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-6.5	MATH-361	Mathematics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-6.6	MATH-362	Mathematics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-6.7	MATH-363	Mathematics: Paper-III: Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-6.8	PHY-361	Physics: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-6.9	PHY-362	Physics: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-6.10	PHY-363	Physics: paper-III: Physics Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (VI Semester)</b>				<b>36</b>	<b>30</b>	<b>24</b>	<b>90</b>	<b>36</b>	<b>510</b>	<b>219</b>	<b>600</b>	<b>195</b>

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

Subject Combination: Chemistry, Botany, Zoology (CBZ)

B.Sc. First and Second Semesters

### Semester Scheme of Examination

Year / Semester	Number, Code or ID and Nomenclature of Paper			Duration of Exam. (in Hrs.)	Teaching Hrs. / Week & Credit Points			Distribution of Assessment Marks				Total Marks	
	Number of Paper	Code or ID of Paper	Nomenclature of Paper		Teaching Th.	Pr.	Credit Points	Continuous Assessment (20%)		Semester Assessment (80%)			
								Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks
1st Year	Paper-1.1	HIND-111	General Hindi	2	2	-	2	-	-	50	20	50	20
	Paper-1.2	ECA-112	Elementary Computer Applications	2	2	-	2	-	-	50	20	50	20
I Semester	Paper-1.3	CHEM-111	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.4	CHEM-112	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.5	CHEM-113	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.6	CHEM-114	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-1.7	BOT-111	Botany: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-1.8	BOT-112	Botany: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-1.9	BOT-113	Botany: Paper-III: Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-1.10	ZOO-111	Zoology: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-1.11	ZOO-112	Zoology: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-1.12	ZOO-113	Zoology: Paper-III: Zoology Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (I Semester)</b>				<b>39+4</b>	<b>30+4</b>	<b>24+4</b>	<b>90</b>	<b>36</b>	<b>510+100</b>	<b>219+40</b>	<b>600+100</b>	<b>195+40</b>
	1st Year	Paper-2.1	ENG-121	General English	2	2	-	2	-	-	50	20	50
Paper-2.2		EVS-122	Environmental Studies	2	2	-	2	-	-	50	20	50	20
II Semester	Paper-2.3	CHEM-121	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.4	CHEM-122	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.5	CHEM-123	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.6	CHEM-124	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-2.7	BOT-121	Botany: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-2.8	BOT-122	Botany: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-2.9	BOT-123	Botany: Paper-III: Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-2.10	ZOO-121	Zoology: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-2.11	ZOO-122	Zoology: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-2.12	ZOO-123	Zoology: Paper-III: Zoology Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (II Semester)</b>				<b>39+4</b>	<b>30+4</b>	<b>24+4</b>	<b>90</b>	<b>36</b>	<b>510+100</b>	<b>219+40</b>	<b>600+100</b>	<b>195+40</b>

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

Subject Combination: Chemistry, Botany, Zoology (CBZ)

### B.Sc. Third and Fourth Semesters Semester Scheme of Examination

Year / Semester	Number, Code or ID and Nomenclature of Paper			Duration of Exam. (in Hrs.)	Teaching Hrs. / Week & Credit Points		Distribution of Assessment Marks				Total Marks		
	Number of Paper	Code or ID of Paper	Nomenclature of Paper		Teaching Th.	Pr.	Credit Points	Continuous Assessment (20%)		Semester Assessment (80%)			
								Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks
2nd Year III Semester	Paper-3.1	CHEM-231	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.2	CHEM-232	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.3	CHEM-233	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.4	CHEM-234	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-3.5	BOT-231	Botany: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.6	BOT-232	Botany: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.7	BOT-233	Botany: Paper-III: Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-3.8	ZOO-231	Zoology: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.9	ZOO-232	Zoology: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.10	ZOO-233	Zoology: Paper-III: Zoology Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (III Semester)</b>				<b>39</b>	<b>30</b>	<b>24</b>	<b>90</b>	<b>36</b>	<b>510</b>	<b>219</b>	<b>600</b>	<b>195</b>	
2nd Year IV Semester	Paper-4.1	CHEM-241	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.2	CHEM-242	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.3	CHEM-243	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.4	CHEM-244	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-4.5	BOT-241	Botany: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-4.6	BOT-242	Botany: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-4.7	BOT-243	Botany: Paper-III: Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-4.8	ZOO-241	Zoology: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-4.9	ZOO-242	Zoology: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-3.10	ZOO-243	Zoology: Paper-III: Zoology Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (IV Semester)</b>				<b>39</b>	<b>30</b>	<b>24</b>	<b>90</b>	<b>36</b>	<b>510</b>	<b>219</b>	<b>600</b>	<b>195</b>	

