

***SCHEME OF EXAMINATION  
AND  
SYLLABUS***

***(for Academic Session 2020-2021)***

**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. 1st Year : 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-I	3	3	-	3	15	06	60	24	75	30
	Paper-1.4	CHEM-112	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-1.5	CHEM-113	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-1.6	MATH-111	Mathematics-I	3	3	-	3	15	06	60	24	75	30
	Paper-1.7	MATH-112	Mathematics-II	3	3	-	3	15	06	60	24	75	30
	Paper-1.8	MATH-113	Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-1.9	PHY-111	Physics-I	3	3	-	3	15	06	60	24	75	30
	Paper-1.10	PHY-112	Physics-II	3	3	-	3	15	06	60	24	75	30
	Paper-1.11	PHY-113	Physics Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (I Semester)</b>				<b>36+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	ENV-122	Environmental Studies	2	2	-	2	-	-	50	20	50	20
<b>II Semester</b>	Paper-2.3	CHEM-121	Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-2.4	CHEM-122	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-2.5	CHEM-123	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-2.6	MATH-121	Mathematics-I	3	3	-	3	15	06	60	24	75	30
	Paper-2.7	MATH-122	Mathematics-II	3	3	-	3	15	06	60	24	75	30
	Paper-2.8	MATH-123	Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-2.9	PHY-121	Physics-I	3	3	-	3	15	06	60	24	75	30
	Paper-2.10	PHY-122	Physics-II	3	3	-	3	15	06	60	24	75	30
	Paper-2.11	PHY-123	Physics Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (II Semester)</b>				<b>36+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. 2nd Year : 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
<b>2nd Year</b> <b>III Semester</b>	Paper-3.1	CHEM-231	Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-3.2	CHEM-232	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-3.3	CHEM-233	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-3.4	MATH-231	Mathematics-I	3	3	-	3	15	06	60	24	75	30
	Paper-3.5	MATH-232	Mathematics-II	3	3	-	3	15	06	60	24	75	30
	Paper-3.6	MATH-233	Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-3.7	PHY-231	Physics-I	3	3	-	3	15	06	60	24	75	30
	Paper-3.8	PHY-232	Physics-II	3	3	-	3	15	06	60	24	75	30
	Paper-3.9	PHY-233	Physics Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (III 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>2nd Year</b> <b>IV Semester</b>	Paper-4.1	CHEM-241	Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-4.2	CHEM-242	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-4.3	CHEM-243	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-4.4	MATH-241	Mathematics-I	3	3	-	3	15	06	60	24	75	30
	Paper-4.5	MATH-242	Mathematics-II	3	3	-	3	15	06	60	24	75	30
	Paper-4.6	MATH-243	Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-4.7	PHY-241	Physics-I	3	3	-	3	15	06	60	24	75	30
	Paper-4.8	PHY-242	Physics-II	3	3	-	3	15	06	60	24	75	30
	Paper-4.9	PHY-243	Physics Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (IV 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.) (Mathematics Group)

