Total No. of Questions :6]

P1157

[5430]-1001

M.Sc.

PHYSICAL CHEMISTRY CHP - 110 : Fundamentals of physical chemistry-I (2014 Pattern) (Semester - I) (New) (4 Credits)

Time : 3 Hours/

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic table/calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1.	Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	Ħ	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
			=	$1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$
			=	$6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	Ξ	$4.803 \times 10^{-10} \text{ esu}$
			=	$1.602 \times 10^{-19} \mathrm{C}$
5.	1 eV		=	23.06 k cal mol ^{-1}
			_	$1.602 \times 10^{-12} \text{ erg}$
			=	$1.602 \times 10^{-19} \text{ J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^1 \text{ mol}^1$
			=	$8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
			-	$1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	=	96487 C equiv ⁻¹
8.	Speed of light	Ċ	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$
			=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	l cal		= .	$4.184 \times 10^{7} \text{ erg}$
			=	4.184 J
10.	1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β _n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m	=	$9.11 \times 10^{-31} \text{ kg}$

[Max. Marks : 50

SEAT No. :

[Total No. of Pages : 3

SECTION - I

Q1) Attempt the following:

- a) State clausius inequality. Give its significance.
- b) Show that ΔG =Wu where Wu=non pv type work.
- c) Write a brief note on condition of equilibrium in terms of chemical potential of one component system.
- d) Explain Henry's law for a liquid showing positive deviation from ideal behaviour with suitable diagram.
- e) Explain 'Ultra-violet catastrophy'?

Q2) Attempt any two of the following:

- a) What is meant by third law entropies? Calculate third law entropy of a substance that melts at 0°c and vaparises at 100°c.
- b) Derive clapeyron equation. Discuss its application to melting point curve of water phase diagram.
- c) Describe Einstein's procedure to obtain planck's constant using photoelectric effect.
- d) Discuss the effect of addition of non-volatile solute on the boiling point of liquids.
- Q3) Solve any one of the following
 - a) Calculate the work done during adiabatic reversible expansion of 0.02m ar at 25°c expanded from 0.5 L to 1.0 L.

 $[\text{Given}: \text{Cv}_1\text{m of }\text{Ar} = 12.48\text{J }\text{K}^{-1}\text{ mol}^{-1}]$

b) Calculate linear momentum of a nanogram particle with de - Broglie wavelength of 700 nm. If the particle is located in a nonometer box, determine the uncertainty in its linear momentum measurement.

[5430]-1001

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SECTION - II

Q4) Attempt the following

- a) Describe the method of determination of order using half life method.
- b) Explain competitive inhibition and draw its line weaver Burk plot.
- c) Write the concept of flash photolysis.
- d) What is stivling approximation?
- e) Give the stark Einstein law of photochemical equivalence, and write the equation of quantum yield (ϕ)
- **Q5)** Attempt any two of the following:
 - a) What are unimolecular reactions? Derive the rate law expression for the same.
 - b) Enlist the postulates of activated complex theory and derive the relation $K=(RT/Nh) e^{-\Delta H \#/RT} e^{\Delta S \#/R}$.
 - c) What is partition function? obtain an expression for the vibrational partition function.
 - d) Explain thermal and chain branching explosion reactions. Draw and explain the graph of explosion limit.

Q6) Attempt any one of the following:

- a) For a given reaction at 25°c the rate constant triples when the temperature is increased by 15°c. Calculate the energy of activation for the reaction. [Given : $R=8.314 \text{ Jk}^{-1} \text{ mol}^{-1}$]
- b) Calculate the translational partition function of an H_2 molecule confined to a 100 cm³ vessel at 25°c. [Given : mH₂ = 2.016 × mu]

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Total No. of Questions :6]

P1158

SEAT No. :

[Total No. of Pages :3

[5430] - 1002

M.Sc. - **I**

INORGANIC CHEMISTRY

CHI - 130 : Molecular Symmetry and Chemistry of P-Block Elements (2014 Pattern) (Semester - I) (4 Credit System)

Time : 3 Hours]

[Max. Marks :50

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answers to the two sections should be written in separate answer books.
- 3) Figures to the right indicate full marks.
- 4) Use of logarithmic table and calculator is allowed.

SECTION - I

Q1) Answer the following.

- a) Define symmetry element and give different types of symmetry elements.
- b) List out symmetry elements of B_2H_6 and classify into point group.
- c) What are non-abelian groups? Illustrate with suitable example.
- d) Give all associative operations of S_5 .
- e) Mention the symmetry elements and classes of D_4h point group.

Q2) Answer any two of the following.

- a) Derive the character table for SOCl₂.
- b) Define plane of symmetry. Mention its different types using examples.
- c) Using matrix multiplication method prove that $S_2 = i$.
- d) Explain all symmetry elements of SO_3 & find out its point group.

[10]

[10]

- Q3) Attempt any one of the following.
 - a) Find the reducible representation for CCl₄ considering σ-bond as basis and find out the orbitals offered by 'C' for sigma bonding. Give character
 Table for Td point group.

Td	E	8C ₃	3C ₂	$6S_4$	$6\sigma_{d}$		
A ₁	1	1	1	1	1		$x^2+y^2+z^2$
A_2	1	1	1	-1	-1		
E	2	-1	2	0	0		$(2z^2-x^2-y^2)$
T ₁	3	0	-1	1	-1	R_x, R_y, R_z	
T ₂	3	0	-1	-1	1	x,y,z	(xz,yz,xy)

b) Find out normalized SALC using projection operator B_1 operates on ϕ_1 orbital of $CH_2 - CH = CH_2$ ion:

$C_2 v$	E	\mathbf{C}_2^z	σ_v^{xz}	$\sigma_{v}^{\ yz}$
B ₁	1	-1	1	-1

SECTION - II

Q4) Answer the following:

- a) What are carbides?
- b) Borazole is called as inorganic benzene. Explain
- c) Hydrosilylation reaction.
- d) What are inter halogen compounds? Mention their types.
- e) Draw the structure of boron nitrides and comment on their properties.
- [5430] 1002

[10]

- *Q5*) Attempt any two of the following.
 - a) Give an account of oxoanions of nitrogen.
 - b) Write notes on oxyacids of halogen.
 - c) Write note on aluminosilicates.
 - d) Give characteristic reactions of COCl₂.
- *Q6*) a) Draw the structures of:

[3]

[2]

[10]

- i) B₆H₁₀
- ii) S_4N_4
- iii) P_4O_{10}
- b) Complete the reactions given below:
 - i) $\text{NH}_4\text{Cl} + \text{PCl}_5 \longrightarrow \dots \text{A}_{600} + \text{HCl}_{100}$

$$\begin{array}{c} Ph_{3}P, \qquad Cl \\ + H_{2} \rightarrow \dots \end{array}$$

$$\begin{array}{c} \text{ii} \\ \text{oc} \qquad PPh_{3} \end{array}$$

[5430] - 1002

Total No. of Questions :6]

P1159

[5430]-1003

M.Sc. - I

ORGANIC CHEMISTRY CHO-150: Basic Organic Chemistry (2013 Pattern) (Semester-I) (4 Credits)

Time : 3 Hours] Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicates full marks.
- 3) Answer to the two sections should be written in separate answer books.