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

Subject Combination: Chemistry, Botany, Zoology (CBZ)

### B.Sc. Fifth and Sixth Semesters Semester Scheme of Examination

Year / Semester	Number, Code or ID and Nomenclature of Paper			Duration of Exam. (in Hrs.)	Teaching Hrs. / Week & Credit Points		Distribution of Assessment Marks				Total Marks		
	Number of Paper	Code or ID of Paper	Nomenclature of Paper		Teaching Th.	Pr.	Credit Points	Continuous Assessment (20%)		Semester Assessment (80%)		Max. Marks	Min. Pass Marks
								Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks		
<b>3rd Year</b>	Paper-5.1	CHEM-351	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
<b>V Semester</b>	Paper-5.2	CHEM-352	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-5.3	CHEM-353	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-5.4	CHEM-354	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-5.5	BOT-351	Botany: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-5.6	BOT-352	Botany: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-5.7	BOT-353	Botany: Paper-III: Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-5.8	ZOO-351	Zoology: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-5.9	ZOO-352	Zoology: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-5.10	ZOO-353	Zoology: Paper-III: Zoology Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (V Semester)</b>				<b>39</b>	<b>30</b>	<b>24</b>	<b>90</b>	<b>36</b>	<b>510</b>	<b>219</b>	<b>600</b>	<b>195</b>
<b>3rd Year</b>	Paper-6.1	CHEM-361	Chemistry: Paper-I: Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
<b>VI Semester</b>	Paper-6.2	CHEM-362	Chemistry: Paper-II: Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-6.3	CHEM-364	Chemistry: Paper-III: Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-6.4	CHEM-364	Chemistry: Paper-IV: Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-6.5	BOT-361	Botany: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-6.6	BOT-362	Botany: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-6.7	BOT-363	Botany: Paper-III: Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-6.8	ZOO-361	Zoology: Paper-I: .....	3	3	-	3	15	06	60	24	75	30
	Paper-6.9	ZOO-362	Zoology: Paper-II: .....	3	3	-	3	15	06	60	24	75	30
	Paper-6.10	ZOO-363	Zoology: Paper-III: Zoology Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (VI Semester)</b>				<b>39</b>	<b>30</b>	<b>24</b>	<b>90</b>	<b>36</b>	<b>510</b>	<b>219</b>	<b>600</b>	<b>195</b>



## Bachelor of Science (B.Sc.): CHEMISTRY PAPER ONLY

*Subject Combination:* Chemistry, Physics, Mathematics (CPM) for Maths. group / Chemistry, Botany, Zoology (CBZ) for Bio. group