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

### B.Sc. 3rd Year : 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-I	3	3	-	3	15	06	60	24	75	30
<b>V Semester</b>	Paper-5.2	CHEM-352	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-5.3	CHEM-353	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-5.4	MATH-351	Mathematics-I	3	3	-	3	15	06	60	24	75	30
	Paper-5.5	MATH-352	Mathematics-II	3	3	-	3	15	06	60	24	75	30
	Paper-5.6	MATH-353	Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-5.7	PHY-351	Physics-I	3	3	-	3	15	06	60	24	75	30
	Paper-5.8	PHY-352	Physics-II	3	3	-	3	15	06	60	24	75	30
	Paper-5.9	PHY-353	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-I	3	3	-	3	15	06	60	24	75	30
<b>VI Semester</b>	Paper-6.2	CHEM-362	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-6.3	CHEM-363	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-6.4	MATH-361	Mathematics-I	3	3	-	3	15	06	60	24	75	30
	Paper-6.5	MATH-362	Mathematics-II	3	3	-	3	15	06	60	24	75	30
	Paper-6.6	MATH-363	Mathematics Practical	6	-	4	2	--	--	50	25	50	25
	Paper-6.7	PHY-361	Physics-I	3	3	-	3	15	06	60	24	75	30
	Paper-6.8	PHY-362	Physics-II	3	3	-	3	15	06	60	24	75	30
	Paper-6.9	PHY-363	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. 1st Year: 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		
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-I	3	3	-	3	15	06	60	24	75	30
	Paper-1.4	CHEM-112	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-1.5	CHEM-113	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-1.6	BOT-111	Botany-I	3	3	-	3	15	06	60	24	75	30
	Paper-1.7	BOT-112	Botany-II	3	3	-	3	15	06	60	24	75	30
	Paper-1.8	BOT-113	Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-1.9	ZOO-111	Zoology-I	3	3	-	3	15	06	60	24	75	30
	Paper-1.10	ZOO-112	Zoology-II	3	3	-	3	15	06	60	24	75	30
	Paper-1.11	ZOO-113	Zoology Practical	6	-	4	2	--	--	50	25	50	25
	<b>Total (I Semester)</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>
1st Year	Paper-2.1	ENG-121	General English	2	2	-	2	-	-	50	20	50	20
	Paper-2.2	ENV-122	Environmental Studies	2	2	-	2	-	-	50	20	50	20
II Semester	Paper-2.3	CHEM-121	Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-2.4	CHEM-122	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-2.5	CHEM-123	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-2.6	BOT-121	Botany-I	3	3	-	3	15	06	60	24	75	30
	Paper-2.7	BOT-122	Botany-II	3	3	-	3	15	06	60	24	75	30
	Paper-2.8	BOT-123	Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-2.9	ZOO-121	Zoology-I	3	3	-	3	15	06	60	24	75	30
	Paper-2.10	ZOO-122	Zoology-II	3	3	-	3	15	06	60	24	75	30
	Paper-2.11	ZOO-123	Zoology Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (II Semester)</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. 2nd Year: 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		
<b>2nd Year</b> <b>III Semester</b>	Paper-3.1	CHEM-231	Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-3.2	CHEM-232	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-3.3	CHEM-233	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-3.4	BOT-231	Botany-I	3	3	-	3	15	06	60	24	75	30
	Paper-3.5	BOT-232	Botany-II	3	3	-	3	15	06	60	24	75	30
	Paper-3.6	BOT-233	Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-3.7	ZOO-231	Zoology-I	3	3	-	3	15	06	60	24	75	30
	Paper-3.8	ZOO-232	Zoology-II	3	3	-	3	15	06	60	24	75	30
	Paper-3.9	ZOO-233	Zoology Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (III 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>2nd Year</b> <b>IV Semester</b>	Paper-4.1	CHEM-241	Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-4.2	CHEM-242	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-4.3	CHEM-243	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-4.4	BOT-241	Botany-I	3	3	-	3	15	06	60	24	75	30
	Paper-4.5	BOT-242	Botany-II	3	3	-	3	15	06	60	24	75	30
	Paper-4.6	BOT-243	Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-4.7	ZOO-241	Zoology-I	3	3	-	3	15	06	60	24	75	30
	Paper-4.8	ZOO-242	Zoology-II	3	3	-	3	15	06	60	24	75	30
	Paper-4.9	ZOO-243	Zoology Practical	6	-	4	2	--	--	50	25	50	25
<b>Total (IV 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. 3rd Year: 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.	Credit Pr.	Continuous Assessment (20%)		Semester Assessment (80%)				
							Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks			
<b>3rd Year</b>	Paper-5.1	CHEM-351	Chemistry-I	3	3	-	3	15	06	60	24	75	30
<b>V Semester</b>	Paper-5.2	CHEM-352	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-5.3	CHEM-363	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-5.4	BOT-351	Botany-I	3	3	-	3	15	06	60	24	75	30
	Paper-5.5	BOT-352	Botany-II	3	3	-	3	15	06	60	24	75	30
	Paper-5.6	BOT-353	Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-5.7	ZOO-351	Zoology-I	3	3	-	3	15	06	60	24	75	30
	Paper-5.8	ZOO-352	Zoology-II	3	3	-	3	15	06	60	24	75	30
	Paper-5.9	ZOO-353	Zoology 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-I	3	3	-	3	15	06	60	24	75	30
<b>VI Semester</b>	Paper-6.2	CHEM-362	Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-6.3	CHEM-363	Chemistry Practical	6	-	4	2	--	--	50	25	50	25
	Paper-6.4	BOT-361	Botany-I	3	3	-	3	15	06	60	24	75	30
	Paper-6.5	BOT-362	Botany-II	3	3	-	3	15	06	60	24	75	30
	Paper-6.6	BOT-363	Botany Practical	6	-	4	2	--	--	50	25	50	25
	Paper-6.7	ZOO-361	Zoology-I	3	3	-	3	15	06	60	24	75	30
	Paper-6.8	ZOO-362	Zoology-II	3	3	-	3	15	06	60	24	75	30
	Paper-6.9	ZOO-363	Zoology 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.) CHEMISTRY