SECTION-I

Q1) Attempt the following:

a) Compound A is less basic than compound B. Explain



- b) Anthracene undergoes bromination at 9 & 10 positions. Explain.
- c) The rate of elimination reaction of isopropyl bromide is greater in t BuOK/DMSO than that in KOH/EtOH. Explain.
- d) In diphenyl acetaldehyde, percentage of enol form is more than keto form. Explain.
- e) The ratio of rates of solvolysis of ethyl tosylate and phenyl ethyl tosylate in CF_3COOH is about 1:3040. Account for the fact.
- **Q2**) Attempt any five of the following:
 - a) Comment of chirality and optical activity of the following.



[Total No. of Pages :4

[Max. Marks: 50

SEAT No. :

[10]

[10]

b) Assign E/Z configuration to the following and justify.



c) Determine the absolute configuration of chiral centres a & b in the following.



d) Determine the absolute configuration.



e) Assign Pro-R and Pro-S labels to $H_A \& H_B$



f) Assign Re/Si face to the following.



[5430]-1003

g) Convert Newman projection to Fischer projection as shown.



Q3) Write notes on (any two)

[5]

[10]

- a) Non-classical carbocation
- b) Hard and Soft acids and bases
- c) Tautomerism

SECTION-II

Q4) Attempt the following:

- a) Phenacyl chloride reacts with KI in acetone 12,000 times faster than 2phenylethylchloride Explain.
- b) Anisole can be nitrated using fuming HNO₃ at O°C while nitration of Benzene requires high temperature.
- c) Cis-2-phenyl cyclohexyl brosylate undergoes elimination 10⁴ times faster than it's trans isomer. Explain.
- d) Vinyl chloride resists hydrolysis write allyl chloride is easily hydrolysed by SN¹ mechanism. Explain.
- e) Explain stereoselective reaction with one example.
- Q5) Suggest the mechanism (any four).



[5430]-1003

[10]



Q6) Predict the product with mechanism (any two).



[5430]-1003

Total No. of Questions : 6]

P1160

[5430]-1004

M.Sc. - **I**

ANALYTICAL CHEMISTRY

CHA - 190 : Safety in Chemical Laboratory and Good Laboratory **Practices**

(2014 Pattern) (Semester - I) (Credit System) (4 - Credits)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answer to the two sections should be written in seperate answer books.
- 2) All questions are compulsory.
- 3) Neat diagrams must be drawn wherever necessary.
- Use of logarithmic table, non-programmable calculator is allowed. *4*)

SECTION - I

Q1) Answer the following:

- Enlist the different types of gloves. a)
- Give corrective measures in inhalation and ingestion of toxic chemicals. b)
- What is role of respirator? c)
- Mention the types of hazards in chemical laboratory. d)
- Describe the role of safety officer. e)

Q2) Answer any two of the following:

- Write a note on fire safety equipments. a)
- Explain safety guidelines for assessing reactive and explosive hazards. b)
- Explain in brief a role of c)
 - Heat and smoke detector i)
 - Safety shower and eye wash unit ii)
- Describe the preventive measures for the risk with acute toxicants. d)
- **Q3**) Answer any one of the following:

P.T.O.

[5]

[Total No. of Pages : 2

[10]

[10]

[Max. Marks : 50

SEAT No. :

- a) Explain in brief the steps involved in chemical management.
- b) Explain the steps involved in establishment of safety and security in chemical laboratory.

SECTION - II

Q4)	Ans	swer t	he fol	llowii	ng:		
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- a) What is protocol amendment?
- b) Define fire and give its types.
- c) What is instrument validation?
- d) Define, Acid spills an Mercury spills.
- e) Explain in brief GMP.

Q5) Answer any two of the following:

- a) Explain the guidelines for working with compressed gas.
- b) Give a brief account of Drug development process.
- c) Describe the safety measures for handling biohazard and toxic materials.
- d) Explain the study plan of protocol with respect to its contents.

Q6) Answer any one of the following:

- a) Explain in brief SOP system overview.
- b) Write a note on Managing Chemical Waste on the basis of treatment and disposal option.

$\mathfrak{R}\mathfrak{R}\mathfrak{R}$

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Total No. of Questions :6]

P1150

[5430]-101

M.Sc.

PHYSICAL CHEMISTRY CHP - 110 : Fundamentals of Physical Chemistry - I (2013 Pattern) (Semester - I) (5 Credits)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the TWO sections should be written in SEPARATE answer books.
- 2) ALL questions are COMPULSORY.
- 3) Figures to the RIGHT SIDE indicate FULL marks.
- 4) Use of logarithmic table/calculator is ALLOWED.
- 5) Neat diagrams must be drawn WHEREVER necessary.

Physico - Chemical Constants

1.	Avogadro Number	Ν	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	Ħ	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
			=	$1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$
			=	$6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$
			=	$1.602 \times 10^{-19} \mathrm{C}$
5.	1 eV		=	23.06 k cal mol ⁻¹
			. ===	$1.602 \times 10^{-12} \text{ erg}$
			==	$1.602 \times 10^{-19} \text{ J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^1 \text{ mol}^1$
			=	$8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
			-	$1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	=	96487 C equiv ¹
8.	Speed of light	C	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$
			=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		= .	$4.184 \times 10^{7} \text{ erg}$
			=	4.184 J
10.	1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m	=	$9.11 \times 10^{-31} \text{ kg}$

[Max. Marks : 50

[Total No. of Pages : 3

SEAT No. :

SECTION - I

Q1) Attempt the following:

- a) What is chemical potential? White the expression of chemical potential in terms of fugacity.
- b) Give the properties of well behaved wavefunction.
- c) What is meant by 'Ultra violet Catastrophy'?
- d) Give the expression for rotational partition function and explain the terms therein.
- e) State zeroth law of thermodynamics. How can it be used to construct thermodynamic temperature scale?
- **Q2)** Attempt any two of the following:
 - a) Derive Clausius Clapeyron equation.
 - b) Derive the expression for energy of a particle in one dimensional box.
 - c) Explain Boltzmann distribution law.
 - d) Write a note on steam distillation.
- **Q3)** Solve any one of the following:
 - a) Evaluate energy of a photon emitted when an electron in one dimensional box of length 528 pm jumps from second excited state to ground state.
 - b) Determine eutropy when 6 g of methane spontaneously mixed with 5 g of ethane at 25°C. Consider methane and ethane are ideal gases. [Given at.wts C=12, H=1]

SECTION - II

Q4) Attempt the following:

- a) Show that half life period of a 1st order reaction is independent of its initial concentration.
- b) Explain the competitive inhibition in enzyme catalyzed reactions.
- c) Define energy of activation. Write the differential form of Arrhenius equation.
- d) Give the postulates of transition state theory.
- e) The energy of activation for a certain first order reaction is 138 K cal Mol^{-1} , 300 K, determine the enthalpy of activation ΔH^* .