### Semester Scheme of Examination

Year / Semester	Number, Code or ID and Nomenclature of Paper			Duration of Exam. (in Hrs.)	Teaching Hrs. / Week & Credit Points			Distribution of Assessment Marks				Total Marks	
	Number of Paper	Code or ID of Paper	Nomenclature of Paper		Teaching Th.	Pr.	Credit Points	Continuous Assessment (20%)		Semester Assessment (80%)			
								Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks
<b>I Semester</b>	Paper-1.3	CHEM-111	Chemistry: Paper-I : Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.4	CHEM-112	Chemistry: Paper-II : Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.5	CHEM-113	Chemistry: Paper-III : Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-1.6	CHEM-114	Chemistry: Paper-IV : Chemistry Practical	6	-	4	2	--	--	50	25	50	25
				<b>12</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>30</b>	<b>12</b>	<b>170</b>	<b>73</b>	<b>200</b>	<b>85</b>
<b>II Semester</b>	Paper-2.3	CHEM-121	Chemistry: Paper-I : Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.4	CHEM-122	Chemistry: Paper-II : Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.5	CHEM-123	Chemistry: Paper-III : Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-2.6	CHEM-124	Chemistry: Paper-IV : Chemistry Practical	6	-	4	2	--	--	50	25	50	25
				<b>12</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>30</b>	<b>12</b>	<b>170</b>	<b>73</b>	<b>200</b>	<b>85</b>
<b>III Semester</b>	Paper-3.1	CHEM-231	Chemistry: Paper-I : Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.2	CHEM-232	Chemistry: Paper-II : Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.3	CHEM-233	Chemistry: Paper-III : Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-3.4	CHEM-234	Chemistry: Paper-IV : Chemistry Practical	6	-	4	2	--	--	50	25	50	25
				<b>12</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>30</b>	<b>12</b>	<b>170</b>	<b>73</b>	<b>200</b>	<b>85</b>
<b>IV Semester</b>	Paper-4.1	CHEM-241	Chemistry: Paper-I : Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.2	CHEM-242	Chemistry: Paper-II : Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.3	CHEM-243	Chemistry: Paper-III : Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-4.4	CHEM-244	Chemistry: Paper-IV : Chemistry Practical	6	-	4	2	--	--	50	25	50	25
				<b>12</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>30</b>	<b>12</b>	<b>170</b>	<b>73</b>	<b>200</b>	<b>85</b>
<b>V Semester</b>	Paper-5.1	CHEM-351	Chemistry: Paper-I : Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-5.2	CHEM-352	Chemistry: Paper-II : Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-5.3	CHEM-353	Chemistry: Paper-III : Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-5.4	CHEM-354	Chemistry: Paper-IV : Chemistry Practical	6	-	4	2	--	--	50	25	50	25
				<b>12</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>30</b>	<b>12</b>	<b>170</b>	<b>73</b>	<b>200</b>	<b>85</b>
<b>VI Semester</b>	Paper-6.1	CHEM-361	Chemistry: Paper-I : Inorganic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-6.2	CHEM-362	Chemistry: Paper-II : Organic Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-6.3	CHEM-363	Chemistry: Paper-III : Physical Chemistry	3	2	-	2	10	04	40	16	50	20
	Paper-6.4	CHEM-364	Chemistry: Paper-IV : Chemistry Practical	6	-	4	2	--	--	50	25	50	25
				<b>12</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>30</b>	<b>12</b>	<b>170</b>	<b>73</b>	<b>200</b>	<b>85</b>

## Rules & Regulations

### **Objectives of the Course:**

Bachelor of Science (B.Sc.) programme of the university is a pioneering model in science. The course shall provide the thorough knowledge of all the branches of the chemistry. The course also emphasizes on the communication & presentation skills of the students. After completing the course, 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.

### **Duration of the Course:**

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%.

### **Structure of the Programme:**

The B.Sc. (Pass Course) programme consists of core and applied courses of theory as well as practical papers which are compulsory for all students.

### **Course Number, Course Code or ID and Nomenclature:**

Number of the Paper has been designated in the Arabic number as Paper-1.1, Paper-1.2, and Paper-1.3 and so on. In the Paper-1.2, 1 represents the semester number and 2 represent the paper number. To give a code to a particular course, following sequence has been adopted:

*“Abbreviation of the programme in upper case +  $n^{\text{th}}$  number of years of study +  $n^{\text{th}}$  number of semesters of the programme + course number in Arabic number.”*

According to the above sequence, code of paper-IV of the first semester of undergraduate Chemistry shall be as "CHEM-114". Nomenclature of the particular course has been given according to the nature or type of contents included in the Unit-I to Unit-V of course of study.

### 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, 3 teaching hours or 3 credit points per week shall carry 75 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 per week. Therefore, 4 contact hours / week shall equal to 2 credit points per week and shall carry 50 maximum marks.

### 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%.

### Teaching Methodologies:

The classroom teaching would be through conventional lectures or use of OHP or 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 student shall be divided into two parts in which first part is continuous assessment / mid-term assessment / internal assessment (20% weightage of the maximum marks) and second part is semester assessment / end-term assessment / external assessment (80% weightage of the maximum marks).