(Common for Mathematics / Biology Group: All Semesters)

*Subject Combination:* Chemistry, Physics, Mathematics (CPM) / Chemistry, Botany, Zoology (CBZ)

### 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-I : Inorganic Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-1.4	CHEM-112	Chemistry-II : Organic Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-1.5	CHEM-113	Practical : Chemistry Practical-I	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-I : Physical Chemistry-I	3	3	-	3	15	06	60	24	75	30
	Paper-2.4	CHEM-122	Chemistry-II : Inorganic Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-2.5	CHEM-123	Practical : Chemistry Practical-II	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-I : Organic Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-3.2	CHEM-232	Chemistry-II : Physical Chemistry-II	3	3	-	3	15	06	60	24	75	30
	Paper-3.3	CHEM-233	Practical : Chemistry Practical-III	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-I : Inorganic Chemistry-III	3	3	-	3	15	06	60	24	75	30
	Paper-4.2	CHEM-242	Chemistry-II : Organic Chemistry-III	3	3	-	3	15	06	60	24	75	30
	Paper-4.3	CHEM-243	Practical : Chemistry Practical-IV	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-I : Physical Chemistry-III	3	3	-	3	15	06	60	24	75	30
	Paper-5.2	CHEM-352	Chemistry-II : Inorganic Chemistry-IV	3	3	-	3	15	06	60	24	75	30
	Paper-5.3	CHEM-353	Practical : Chemistry Practical-V	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-I : Organic Chemistry-IV	3	3	-	3	15	06	60	24	75	30
	Paper-6.2	CHEM-362	Chemistry-II : Physical Chemistry-IV	3	3	-	3	15	06	60	24	75	30
	Paper-6.3	CHEM-363	Practical : Chemistry Practical-VI	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 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 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 recognised 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 recognised 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<sup>th</sup> number of year of study + n<sup>th</sup> number of semester 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.	7.5 Marks
(ii)	Mid-Term / Internal / Continuous Assessment-II	Seminar / Presentation / Assignment / Dissertation / Quiz / Group Discussion / Viva-voce or any other mode of assessment.	7.5 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 (15 Marks out of 75 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 : 7.5 Marks
Name of Semester :	Duration of Exam. : 1.00 Hr
No. & Name of Paper :	Date of Exam. :

Q. No. 1. ....  
or

2.5 Marks

Q. No. 2. ....  
or

2.5 Marks

Q. No. 3. ....  
or

2.5 Marks

**(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 : 7.5 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			
			Int. Assess.-I	Int. 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 (60 Marks out of 75 Maximum Marks).