[5430]-101

[10]

[10]

[5]

[10]

- **Q5)** Attempt any two of the following:
 - a) Explain half life method of determination of order of reaction.
 - b) Explain primary salt effect. Derive an expression for the dependence of reaction rate on ionic strength.
 - c) 'Enzyme catalyzed reaction is first order with respect to substrate concentration', explain.
 - d) A possible mechanism for the reaction $C_2H_6+H_2 \rightarrow 2CH_4$ is
 - i) $C_2H_6 \rightleftharpoons 2CH_3$ ii) $CH_3 + H_2 \rightarrow CH_4 + H$
 - iii) $H + C_2H_6 \rightarrow CH_4 + CH_3$ Show that $\frac{d [CH_4]}{dt} = Keff. [C_2H_6]^{\frac{1}{2}}$. $[H_2]$
- **Q6)** Solve any one of the following
 - a) The rate constant at 300 K is 1.352×10^{-2} s⁻¹ and its frequency factor is $2.785 \times 10^{+6}$ s⁻¹. Determine enthalpy of activation.
 - b) For the reaction $2N_2O_5 \rightarrow 4NO_2+O_2$. The rate is directly proportional to $[N_2O_5]$. At 45°C, 90% of N_2O_5 reacts in 3600 seconds, find the value of rate constant.

[5430]-101

Total No. of Questions : 6]

P1151

SEAT No. :

[Total No. of Pages : 2

[5430]-102

M.Sc.

INORGANIC CHEMISTRY

CHI-130 : Molecular Symmetry and Chemistry of P-Block Elements (2013 Pattern) (5 Credit System) (Semester-I)

Time : 3 Hours] Instructions to the candidates: [Max. Marks : 50

[10]

[10]

- 1) All questions are compulsory.
- 2) Answers to the two sections should be written in separate answer books.
- 3) Figures to the right indicate full marks.
- 4) Use of log table and calculator is allowed.

SECTION-I

Q1) Answer the following.

- a) Define proper axis of rotation. Draw the axis of rotation in NH_3 .
- b) Define an abelian group. Give one example.
- c) Find the improper axis of rotation in CH_4 molecule.
- d) Find symmetry elements of HOCl molecule.
- e) Predict the product of $C_2^z \times C_2^x$ using cartesian coordinates.

Q2) Attempt any two of the following.

- a) Derive the character table for cis-1, 2- dichloroethylene.
- b) Prove that $S_n^n = E$ using staggered ethane.
- c) Explain all symmetry elements of SO₃.
- d) For H₂O molecule, E, $C_2^z, \sigma_v^{xz}, \sigma_v^{yz}$ are the symmetry elements. Divide them into appropriate classes using similarity transformation.

Q3) Attempt any one of the following:

a) Find the normalized SALC using projection operator B_1 operates on ϕ_1 orbital of CH_2 -CH=CH₂ ion

b) Fill in the missing entries in the following table. Justify.

C_2h	E	\mathbf{C}_2^z	$\sigma_{\scriptscriptstyle h}^{\scriptscriptstyle xy}$	i
	1		1	1
A_2g	1	1	-1	-1
	1		1	-1
	1	-1	-1	1

SECTION-II

[10]

[10]

[5]

Q4) Answer the following.

- a) What are allotropes of carbon? Draw the structure of graphite.
- b) What are interhalogen compounds? Mention its types.
- c) What are borohydrides? How they are classified.
- d) How alkali metals are extracted using crown ethers?
- e) Draw the structure of borazole & explain, why it is called as inorganic benzene?

Q5) Attempt any two of the following.

- a) Write a note on nitrogen activation.
- b) Write a note on oxyacids of chlorine.
- c) Write a note on fullerenes and give its reactions.
- d) Give an account of molecular sieves.

Q6) Attempt the following.

- a) Explain the structure and bonding in AS_4O_{10}
- b) Draw the structures of following.
 - i) IFT ii) S_4N_4 iii) $Li_4(CH_3)_4$

 \checkmark \checkmark \checkmark

Total No. of Questions :6]

P1152

[5430]-103

M.Sc. -I

ORGANIC CHEMISTRY (Part-I) CHO-150: Organic Reaction Mechanism and Stereo Chemistry (2013 Pattern) (Semester-I)

Time : 3 Hours] Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicates full marks.
- 3) Answers to the two sections should be written in seperate answer books.

SECTION-I

Q1) Attempt any three of the following:

- a) Cyclohexane does not exist in planner form explain.
- b) What is the concept of NGP?
- c) Discuss in brief stereoselective reactions.
- d) What are epimers? Explain it with suitable examples.
- e) 2,6-Diisopropylaniline is a stronger base than aniline. Explain
- *Q2*) Explain any four of the following:
 - i) The stability of the following.



ii) The structure and stability of carbene

[Max. Marks : 50

[8]

[9]

[Total No. of Pages :4

SEAT No. :

iii) Discuss the acidity of the following.



- iv) Comment on the optical activity of biphenyls.
- v) Cycloheptatrienyl cation is aromatic.
- *Q3*) Attempt any four of the following:

[8]

- a) Describe the stereochemistry of the product formed by the reaction of moleic acid with osmium tetraoxide.
- b) Assign R/s labels to the chiral carbons.



c) Comment on the basicity of the following.



d) Write the equivalent structures.



[5430]-103

e) Make the conversion from Newman projection into Fischer projection and assign the configuration at each chiral centers.



SECTION-II

Q4) Attempt any three of the following:

- a) Explain Benzyne intermediate with suitable example.
- b) Explain hydrolysis of 2- bromopropionic acid.
- c) What is SN^2 reaction?
- d) Write any one reaction involving SET mechanism.
- e) Describe resioselectivity in ambident nucleophile.
- Q5) Suggest the mechanism (any four).



[9]

[8]

Q6) Predict the products (any four).



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[5430]-103

Total No. of Questions : 6]

P1153

[5430]-104 M.Sc. - I CHEMISTRY

CHA - 190 :Safety in Chemical Laboratory and Good Laboratory Practices

(2013 Pattern) (Semester - I) (5 - Credits)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answer to two sections should be written in seperate answer books.
- 2) All questions are compulsory.
- 3) Neat diagrams must be drawn wherever necessary.

SECTION - I

Q1)	Atte	mpt the following:	[10]
	a)	What are the contents of first aid kit?	
	b)	Enlist the various types of hazards.	
	c)	Explain the term 'Good House Keeping'.	
	d)	Give the guideline for the storage of chemicals.	
	e)	Mention the different types of gloves.	
Q2)	Ansv	wer any two of the following:	[10]
	a)	Write a short note on Material Safety Data Sheet.	
	b)	Explain in brief an effect of hazards on health.	
	c)	Comment on Do's and Dont's in chemical laboratory.	
	d)	Explain the different types of fire extinguisher.	
Q3)	Ansv	wer any one of the following:	[5]
	a)	Write a short note on personnel protective equipments.	
	b)	Explain in brief the importance of safety and health in laboratory.	

P.T.O.