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

- (a) The continuous / mid-term / internal assessment (20% weightage of the maximum marks) 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:

S. No.	Internal Assessment	Mode of Internal Assessment	Max. Marks
(i)	Mid-Term / Internal / Continuous Assessment-I	Written Examination.	5 Marks
(ii)	Mid-Term / Internal / Continuous Assessment-II	Seminar / Presentation / Assignment / Dissertation / Quiz / Group Discussion / Viva-voce or any other mode of assessment.	5 Marks

*Note: In the Mid-Term/Internal/Continuous 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 / University. Time duration for Mid-Term/Internal/Continuous Assessment-II is not allotted. It will be decided by the faculty member which will be taking internal assessment.*

- (b) For practical papers, there will be only one external or semester or end term assessment (100% weightage of maximum marks) and there will be no continuous or internal or midterm assessment.
- (c) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concern Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be taken from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to Head of the Department who may permit the candidate to appear in the 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. 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) shall 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 20% weightage of the maximum marks of the 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 20% 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) End-Term / External / Semester Assessment:**

- (a) The semester or external or end-term assessment (80% weightage of the maximum marks) shall be three hours duration to each theory paper and six 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) Mid-Term / Internal / Continuous Assessment:**

20% weightage of Maximum Marks (10 Marks out of 50 Maximum Marks).

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

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

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

Name of Class/Course :	Max. Marks : 5 Marks
Name of Semester :	Duration of Exam. : 1.00 Hr
No. & Name of Paper :	Date of Exam. :

- Q. No. 1. ....  
or  
.....  
01 Mark
- Q. No. 2. ....  
or  
.....  
01 Mark
- Q. No. 3. ....  
or  
.....  
01 Mark
- Q. No. 4. ....  
or  
.....  
01 Mark
- Q. No. 5. ....  
or  
.....  
01 Mark

**(ii) Mid-Term / Internal / Continuous Assessment-II:**

Department of .....

University / College: .....

Address .....

**Second Internal Assessment Test 20... - 20....**

(Seminar / Presentation / Assignment / Dissertation / Quiz / Group Discussion  
/ Viva-voce or any other mode of assessment)

Name of Class/Course :	Max. Marks : 5 Marks
Name of Semester :	Mode of Assessment:
No. & Name of Paper :	Date of Assessment :

**Format for**

**Compilation of Marks/Awards of Internal Assessment-I & II**

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 Assess. - I	Internal Assess. - II	Total Marks (in Figure)	Total Marks (in Words)

Name & Signature of the Faculty Member

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

80% weightage of Maximum Marks (40 Marks out of 50 Maximum Marks).

**Duration of Examination: 3 Hours**

**Max. Marks: 40**

*Note: There will be ten long answer type questions covering all units but not more than two questions from each unit, descriptive type and answer in about 400 words. Students have to attempt 5 questions taking one from each unit. Paper setter shall be advised to frame the two questions from each unit covering all five units. All the questions will carry equal marks.*

	<b>Unit-I</b>	
Q. No. 1		08 Marks
	or	
Q. No. 2		08 Marks
	<b>Unit-II</b>	
Q. No. 3		08 Marks
	or	
Q. No. 4		08 Marks
	<b>Unit-III</b>	
Q. No. 5		08 Marks
	or	
Q. No. 6		08 Marks

Q. No. 7	<b>Unit-IV</b>	08 Marks
	or	
Q. No. 8		08 Marks
	<b>Unit-V</b>	
Q. No. 9		08 Marks
	or	
Q. No. 10		08 Marks

### Practical Examinations:

#### Mid-Term / Internal / Continuous Assessment:

*Not applicable in Practical Examinations.*

#### End-Term / External / Semester Assessment:

**Duration of Exam: 6 Hours**

**Maximum Marks: 50**

#### Distribution of Maximum 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
<b>Total Marks</b>		<b>50</b>

### 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:

- 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 external & internal examination and 50% marks in each practical paper / project / dissertation with 40% aggregate marks in that semester.
- 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.
- 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 reappear in the due papers along with next odd/even semester exams.
- 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, wishes to improve his/her performance in the theory papers of previous semester, he/she may re-appear only one time in these 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 under-graduate programme up to five years and so on.
- (i) The marks secured in the Gen Hindi, Gen English, Elementary Computer applications and Environment studies shall not be counted in awarding the division to a candidate. The candidate shall have to clear the compulsory subjects in the additional three chances and non-appearance or absence in the examination of compulsory 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:**

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

<b>Description of Marks Obtained</b>	<b>Division / Result</b>
• 75% and above marks in a paper.	Distinction in that paper
• A candidate who has secured aggregate 60% and above marks	First Division
• A candidate who has secured aggregate 50% and above but less than 60% marks	Second Division
• A candidate who has secured aggregate 40% and above but less than 50% marks	Pass

..... X ..... X ..... X .....