**Duration of Examination: 3 Hours**

**Max. Marks: 60**

*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		12 Marks
	or	
Q. No. 2		12 Marks
	<b>Unit-II</b>	
Q. No. 3		12 Marks
	or	
Q. No. 4		12 Marks
	<b>Unit-III</b>	
Q. No. 5		12 Marks
	or	
Q. No. 6		12 Marks
	<b>Unit-IV</b>	
Q. No. 7		12 Marks
	or	
Q. No. 8		12 Marks

Q. No. 9	<b>Unit-V</b>	12 Marks
	or	
Q. No. 10		12 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	15
2.	Exercise No. 2	15
3.	Practical Record	10
4.	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 the 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.
- 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.
- 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 University norms.

### Classification of Successful Candidates:

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

Description of Marks Obtained	Division / Result
• 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: Organic Chemistry-II**

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 75 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 15 Marks
		Semester Assessment	: 60 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.

*Note:* Contents of each unit may be completed into 8-10 lectures or contact hours which also include revisions, seminars, internal assessments, etc.

#### **Unit-I Arenes and Aromaticity:**

Nomenclature of benzene derivatives. The aryl group. 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.

Aromaticity: the 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, alkynylbenzene and biphenyl.

#### **Unit-II Alkyl and Aryl 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. 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-III 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 [ $Pb(OAc)_4$  and  $HIO_4$ ] and pinacol-pinacolone rearrangement. Trihydric alcohols: Nomenclature and methods of preparation, chemical reactions of glycerol.

### **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, Gatterman synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

### **Unit-IV 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-V Ethers and Epoxides:**

Nomenclature of ethers and methods of preparation, physical properties. Chemical reactions: cleavage and autoxidation. Ziesel'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.

### **Organic Synthesis via Enolates:**

Acidity of  $\alpha$ -hydrogens. alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes. Alkylation and acylation of enamines.

### **Books Suggested :**

- *Structure and Mechanism in Organic Chemistry*, C.K. Ingold, Cornell University Press.
- *Organic Chemistry*, Clayden, 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, TataMcGraw 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-3.2: CHEM-232: Physical Chemistry-II

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 75 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 15 Marks
		Semester Assessment	: 60 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.

*Note:* Contents of each unit may be completed into 8-10 lectures or contact hours which also include revisions, seminars, internal assessments, etc.

### Unit-I Mathematical Concepts:

Logarithmic relations, curve sketching, linear graphs and calculations of slopes, differentiation of functions like  $k_x$ ,  $e^x$ ,  $x^n$ ,  $\sin x$ ,  $\log x$ ; maxima and minima, partial differentiation and reciprocity relations, integrations of some useful / relevant functions: Permutations and combinations. Factorials. Probability.

### Computers:

General introduction to computers, different components of a computer, hardware and software input output devices; binary numbers and arithmetic; introduction to computer languages. Programming, operating systems.

### Unit-II Thermodynamics-I:

Definition of thermodynamic terms: System, surroundings, etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process, concept of heat and work.

*First Law of Thermodynamics:* Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature. Calculation of  $w$ ,  $q$ ,  $dU$  &  $dH$  for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

*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 III Thermodynamics-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 criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

### Unit-IV Thermodynamics-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-V 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 ferromagnetics.

#### Books Suggested :

- *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-3.3: CHEM-233: Chemistry Practical-III

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: Organic Chemistry Experiment	15
2.	Exercise No. 2: Physical Chemistry Experiment	15
3.	Viva-voce	10
4.	Practical Record	10
<b>Total Marks</b>		<b>50</b>

#### Organic Chemistry

##### Qualitative Analysis:

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

##### Thin Layer Chromatography:

Determination of R<sub>f</sub> values and identification of organic compounds.

- Separation of green leaf pigments (spinach leaves may be used)
- Preparation and separation of 2,4-Dinitrophenyl hydrazones of acetone, 2-butanone, hexan-2 and 3-one using toluene and light petroleum (40:60)
- Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5)

##### Paper Chromatography-Ascending and Circular:

Determination of values and Identification of organic compounds.