SEAT No. :

[Total No. of Pages : 2

[Max. Marks : 50

SECTION - II

Q4)	Atte	mpt the following:	[10]
	a)	What is acid spillage? Give its preventive measures.	
	b)	Explain chemical hygine.	
	c)	What is instrument validation?	
	d)	Define mixed waste.	
	e)	Define NABL and give its role.	
Q5)	Ans	wer any two of the following:	[10]
	a)	Define SOP and explain the protocol for its approval.	
	b)	Explain any two methods of calibration.	
	c)	How will you classify the waste material.	
	d)	Explain the injuries and emergencies in chemical laboratory.	
0 6)	Ans	wer any one of the following:	[5]
2.07	a)	Write a note on GLP in chemical laboratory	[-]
	b)	What type accident may occur in chemical laboratory? What are precautions tobe taken?	e the

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P1161

[5430]-2001

M.Sc. - I

PHYSICAL CHEMISTRY

CHP - 210 : Fundamentals of Physical Chemistry - II (2014 Pattern) (Semester - II) (New 4 Credit)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic tables/calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1.	Avogadra Number	Ν	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg } \text{K}^{-1} \text{ molecule}^{-1}$
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3.	Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$
			=	$6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$
			=	$1.602 \times 10^{-19} \text{ C}$
5.	leV		=	23.06 k cal mol ⁻¹
			=	$1.602 \times 10^{-12} \text{ erg}$
			=	$1.602 \times 10^{-19} \text{ J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^{7} \text{ erg } \text{K}^{-1} \text{ Mol}^{-1}$
			=	8.314 J K ⁻¹ Mol ⁻¹
			=	$1.987 \text{ cal } \mathrm{K}^{-1} \mathrm{Mol}^{-1}$
7.	Fraday Constant	F	=	96487 C equiv ⁻¹
8.	Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$
			=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		=	$4.184 \times 10^{7} \text{erg}$
			=	4.184 J
10.	l amu		=	$1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β _c	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β _n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m _c	=	$9.11 \times 10^{-31} \text{ kg}$

[Max. Marks : 50

SEAT No. : [Total No. of Pages : 3

P.T.O.

SECTION - I

Q1) Attempt the following:

- a) Write and explain the expression for the width of a spectral line.
- b) Classify the following molecules based on moment of inertia.
 - i) Vinyl chloride
 - ii) C_6H_6
 - iii) H₂O
 - iv) BF₃
- c) State the conditions for Raman activity.
- d) State Born-oppenheimer approximation. Under what conditions it breaks down.
- e) Write the expression for resolving power of FT-IR spectrophotometer.
- **Q2)** Attempt any two of the following:
 - a) Explain the rule of mutual exclusion and its converse.
 - b) Explain UPES with the help of a spectrum for CO molecule.
 - c) How many fundamental modes of vibrations are their for water molecule? Sketch and explain each vibrational mode.
 - d) Explain the applications of ESR spectroscopy.
- **Q3)** Solve any one of the following:
 - a) Calculate the fundamental frequency of DCI if the fundamental vibrational frequency of HCl is 2990 cm⁻¹ assuming force constant to be the same.
 - b) The fundamental and first overtone transition of the NO molecule are at 1877.05 cm⁻¹ and 3725.0 cm⁻¹ respectively. Evaluate the equilibrium vibration frequency and the force constant of the molecule.

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SECTION - II

Q4) Attempt the following :

- a) Explain the different types of radioactive decay process.
- b) State Ficks laws of diffusion.
- c) Define the terms radiation track, spurs, δ -ray and stopping power.
- d) Give the preparation of ${}^{14}C$ and ${}^{3}H$ isotopes.
- e) Define elementary separation factor. Write Fermis four factor formula. Give the meaning of each terms involved in it.
- **Q5)** Attempt any two of the following :
 - a) What are the modes of interaction of γ -rays with matter? Explain the photoelectric effect in detail.
 - b) What is diffusion phenomenon? Discuss zone-diffusion technique to determine diffusion coefficient.
 - c) Explain the principle and working of a breeder reactor.
 - d) Describe the principle, construction and working of G.M. counter.
- **Q6)** Solve any one of the following :
 - a) The half life period of ²²⁶Ra is 1600 years. How many gram of it will be left undisintigrated from 1.0 gram of the isotope after 4750 years.
 - b) Calculate the thickness of Pb (Z = 82, A = 207.2) plate required to reduce the level of radiation from 0.1 Gy/min to 3.1 m Gy/hour.

[Given $e\mu = 0.211$ b/electron, Density of pb = 11.35 g cm⁻³]

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Total No. of Questions : 6]

P1162

[5430]-2002

M.Sc.-I

INORGANIC CHEMISTRY CHI-230 : Coordination and Bioinorganic Chemistry (2014 Pattern) (Semester - II)

Time : 3 Hours] Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answer to the two sections should be written in separate answer books.
- 3) Neat and labelled diagrams must be drawn wherever necessary.
- 4) Figures to the right indicate full marks.

SECTION-I

Q1) Answer the following:

- a) State and explain Hund's rule to determine the ground state term symbols.
- b) Hydrated cupric sulphate containing $[Cu(H_2O)_4]^{2+}$ is blue in colour why?
- c) Determine full spectroscopic term symbols for the following free ions:
 i) Fe³⁺
 - ii) Co²⁺
- d) The magnetic moment of $[MnBr_4]^{2-}$ is 5.9 B.M. What is the geometry of this complex ion?
- e) Give the spectrochemical series for ligands.

Q2) Attempt any two of the following:

- a) Give splitting of ⁴F R–S term in weak cubic field using character table for pure rotational point group and reduction formula.
- b) In the following pair of transitions in octahedral complex, which would you expect to be more intense?
 - i) ${}^{3}A_{2g} \rightarrow {}^{3}T_{2g}$ and ${}^{3}A_{2g} \rightarrow {}^{1}E_{g}$
 - ii) $A_{2u} \rightarrow T_{2g}$ and $A_{1g} \rightarrow T_{2u}$
- c) Describe Orgel diagram for D and F ground state terms.
- d) A complex $[Cr(H_2O)_6]Cl_3$ records three spin allowed transitions at 17400cm⁻¹, 24600cm⁻¹ and 37800cm⁻¹. Calculate nephelauxatic ratio (β) and comment on the nature of M-L bond.

[Total No. of Pages : 4

SEAT No. :

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[Max. Marks : 50

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Q3) Attempt <u>any one</u> of the following:

- a) Write a note on luminescence spectra.
- b) Co²⁺ (Td) complex shows 23% increase in the magnetic moment compared to it's spin only value. Calculate spin-orbit coupling constant (λ) for Co²⁺ ion, its crystal field splitting parameter in 10Dq=3600cm⁻¹.

SECTION-II

Q4) Answer the following:

- a) Give biological functions of the following elements : Fe, P, V, W.
- b) Enlist functions of copper Type I proteins.
- c) Give names of enzymes involved in mercury detoxification.
- d) What is bio-availability of an element?
- e) What is receptor-mediated endocytosis?
- **Q5)** Attempt <u>any two</u> of the following:
 - a) Explain in detail role of Mangnese in photosynthesis.
 - b) Discuss electron transfer reactions as applicable to bioinorganic chemistry.
 - c) Give a comparative account of Hemoglobin, Hemocyanin and Hemerythrin.
 - d) Discuss mechanism of cellular uptake of cisplation.
- *Q6*) Draw structures of : (any five)
 - a) Rubredoxin
 - b) Flavin
 - c) MECAM
 - d) 3Fe-4s cluster
 - e) Adenine
 - f) Pterin.