## Syllabus

### **B.Sc. Chemistry Third Semester Examination**

#### **Paper-3.1: CHEM-231 Paper-I: Inorganic Chemistry**

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 50 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 10 Marks
		Semester Assessment	: 40 Marks

The syllabus is divided into five independent units and There will be ten long answer type questions covering all units but not more than two questions from each unit, descriptive type and answer in about 400 words. Students have to attempt 5 questions taking one from each unit. Paper setter shall be advised to frame the two questions from each unit covering all five units. All the questions will carry equal marks.

#### **Unit-I s-Block Elements:**

Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their functions in biosystems, an introduction to alkyls and aryls of s-block elements.

#### **Unit-II p-Block Elements:**

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, halides oxides and oxy-acids of groups 13-16.

#### **Unit-III Chemistry of Noble Gases:**

Chemical properties of noble gases, chemistry of helium, argon and xenon, structure and bonding in xenon compounds.

#### **Unit-IV Hydrides of Boron:**

Diborane and higher boranes, borazines, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetra-sulphur tetranitride, basic properties of halogens, interhalogens and poly-halides.

#### **Unit-V Silicones and Phosphazenes:**

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in tri-phosphazenes.

#### **Suggested Books:**

- *Advanced Inorganic Chemistry, Vol I & II. Satya Praksh, G.D. Tuli, S.K. Basu and R.D. Madan*
- *Principles of Inorganic Chemistry: B. R. Puri and L. R. Sharma*
- *Shriver & Atkins' Inorganic Chemistry*
- *Concise Inorganic Chemistry: J. D. Lee*
- *General Inorganic Chemistry: J. A. Duffy, Longman (2nd Ed.)*
- *Basic Inorganic Chemistry: F. A. Cotton and G. Wilkinson, Wiley Eastern*

**Paper-3.2: CHEM-232**  
**Paper-II: Organic Chemistry**

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 50 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 10 Marks
		Semester Assessment	: 40 Marks

The syllabus is divided into five independent units and There will be ten long answer type questions covering all units but not more than two questions from each unit, descriptive type and answer in about 400 words. Students have to attempt 5 questions taking one from each unit. Paper setter shall be advised to frame the two questions from each unit covering all five units. All the questions will carry equal marks.

**Unit-I Arenes:**

Nomenclature of benzene derivatives. The aryl groups. Aromatic nucleus and side chain. Structure of benzene: Molecular formula and Kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure and MO picture.

**Unit-II Aromaticity:**

Huckle's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of  $\pi$ - and  $\sigma$ -complexes. Mechanisms of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating & deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction. methods of formation and chemical reactions of alkylbenzene, alkynyl benzene and biphenyl.

**Unit-III Alkyl Halides:**

Nomenclature and classes of alkyl halides, methods of preparation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides,  $S_N2$  and  $S_N1$  mechanisms with energy profile diagrams. Polyhalogen compounds: chloroform and carbon tetrachloride.

**Unit-IV Aryl Halides:**

Methods of preparation of aryl halides, nuclear and side chain reactions. The addition, elimination and the elimination-addition mechanism of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

**Unit-V Ethers and Epoxides:**

Nomenclature of ethers and methods of preparation, physical properties. Chemical reactions: cleavage and autoxidation. Zeisel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening. Reactions of Grignard and organolithium reagents with epoxides.

**Suggested Books:**

- *Structure and Mechanism in Organic Chemistry*, C.K. Ingold, Cornell University Press.
- *Organic Chemistry*, Claydon, Nick Greeves and Stuart Warren, Oxford University Press
- *A Guide Book to Mechanism in Organic Chemistry*, Peter Sykes, Longman.
- *Reaction Mechanism in Organic Chemistry*, S. M. Mukherjee and S. P. Singh, Macmillan.
- *Textbook of Organic Chemistry* by P S Kalsi, New Age International
- *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.
- *Stereochemistry, Conformation and Mechanism* by P S Kalsi, New Age International
- *Organic Chemistry*, R. T. Morrison and R. N. Boyd, Prentice-Hall.