- Separation of a mixture of phenyl alanine and glycine. Alanine and aspartic acid. leucine and glutamic acid. 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 mono saccharides-a mixture of D-galactose and D-fructose using n-butanol:acetone:water (4:5:1). Spray reagent- Aniline hydrogen phthalate.

**Physical Chemistry:**

**Transition temperature:**

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

**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 versus strong acid and strong base and determine the enthalpy of ionisation 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.

**Books Suggested :**

- *Vogel's Textbook of Practical Organic Chemistry*, A.R. Tatchell, John Wiley.
- *Systematic Qualitative Organic Analysis*, H. Middleton, Adward Arnold.
- *Handbook of Organic Analysis: Qualitative and Quantitative*. H. Clark, Adward 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: Inorganic Chemistry-III**

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 75 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 15 Marks
		Semester Assessment	: 60 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.

*Note:* Contents of each unit may be completed into 8-10 lectures or contact hours which also include revisions, seminars, internal assessments, etc.

#### **Unit-I Chemistry of Elements of First Transition Series:**

Characteristics properties of d-block elements, properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

#### **Unit-II Chemistry of Elements of Second and Third Transition Series:**

General characteristics, comparative treatment with their 3d-analogues in respect to ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

#### **Unit-III Coordination Compounds:**

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

#### **Unit-IV Metal-Ligand Bonding in Transition Metal Complexes:**

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal field parameters, Jahn-Teller distortions, applications and limitations of crystal field theory.

#### **Unit-V Magnetic Properties of Transition Metal Complexes:**

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of  $n_s$  and  $n_{eff}$  values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

#### **Books suggested:**

- *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: Organic Chemistry-III

Contact Hours / Week	: 3 Hours / Week	Maximum Marks	: 75 Marks
Duration of Examination	: 3 Hours	Continuous Assessment	: 15 Marks
		Semester Assessment	: 60 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.

**Note:** Contents of each unit may be completed into 8-10 lectures or contact hours which also include revisions, seminars, internal assessments, etc.

### Unit-I 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-II 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).

### Unit-III Organic Compounds of Nitrogen:

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline media. Picric acid. Halonitroarenes: reactivity.

### Alkyl and Aryl Amines:

Structure and nomenclature of amines, physical properties, stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds and nitriles). Reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substitution in arylamines, reactions of amines with nitrous acid. Synthetic transformations of aryldiazonium salts, azo coupling.

### Unit-IV Synthetic Polymers:

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.



### Synthetic Dyes:

Colour and constitution (electronic concept), classification of dyes. Synthesis of methyl orange, Congo red, malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.

### Unit-V Organometallic Compounds:

Organomagnesium Compounds: The Grignard reagents-formation, structure and chemical reactions. Organozinc Compounds: Formation and chemical reactions. Organolithium compounds: Formation and chemical reactions. Organosulphur compounds: Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

#### Books Suggested :

- *Structure and Mechanism in Organic Chemistry*, C.K. Ingold, Cornell University Press.
- *Organic Chemistry*, Clayden, 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: Chemistry Practical-IV

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 Experiment	15
2.	Exercise No. 2: Organic Chemistry Experiment	15
3.	Viva-voce	10
4.	Practical Record	10
<b>Total Marks</b>		<b>50</b>

### Inorganic Chemistry:

#### 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.
- 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 CuSCN and Ni as Nickel dimethylglyoxime.



**Organic Chemistry:**

**Qualitative Analysis:**

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

**Column Chromatography:**

- Separation of fluorescein and methylene blue.
- Separation of leaf pigments from spinach leaves.
- Resolution of racemic mixture of (Z)-mandelic acid.

**Books Suggested :**

- *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.
- *Vogel's Textbook of Practical Organic Chemistry*, A.R. Tatchell, John Wiley.
- *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.

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