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DIRECT PRODUCTS

	l	Group	ps of th	c.form	GxiorG× v.r			
		The p	g, u or	', ' add	ditions to the IR :	symbols in these g	groups satisfy	
		g × g	: = u Х	u = g	g x :u = u, 'x' :	= 'x'='.'x'=	z	
	2	Produ	tis es i	the form	$A \times A, B \times B,$	A × B :		
		For a	ll group	: 20				
		Letter	symbo	is : A >	$(A = A, B \times B)$	$= A_1 A \times B = I$	3.	
		Subsci	ripts :]	×!=	$1, 2 \times 2 = 1, 1$	$\times 2 = 2$		
		except	for the	B repre	scatations of D ₂	and D ₁₄ where		
		B×E	3 = B :	and 1 ×	$2 = 3, 2 \times 3 = 1$	$3 \times 1 = 2$.		
	3	Produc	cts of L	he form	: A x E, B x E	:		
		(a) 1	Por ill	groups :	$A \times E_{t} = E_{t}$ irre	spective of the su	fir on A.	
		(6) 1	For ill	groups e	xcept Du, Du, S	:		
		Ì	B × E.	= F2, B	$\times E_1 = E_1$			
		ĩ	rrespect	ivo of 1	he suffix on B (If the group has o	only one B represen	atative
		5	out E.	=E, = E	-)			
		(c) F	or De	:				~
		I	B × E,	Es. B	×E1=E. B>	$(E_1 = E_1, B \times$	$E_4 = E_7, B \times E_7$	as Et
		i	rrespect	ive of th	e selfix on B:			
		(d) F	for De	S. :				
		1	B × E,	- E, B	$X E_2 = E_2 B X$	$E_1 = E_1$		
		i	rrespect	ive of th	e suffix on B.			
	4.	Produc	as of 1	be form	ExE:	1 (1995) 1 (1995)		
		(For	roups	which h	Ive A, B or E syn	abols without su	fixes put $A_i = A_j$	₩ Λ ,
		etc. in	the eq	untions l	below)			
		(a) F	tor Op	0, T, E	De De Ce Ce C	S. Dy, Dy, D,	C3++ C34, C3 :	
		E	XE	=E, X	$\mathbf{E}_2 = \mathbf{A}_1 + \mathbf{A}_2 +$	$E_1: E_1 \times E_2 = B$	$B_1 + B_2 + E_1$	
		(b) F	tor De	Da, Can	, Cas, C4, S4, D34 :			
		E	3×E-	· A1 + /	$A_2 + B_1 + B_2.$			
		(c) F	For Du	:		-		
		E	$E_1 \times E_1$	$= E_{j} \times$	$E_j = A_1 + A_2 +$	E ₁ ,		
		E	$E_2 \times E_2$	$= E_4 \times$	$E_1 = A_1 + A_2 + A_3 + A_4 $	E4.		
		E	5 × E	= A, +	A1+B1+B2	VR - F. VF.	F+ F.	
		1	$E_1 \times E_2$	= E. X		XG-GAG	E + E	
		1	S X E	= E2 X	$E_j = E_j + E_j, E_j$	R - R + R + I		
		E	Y X E	$= B_1 +$	· B1. T Em E2 A		T	
				s	-34, C5 :			
		E, :	$\times \mathbf{E}_{i} =$	$A_1 + A_2$	$+ E_2, E_2 \times E_1 =$	$A_1 + A_2 + E_1,$		
	,	E_1	$\times E_{2} =$	$E_1 + E_2$				
	(4	c) for	Der, Se	•	a like an at some the			
		E, S	$E_1 =$	$E_1 \times E_1$	$= A_1 + A_2 + E_2$			
		E ₂ >		$A_1 \dashv A_2$	$+ B_1 + B_2$	- D) 7 1 B		
5	Pr.	aducte i			$= E_1 + E_1, E_1 \times E_2$	$a = b_1 + b_2 + b_3$	2- T	
э.	A.	YT -	-T A	the I (or F) representat	$A \times T = T$	1.	
	E	× T. =	EXT		$T_2, \Lambda_2 \times T_1 = T_2$	$n_1 \wedge n_2 - n_1$		
	Т,	× T, =	- T, X	$\Gamma_1 = \Lambda_1$	$+B+T_1+T_2$			
	T,	× T, =	- A3 +	B + 7	+ Tr			
6.	Th	e compl	lete rest	its for C	are :			
	-	0	~	A.,	E	T,	Τ,	
		A.	A	A2	E	T ₁	<i>T</i> ₂	
		A2 57	A2	A	B	T1	T,	
		т.	т.	л Т	A1+A2+E T -LT	11+J2 T+ T+R+A	11+12 A. + B+T +T	
		T-	т.	T.	7773 7.1T	A+E+T.+T.	L+E+T.17	
			-1		11712	· · · · · · · · · · · · · · · · · · ·	-4	

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CORRELATION TABLE FOR GROUP 0_h

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0.	0	r4	D.	Dzi	Cu	C2.	D 34	D3	C 28
A	A	A	A 10	A.	A1	A 1	Ase	A .	A.
A 24	A1	Az	BLE	81	B1	A2	A4	41	
E	E	E	A10+ B10	$A_1 + B_1$	A1+ B1	A1+ A1	E,	E	A4+ B4
Tia	T.	TI	A 34 + E4	$A_2 + E$	$A_1 + E$	A1+ B1+ B2	An + Ey	$\lambda_3 + E$	1,+28,
Tu	T2	T1	814 + E4	$B_1 + E$	$B_1 + E$	A1+ #1+ #2	Au+Ey	$A_1 + E$	24+4
Ain	A	Az	Ain	B 1	Az	As	ALD	A1 .	A,
A	A.	A	1 te	A	8,	A1	Aze	Az	B.
E	E	E	Asa+ Bis	A1+ B1	A1 + B1	A1 + A1	E.	E	· 4+ #
Ter	T.	T.	Asa+ Ea	8, + E	AI+E	$A_1 + B_1 + B_2$	Aza + Ea	$A_1 + E$	A. + 28.
T 1.	T	Ti	B10 + E.	$A_2 + E$	$B_1 + E$	$A_1 + B_1 + B_2$	Ase+ E.	$A_1 + E$	21+ B.

Character Table for (O) rotational group

0	E	62.	$\Im C_2 (= C_{\mathbf{k}}^2)$	8C,	6C,		<u> </u>
A1 A1 E	1 1 2		1 1 2	1 1 -1	-1 0		$x^2 + y^2 + z^2$ $(2x^2 - x^2 - y^2)$
T_1 T_3	3	1 - 1	-1	0	-!	$(R_{x_1}, R_{y_1}, R_{z}); (x, y_1, z)'$	x ² - y ²) (xy, xz, yz)

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[5430]-2002

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Total No. of Questions : 6]

P1163

[5430]-2003

M.Sc. - I

ORGANIC CHEMISTRY

CHO - 250 : Synthetic Organic Chemistry and Spectroscopy (2014 Pattern) (Semester - II) (4 - Credits)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right indicate full marks.

SECTION - I

Q1) Explain any five of the following:

- a) O-hydroxy acetophenones are generally prepared by fries rearrangement. Explain.
- b) Discuss the limitations of BH_3 as hydroborating agent.
- c) Compare the reactivities of RMgx and R₂CuLi.
- d) N-Methyl benzamide fails to show Hoffmann's rearrangement.
- e) What are phosphorous ylides? Explain with suitable example.
- f) Discuss any one reaction used for homologation of acid.

Q2) Attempt any five of the following:

- a) Wilkinson's catalyst.
- b) Bayer Villiger oxidation.
- c) 9-BBN.
- d) Synthetic applications of Reformatskii reaction.
- e) Limitations of F.C. alkylation.
- f) Schimidt's rearrangement.