- *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*
- *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*
- *Modern Principles of Organic Chemistry: M. K. Jain and S. C. Sharma.*

### **Paper-3.3: CHEM-233**

#### **Paper-III: Physical Chemistry**

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 50 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 10 Marks
		Semester Assessment	: 40 Marks

*The syllabus is divided into five independent units and There will be ten long answer type questions covering all units but not more than two questions from each unit, descriptive type and answer in about 400 words. Students have to attempt 5 questions taking one from each unit. Paper setter shall be advised to frame the two questions from each unit covering all five units. All the questions will carry equal marks.*

#### **Unit-I Thermochemistry:**

*Thermochemistry:* Standard state, standard enthalpy of formation-Hess's law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

#### **Unit II Second Law of Thermodynamics:**

Need for the law, different statements of the law. Carnot's cycle and its efficiency, Carnot theorem.

*Concept of Entropy:* Entropy as a state function, entropy as a function of V&T, entropy as a function of P&T, entropy change in physical change, Clausius inequality and entropy as a criterion of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases.

#### **Unit-III Third Law of Thermodynamics:**

Nernst's heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz function; Gibbs function (G) & Helmholtz function (A) as thermodynamic quantities, A&G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G & A with P, V & T.

#### **Unit-IV Chemical Equilibrium:**

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochores, isochore-Clapeyron equation and Clausius-Clapeyron equation. applications.

#### **Unit-V Phase Equilibrium:**

Statement and meaning of the terms: Phase, component and degree of freedom. derivation of Gibbs phase rule, phase equilibria of one component system-water, CO<sub>2</sub> and S systems. Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Pb-Ag system. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H<sub>2</sub>O)

system. Freezing mixtures: acetone-dry ice. Partially miscible liquids: Phenol-water and nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature.

**Suggested Books:**

- *Principles of Physical Chemistry: B. R. Puri and L. R. Sharma*
- *A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand*
- *Physical Chemistry, Pt. I & II: C. M. Gupta, J. K. Saxena and M. C. Purohit*
- *Atkins' Physical Chemistry, Oxford University Press.*
- *Basic Programming with Application, V.K. Jain. Tata McGraw Hill.*
- *Computers and Common Sense. R Hunt and Shelly, Prentice Hall.*

**Paper-3.4: CHEM-234**  
**Paper-IV: Chemistry Practical**

Contact Hours / Week : 4 Hours / Week                      Maximum Marks : 50 Marks  
Duration of Examination : 6 Hours                              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.	Viva-voce	10
5.	Practical Record	10
<b>Total Marks</b>		<b>50</b>

**Inorganic 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.

**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 permanganometry.

**Organic Chemistry:**

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

**Physical Chemistry:**

**Thermochemistry:**

- To determine the solubilities of benzoic acid at different temperatures and to determine  $\Delta H$  of the dissolution process.
- To determine the enthalpy of neutralization of a weak acid weak base verses strong acid and strong base and determine the enthalpy of ionization of the weak acid/weak base.

- To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born-Haber cycle.

**Phase Equilibrium:**

- To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system)
- To construct the phase diagram of two component (e.g. diphenyl-benzophenone) system by cooling curve method.

**Suggested Books:**

- *Vogel's Textbook of Practical Organic Chemistry*, A.R. Tatchell, John Wiley.
- *Vogel's Textbook of Quantitative Analysis*, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham
- *Macro scale and Micro scale Organic Experiments*, K.L. Williamson, D.C. Heath
- *Systematic Qualitative Organic Analysis*, H. Middleton, Edward Arnold.
- *Handbook of Organic Analysis: Qualitative and Quantitative*. H. Clark, Edward Arnold.
- *Experiments and Techniques in Organic Chemistry*, D.P. Pasto, Johnson and Miller, Prentice Hall
- *Practical Chemistry: Giri Bajpai and Pandey*, S. Chand & Co. Ltd., New Delhi.
- *Practical Physical Chemistry*, A.M. James and F.E. Prichard, Longman.
- *Findley's Practical Physical Chemistry*, B.P. Levitt, Longman.
- *Experimental Physical Chemistry*, R.C. Das and B. Behera, Tata McGraw Hill

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## Syllabus

### **B.Sc. Chemistry Fourth Semester Examination**

#### **Paper-4.1: CHEM-241 Paper-I: Inorganic Chemistry**

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 50 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 10 Marks
		Semester Assessment	: 40 Marks

The syllabus is divided into five independent units and There will be ten long answer type questions covering all units but not more than two questions from each unit, descriptive type and answer in about 400 words. Students have to attempt 5 questions taking one from each unit. Paper setter shall be advised to frame the two questions from each unit covering all five units. All the questions will carry equal marks.