[Total No. of Pages : 3

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[Max. Marks: 50

- I

SEAT No. :

Q3) Predict the products and suggest the mechanism (any two).



SECTION - II

Q4) Attempt the following:



b) How will you distinguish the following pair of the compounds using IR.



c) How will you monitor the following reaction using PMR? Suggest the reagents.



d) Explain the genesis of following compounds in mass spectrometry.

$$m_{\chi_2} = g_{1,43}$$

e) Factors affecting chemical shift in PMR spectroscopy.

[5430]-2003

[10]

Q5) Deduce the structures of any five of the following:

- a) MF = $C_8 H_{10} O_2$ IR = 1600, 1500, 1100, 1200 cm⁺ PMR = 3.32 (s, 3H) 4.01 (s, 3H) 7.24 (m, 5H)
- b) $M.F = C_8 H_7 N$ IR = 1610, 1520, 2245 cm⁺ PMR = 7.32 (5H, multiplet) 4.0 (2H, singlet)

c) MF =
$$C_{3}H_{4}N_{2}$$

PMR = δ : 6.22 (m, 5mm)
7.52 (m, 10mm)
12.58 (bs, 5mm)

d) MF =
$$C_6 H_7 \text{ NO}$$

IR = 1710 cm⁺
¹H-NMR : δ : 2.3 (s, 3H)
2.4 (t, J = 6 Hr, 2H)
2.6 (t, J = 6 Hr, 2H)

e) MF =
$$C_{10} H_{12}$$

¹H-NMR - δ = 0.8 δ (t, J = 7 Hz, 2H)
0.9 (t, J = 7 Hz, 2H)
1.2 (s, 3H)
7.2 (m, 5H)

f) MF = C₇ H₇ NO
IR = 3300, 1680, 1600, 1500 cm⁻¹
PMR =
$$\delta$$
 : 5.00 (bs, 2H)
7.46 (m, 3H)
7.92 (m, 2H)

Q6) Attempt <u>any two</u> of the following:

- Explain Nitrogen rule in mass spectrometry.
- b) Various modes of vibration in IR spectroscopy.
- c) ${}^{13}C{}^{-13}C$ coupling is absent in CMR spectroscopy.
- d) Acetylenic protons are shielded. Explain.

$\mathfrak{H}\mathfrak{H}\mathfrak{H}$

a)

Total No. of Questions : 3]

SEAT No. :

[Total No. of Pages : 11

[5430]-2004

M.Sc. - I

ANALYTICAL CHEMISTRY

CHA - 290 : General Chemistry

(2013 Pattern) (Semester - II) (New 4 Credits)

New Course Based on Credit & Semester System

- PART A: Modern Separation Methods and Hyphenated Techniques (2.0 Credit / 25 marks)
- PART B: Basic Biochemistry (4.0 Credit / 50 marks)
- PART C: Concept of Analytical Chemistry (2.0 Credit / 25 marks)
- PART D: Industrial Methods of Analysis (2.0 Credit / 25 marks)
- PART E: Organometallic and Inorganic Reaction Mechanism (2.0 Credit / 25 marks)
- PART F: Mathematics for Chemists (2.0 Credit / 25 marks)

PART - G: Pericyclic, Photochemistry and Free Radical Reactions (2.0 Credit / 25 marks)

Time : 3 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) All questions of the respective section/part are compulsory.
- 2) Figures to the right hand side indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of logarithmic table / non-programmable calculator is allowed.
- 5) Students should attempt any two parts from Part A, C, D, E, F and G or full paper of Basic Biochemistry (Part B).
- 6) Write the answers of two parts in separate answer books.

PART-A

Modern Separation Methods and Hyphenated Techniques

Q1) Attempt the following :

- a) State the principle of Mass spectrometry.
- b) How qualitative and quantitative information is obtained by gas chromatography?
- c) Define:
 - i) Base peak.
 - ii) Metastable ion.
- d) Give the mechanism of exchange in ion-exchange chromatography.
- e) Give any two applications of HPLC.

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- **Q2)** Answer any two of the following :
 - a) Explain the electron impact ionization method.
 - b) Enlist the various detectors used in GC and explain Thermal conductivity detector.
 - c) With the help of neat labelled diagram, explain the working of magnetic field mass analyzer.
 - d) Explain the normal and reverse phase HPLC technique.

Q3) Answer <u>any one</u> of the following :

- a) Draw a block diagram of HPLC instrument and explain its essential components.
- b) A time of flight mass analyzer has flight path of 100 cm and it uses accelerating potential of 2500V. Calculate the time required for ionic fragment with m/z = 100 and 101 to strike the detector. Calculate difference in time of arrival of two ions at the detector.

Total No. of Questions : 6]

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[5430]-2004 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 (B) : Basic Biochemistry (2013 Pattern) (Semester - II) (4 Credits) <u>PART - B</u>

Time : 3 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answer to the two sections to be written in separate answer books.
- 3) Draw neat diagrams wherever necessary.
- 4) Figures to the right side indicate full marks.

SECTION - I

Q1) Answer any four of the following :

- a) Explain Titration curve of aminoacid and give its significance.
- b) Comment on Sulphur containing amino acids and aromatic amino acids present in a protein.
- c) Explain the following in brief:
 - i) Protein denaturation.
 - ii) Ninhydrin reaction.
- d) What do you mean by primary active transport? Explain with example.
- e) What are oligosaccharides? Draw the structures of any two disaccharides.

Q2) Attempt any two of the following :

- a) Comment on preparatory and payoff phase of Glycolytic pathway.
- b) What are simple proteins? How are they classified further?
- c) Answer in brief on :
 - i) Mitochondria, power house of cell.
 - ii) Lysosomes.

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[8]
Q3) Explain the following terms (any five):

- a) Facilitated diffusion.
- c) Glycogenesis.
- e) Essential amino acids.
- g) Ribosomes.

SECTION - II

- **Q4)** Answer any four of the following :
 - a) Explain:
 - i) Reverse transcription.
 - ii) Watson and Crick Model.
 - b) Give the importance of double reciprocal plot.
 - c) Explain the elongation stage of transcription process.
 - d) Write a note on vitamin B_1 .
 - e) Discuss therapeutic uses of enzyme.

Q5) Attempt any two of the following :

- a) i) What is Replication fork?
 - ii) Give an account on enzymes and protein factors involved in replication process.
- b) Derive Michaelis Menten equation.
- c) What is nutritional deficiency? Give an overview on diseases related to nutritional deficiency.

Q6) Explain the following terms (any five)

- a) Xerophthalmia.
- b) Genetic code.
- c) Coenzyme.
- d) Termination codons.
- e) Non competitive enzyme inhibition.
- f) Enzyme immobilization.
- g) Gene therapy.

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[5430]-2004

[12]

- b) Protein Engineering.
- d) Complex lipids.
- f) Mutarotation.

[8]

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[5430]-2004 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry (2013 Pattern) (Semester - II) <u>PART - C</u> Concept of Analytical Chemistry

Q1) Answer the following :

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- a) What is real sample?
- b) Give the procedure for sampling of particulate solids.
- c) Explain the test of significance.
- d) What is indeterminate error?
- e) Give the classification of chromatographic methods.
- **Q2)** Attempt any two of the following :
 - a) Explain multiplication and division with suitable example.
 - b) Write a note on automated sample handling.
 - c) Which precipitating agents have been employed for quantitative inorganic separations?
 - d) Give the relationship between migration rate and distribution constant.
- **Q3)** Attempt any one of the following :

- a) Explain Q-test with suitable example.
- b) You have received three shipments of Uranium ore of equal weight. Analysis of three ores indicated contents of $3.978 \pm 0.004\%$, $2.536 \pm 0.003\%$ and $3.680 \pm 0.003\%$ respectively. What is the average Uranium content of the ores and what are the absolute and relative uncertainties?

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[5430]-2004 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry (2013 Pattern) (Semester - II) (2.0 Credits) <u>PART - D</u> Industrial Methods of Analysis

Q1) Answer the following :

- a) What is solubility product? Explain its application in qualitative analysis.
- b) Describe the preparation of 500 ml of 1.0 mg/ml solution of chloride from solid KCl. (Atomic weight K = 39, Cl = 35.5).
- c) Explain the terms theoretical yield and practical yield.
- d) What is buffer solution? Give its types with suitable examples.
- e) Calculate the amount of KMnO_4 required for preparation of its 100 ml of $\frac{\text{N}}{10}$ solution. (Molecular weight of $\text{KMnO}_4 = 158.0$).
- Q2) Attempt any two of the following :
 - a) Explain the terms stability constant and stepwise stability constant of the complex.
 - b) Calculate solubility of lead iodide in grams per liter, if its solubility product (Ksp) is 7.1 × 10⁻⁹ at 25°C.
 (Atomic weight Pb = 207.2, I = 126.9)

c) Write a short note on 'total quality management'.

d) What are the different responsibilities of laboratory staff for quality?

Q3) Attempt any one of the following :

- a) A sample of hematite ore is analyzed for iron content by gravimetric method. If 0.200 grams of ore yields 0.210 grams of Fe₂O₃. Calculate the percentage of iron in the ore sample. (Atomic weight Fe = 55.85, O = 16.00).
- b) Explain the types of quality standards for chemical laboratories.

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[5430]-2004 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry (2013 Pattern) (Semester - II) <u>PART - E</u> Organometallic and Inorganic Reaction Mechanism

Q1) Answer the following :

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a) Predict A and B of the following reaction

$$\left[\operatorname{Fe}(\operatorname{H}_{2}\operatorname{O})_{6}\right]^{2+} + \left[\operatorname{CO}(\operatorname{NCS})(\operatorname{NH}_{3})_{5}\right]^{2+} \rightarrow \operatorname{A} + \operatorname{B}.$$

- b) CO is a very weak ligand but it forms stable carbonyls with metals. Why?
- c) Give the valence electron counts for the following complexes
 - i) $CO_2(CO)_8$
 - ii) IrCl(CO)(PPh₃)₂
- d) Discuss the relationship between the d electron configuration of metal and lability of complex?
- e) Write a note on Chelate effect.
- **Q2)** Attempt any two of the following :
 - a) Describe briefly the hydroformylation with $HCO(CO)_4$.
 - b) Explain in detail bonding in metal alkylidene complexes.
 - c) Write a note on nucleophilic substitution reaction.
 - d) Explain with an example oxidative addition and reductive elimination reaction.
- Q3) Attempt any one of the following :
 - a) Explain with an example outer sphere mechanism.
 - b) Predict which of the complex $[V(CO)_6]^-$, $Cr(CO)_6$, $[Mn(CO)_6]^+$ has the shortest C O bond and justify your answer.

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P1164

[5430]-2004 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry (2013 Pattern) (Semester - II) <u>PART - F</u> Mathematics for Chemists

Q1) Answer the following : [10]
a) For the matrices
$$A = \begin{bmatrix} 3 & 2 \\ 1 & 5 \end{bmatrix}$$
, $B = \begin{bmatrix} 2 & -4 \\ -3 & 1 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 2 \\ 3 & -1 \end{bmatrix}$ evaluate
(A + B)C = AB + BC.
b) Define :
i) Singular and multiple points
ii) Concave curve
with suitable examples.
c) Differentiate between exact and inexact differentiation.
d) Find the value of the determinant $\begin{vmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{vmatrix}$.
e) Define :
i) Square matrix ii) Diagonal matrix
Q2) Attempt any two of the following : [10]
a) Differentiate the following :
i) $y = e^x \cdot \cos x$ ii) $y = x^2 \log x$.
b) What is a Cusp? With suitable diagrams explain types of cusps.
c) What is integration? Explain the types of integrals.
d) Evaluate the following :
i) $\int (x^3 - 3)^2 dx$ ii) $\int \frac{\sin^2 x - \cos^2 x}{\sin^2 x \cos^2 x} dx$

- **Q3)** Attempt any one of the following :
 - a) Define the following :
 - i) Periodic function
 - ii) Trigonometric function
 - iii) Fourier series.
 - b) Define the following :
 - i) Linear equations
 - ii) Homogeneous equation
 - iii) Singular solution.

P1164

F [5430]-2004 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry (2013 Pattern) (Semester - II) <u>PART - G</u> Pericyclic, Photochemistry and Free Radical Reaction

Q1) Attempt any three of the following :

- a) Construct a correlation diagram for the disrotatory opening of the cyclohexadiene to hexatriene. Predict whether these transformation are allowed thermally or photochemically.
- b) Give mechanism of photo rearrangement of 4, 4-disubstituted 2, 5 cyclohexadienones.
- c) Explain photochemical cis-trans isomerisation.
- d) Explain the Paterno-Buchii reaction.





ii]
$$h^{2}$$
 h^{2} h

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 $\frac{NBS}{BZ_2O_2} A + B + C$

b) Write short note on any two of the following :

[4]

[9]

- i) Diradicals.
- ii) Photochemistry of diazo compounds.
- iii) [1, 3] sigmatropic rearrangement.

Q3) Explain the mechanism for the following reaction (any four):



[8]

* * * *

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P1199

[Total No. of Pages : 3

[5430]-201

M.Sc.

PHYSICAL CHEMISTRY CHP - 210 : Fundamentals of Physical Chemistry - II (2013 Pattern) (5 Credits) (Semester - II)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the TWO sections should be written in SEPARATE answer books.
- 2) ALL questions are COMPULSORY.
- 3) Figures to the RIGHT SIDE indicate FULL marks.
- 4) Use of logarithmic table/calculator is ALLOWED.
- 5) Neat diagrams must be drawn WHEREVER necessary.

Physico - Chemical Constants

1.	Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
			=	$1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$
			=	$6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	=	4.803×10^{-10} esu
			=	1.602 × 10 ⁻¹⁹ C
5.	1 eV		=	23.06 k cal mol ⁻¹
			_	$1.602 \times 10^{-12} \text{ erg}$
			=	$1.602 \times 10^{-19} \mathrm{J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
			=	$8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
			-	$1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	=	96487 C equiv ¹
8.	Speed of light	Ċ	=	$2.997 \times 10^{10} \mathrm{~cm~s^{-1}}$
			=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		= .	$4.184 \times 10^{7} \mathrm{erg}$
			=	4.184 J
10.	1 amu		=	1.673×10^{-27} kg
11.	Bohr magneton	β_	=	$-9.274 \times 10^{-24} \mathrm{J T}^{-1}$
12.	Nuclear magneton	β	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m	=	$9.11 \times 10^{-31} \text{ kg}$
	•	÷		-

[Max. Marks : 50

P.T.O.