#### **Unit-I Acids and Bases:**

Arrhenius, Bronsted-Lowry, the Lux-Flood solvent system and Lewis's concept of acids and bases, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents.

#### **Unit-II Hard and Soft Acids and Bases (HSAB):**

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

#### **Unit-III Non-aqueous Solvents:**

Physical properties of solvents, type of solvents and their general characteristics, reactions in liquid  $\text{NH}_3$ , liquid  $\text{SO}_2$  and liquid  $\text{HF}$ .

#### **Unit-IV Oxidation and Reduction:**

Use of redox potential data-analysis of redox cycle, redox stability in water, Frost, Latimer and Pourbaix diagrams. Principle involved in the extraction of the elements.

#### **Unit-V Coordination Compounds:**

Werner's theory and its experimental verification, effective atomic number, chelates, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. crystal field theory, measurement of  $10 Dq$  ( $\Delta_o$ ), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of  $10 Dq$  ( $\Delta_o$ ,  $\Delta_t$ ), nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

#### **Suggested Books:**

- *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*
- *Shriver & Atkins' Inorganic Chemistry*
- *Concise Inorganic Chemistry: J. D. Lee*
- *General Inorganic Chemistry: J. A. Duffy, Longman (2nd Ed.)*
- *Basic Inorganic Chemistry: F. A. Cotton and G. Wilkinson, Wiley Eastern*

**Paper-4.2: CHEM-242**  
**Paper-II: Organic Chemistry**

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 50 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 10 Marks
		Semester Assessment	: 40 Marks

*The syllabus is divided into five independent units and There will be ten long answer type questions covering all units but not more than two questions from each unit, descriptive type and answer in about 400 words. Students have to attempt 5 questions taking one from each unit. Paper setter shall be advised to frame the two questions from each unit covering all five units. All the questions will carry equal marks.*

**Unit-I Alcohols:**

Classification and nomenclature.

Monohydric alcohols: Nomenclature, method of preparation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols.

Dihydric alcohols: Nomenclature, methods of preparation, chemical reaction of vicinal glycols, oxidative cleavage [ $\text{Pb}(\text{OAc})_4$  and  $\text{HIO}_4$ ] and pinacol-pinacolone rearrangement. Trihydric alcohols: Nomenclature and methods of preparation, chemical reactions of glycerol.

**Unit-II Phenols:**

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols: electrophilic aromatic substitution, acylation and carboxylation. Mechanism of Fries rearrangement, Claisen rearrangement, Gattermann synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tieman reaction.

**Unit-III 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, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro's reaction, Meerwein-Ponndorf-Verley, Clemmensen, Wolff-Kishner,  $\text{LiAlH}_4$  and  $\text{NaBH}_4$  reductions. Halogenation of enolizable ketones. An introduction to  $\alpha,\beta$ -unsaturated aldehydes and ketones.

**Unit-IV Carboxylic Acids:**

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effect of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reductions of carboxylic acids. Mechanism of decarboxylation. Methods of formation, chemical reactions of haloacids. Hydroxyacids: malic, tartaric and citric acids. Methods of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids: Methods of synthesis and effect of heat and dehydrating agents.

### Unit-V Carboxylic Acid Derivatives:

Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides. Relative stability and reactivity of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives and chemical reactions. Mechanism of esterification and hydrolysis (acidic and basic).

#### Suggested Books:

- *Structure and Mechanism in Organic Chemistry*, C.K. Ingold, Cornell University Press.
- *Organic Chemistry*, Claydon, Nick Greeves and Stuart Warren, Oxford University Press
- *A Guide Book to Mechanism in Organic Chemistry*, Peter Sykes, Longman.
- *Reaction Mechanism in Organic Chemistry*, S. M. Mukherjee and S. P. Singh, Macmillan.
- *Textbook of Organic Chemistry by P S Kalsi*, New Age International
- *Organic Chemistry*, R. T. Morrison and R. N. Boyd, Prentice-Hall.
- *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
- *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
- *Modern Principles of Organic Chemistry: M. K. Jain and S. C. Sharma.*

### Paper-4.3: CHEM-243

#### Paper-III: Physical Chemistry

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 50 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 10 Marks
		Semester Assessment	: 40 Marks

The syllabus is divided into five independent units and There will be ten long answer type questions covering all units but not more than two questions from each unit, descriptive type and answer in about 400 words. Students have to attempt 5 questions taking one from each unit. Paper setter shall be advised to frame the two questions from each unit covering all five units. All the questions will carry equal marks.

#### Unit-I Elementary Quantum Mechanics:

Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects. Compton effect. De Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one-dimensional box. Schrodinger wave equation for H-atom. separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

#### Unit-II Molecular Orbital Theory:

Calculation of energy level from wave functions, physical picture of bonding and anti-bonding wave functions, concept of  $\sigma$ ,  $\sigma^*$ ,  $\pi$ ,  $\pi^*$  orbitals and their characteristics. Hybrid orbitals-sp,  $sp^2$ ,  $sp^3$ . calculation of coefficients of AO's used in these hybrid orbitals. Introduction to valence bond model of  $H_2$ , comparison of MO and VB models.



### Unit-III Physical Properties and Molecular Structure:

Optical activity, polarization (Calusius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method. Dipole moment and structure of molecules. Magnetic properties-paramagnetism, diamagnetism and ferromagnetism.

### Unit-IV Solutions and Dilute Solutions:

Ideal and non-ideal solutions and their properties, methods of expressing concentrations of solutions, activity and activity coefficient. Roul't's and Henry's laws, Azeotropes-ethanol-water system. Nernst Distribution Law-Thermodynamic derivation, applications. Dilute solutions.

### Unit-V Colligative Properties:

Introduction to colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal value and abnormal molar mass, degree of dissociation and association of solutes.

#### Suggested Books:

- *Principles of Physical Chemistry: B. R. Puri and L. R. Sharma*
- *A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand*
- *Physical Chemistry, Pt. I & II: C. M. Gupta, J. K. Saxena and M. C. Purohit*
- *Atkins' Physical Chemistry, Oxford University Press.*

## Paper-4.4: CHEM-244 Paper-IV: Chemistry Practical

Contact Hours / Week : 4 Hours / Week                      Maximum Marks : 50 Marks  
Duration of Examination : 6 Hours                              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.	Viva-voce	10
5.	Practical Record	10
<b>Total Marks</b>		<b>50</b>

### Inorganic Chemistry:

#### Volumetric Analysis

- Estimation of hardness of water by EDTA.
- Estimation of ferrous and ferric by dichromate method.
- Estimation of copper using thiosulphate.

#### Gravimetric Analysis:

- Analysis of Cu as Copper thiocyanate.
- Analysis of Ni as Nickel dimethylglyoxime.

**Organic Chemistry:**

Analysis of an organic mixture containing two solid components using water,  $\text{NaHCO}_3$ ,  $\text{NaOH}$  for separation and preparation of suitable derivatives.

**Physical Chemistry:**

**Distribution Law**

- To study the distribution of iodine between water and  $\text{CCl}_4$
- To study the distribution of benzoic acid between benzene and water.

**Transition temperature:**

- Determination of the transition temperature of the given substance by thermometric / dilatometric method (e.g.  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$  /  $\text{SrBr}_2 \cdot 2\text{H}_2\text{O}$ )

**Molecular Weight Determination**

- Determination of molecular weight of a non-volatile solute by Rast method / Beckmann freezing point method.
- Determination of the apparent degree of dissociation of an electrolyte (e.g.  $\text{NaCl}$ ) in aqueous solution at different concentrations by ebullioscopy.

**Suggested Books:**

- *Vogel's Textbook of Practical Organic Chemistry*, A.R. Tatchell, John Wiley.
- *Vogel's Textbook of Quantitative Analysis*, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham
- *Macro scale and Micro scale Organic Experiments*, K.L. Williamson, D.C. Heath
- *Systematic Qualitative Organic Analysis*, H. Middleton, Edward Arnold.
- *Handbook of Organic Analysis: Qualitative and Quantitative*. H. Clark, Edward Arnold.
- *Experiments and Techniques in Organic Chemistry*, D.P. Pasto, Johnson and Miller, Prentice Hall
- *Practical Chemistry: Giri Bajpai and Pandey*, S. Chand & Co. Ltd., New Delhi.
- *Practical Physical Chemistry*, A.M. James and F.E. Prichard, Longman.
- *Findley's Practical Physical Chemistry*, B.P. Levitt, Longman.
- *Experimental Physical Chemistry*, R.C. Das and B. Behera, Tata McGraw Hill.

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