- **Q1)** Attempt the following :
 - a) Explain Doppler broadening.

b) Show that
$$v_{max} = \frac{1}{2x_e} - 1$$
.

- c) What is Bom Oppenheimer approximation.
- d) State rule of mutual exclusion with suitable example.
- e) Give the difference between symmetric top and assymmetric top molecules with respect to rotations.

Q2) Attempt any two of the following:

- a) Discuss the spectrum of non-rigid rotator.
- b) Explain different modes of vibration of H₂O and CO₂.
- c) How can Birge-Sponer extrapolation be used to determine the molecular dissociation energies in ground state.
- d) What is Raman effect? Explain quantum mechanical approach for Raman Scattering.
- **Q3)** Solve any one of the following
 - a) Determine the rotational constant for ${}^{13}C^{16}O$ if the rotational constant of ${}^{12}C^{16}O$ is 3.84235 cm⁻¹.
 - b) Fundamental and first overtone transitions of ¹⁴N¹⁶O are centred at 1876.06 and 3724.20 cm⁻¹ respectively. Evaluate equilibrium vibrational frequency and the force constant.

SECTION - II

Q4) Attempt the following:

- a) Sketch the plane (110) in simple cubic cell.
- b) Give the general characteristics of radioactive decay.
- c) Draw bonding and anti-bonding wave functions for H₂ molecule using valence bond theory.

2

- d) Why alcohol is used as quenching agent in G.M. Counter?
- e) Give preparation of ³H and ³²P radioisotopes.

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[10]

[5]

- **Q5)** Attempt any two of the following:
 - a) Explain the use of radio isotopes to determine the solubility of sparingly soluble salt.
 - b) Using Huckel's molecular orbital theory obtain energy levels in cyclobutadiene.
 - c) Derive Bragg's equation relating the wavelength and order of reflection of X-rays with the interplaner distance d and the angle of maximum reflection θ .
 - d) What is meant by tracer and self diffusion? Explain use of radioisotopes in diffusion studies.
- *Q6*) Solve any one of the following:
 - a) The diffraction of crystal of sample with X-rays (λ =1.54 Å) gives a first order reflection at 26.5°. Calculate the distance between the different planes.
 - b) Calculate the fraction of a radioactive element left behind after 40 hours. If the half life period is 14 hours.

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[5430]-202

M.Sc.-I

[Total No. of Pages : 4

INORGANIC CHEMISTRY CHI-230 : Coordination and Bioinorganic Chemistry (2013 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 50

[10]

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answer to the two sections should be written in separate answer books.
- 3) Neat and labelled diagrams must be drawn wherever necessary.
- 4) Figures to the right indicate full marks.
- 5) Given : Atomic numbers: Cr=24, Ni-28, Ti=22, Mn=25, Cu=29, Co=27.

SECTION-I

Q1) Answer the following:

- a) Prepare a microstate table for 2p¹ configuration and find out the R-S term symbol.
- b) Calculate the total degeneracy for the following terms /states/ configuration.
 - i) $2(p^2 d^3)$
 - ii) 5_H
- c) What is Laporte selection rule for electronic transition? State whether the following transition is laporte allowed or Laporte forbidden.

 ${}^{3}T_{2g} \rightarrow {}^{3}T_{1g}$

- d) Write following R-S terms in increasing order and justify. ²F, ³D, ²P, ³I, ⁴S.
- e) Explain : First and second order Zeeman effect.

Q2) Attempt any two of the following:

- a) Derive the allowed R-S terms and hence prepare a table of microstates for d² configuration.
- b) Give the splitting of ⁶HR-S term in weak cubic field using character table for pure rotational point group and reduction formula.
- c) Write a note on Phosphorescence in Ruby.

- d) How would you account for the magnetic moment listed against each of the following complexes.
 - i) $[Ni(NH_3)_6]$ SO₄, $\mu = 2.84$ B.M.
 - ii) $[Co(H_2O)_6] SO_4 \quad \mu = 5.1 B.M.$

Q3) Attempt any one of the following:

- a) For hexaquo Co(III) complex,three absorption bands are observed at 8100cm⁻¹, 16000cm⁻¹ and 19400cm⁻¹. Calculate crystal field splitting parameter, nephelauxetic parameter and camment on nature of M-L bond. Bo=971cm⁻¹
- b) Calculate the effective magnetic moment of $[Cr(OX)_3]^3$ using following data.
 - i) $\lambda = +92 \text{ cm}^{-1}$
 - ii) $10 \text{ Dq} = 17,000 \text{ cm}^{-1}$

SECTION-II

- *Q4*) Answer the following:
 - a) Define Homeostasis. Give suitable example.
 - b) Name three important ligands in bioinorganic chemistry.
 - c) What is an essential element? Give example.
 - d) Discuss two mechanisms by which substitution reactions take place.

2

e) What is calculate effect? Give Irwing-Williams series.

Q5) Attempt any two of the following.

- a) Write a note on passive diffusion with respect to cisplatin.
- b) Compare copper Type I and Type II proteins
- c) What are zinc finger proteins? Explain.
- d) Give an account of Acetylcholine receptors.
- **Q6)** Attempt any one of the following.
 - a) Give an account of amino acids as ligands.
 - b) Draw structures of
 - i) 4Fe 4s cluster
 - ii) Oxyhaemoglobin
 - iii) Calmodulin.
 - iv) Molybdenum cofactor.
 - v) Chlorophyll.

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Direct Product

1.	Group of the form $G \times p$ i or $G \times \sigma h$
	The g, u, or '," additions to the IR symbol in this group satisfy
	$g \times g = u \times u = g, g \times u = u,$
2.	Product of the form A x A, B x B, A x B
	For all groups:
	Letter Symbol: $A \times A = A$, $B \times B = A$, $A \times B = B$
	Subscript: $1 \times 1 = 1 \cdot 2 \times 2 = 1 \cdot 1 \times 2 = 2$
	Except for the B representations of D_2 and D_2 where
	$P \times P = P$ and $1 \times 2 = 3 \cdot 2 \times 3 = 1 \cdot 3 \times 1 = 2$
2	$\mathbf{D} \times \mathbf{D} - \mathbf{D}$, and $\mathbf{I} \times 2 - \mathbf{J}$, $2 \times \mathbf{J} - \mathbf{I}$, $3 \times \mathbf{I} - 2$
5.	Frontiers of the forms, $\mathbf{A} \times \mathbf{E} = \mathbf{E}$ irrespective of the suffix on A
	(a) For all groups $A \times E_k - E_k$ intespective of the suffix of A.
	(b) For an groups except D_{41} , D_{42} , S_8 .
	$B \times E_1 = E_2, B \times E_2 = E_1$
	irrespective of the suffix on B (If the group has only one B representative
	put $E_1 = E_2 = E_1$
	(c) For D_4h :
	$B \times E_1 = E_3, E \times F_2 = E_3, B \times E_3 = E_3, B \times E_2 = E_2, B \times E_3 = E_1$
	Irrespective of the suffix on B:
	(d) For D_4d , S_8 :
	$B \times E_1 = E_3$, $B \times E_2 = E_2$, $B \times E_3 = E_1$
	Irrespective of the suffix on B:
4.	Products of the form E x E:
	(For groups which have A, B, or E symbols without suffixes put $A_1 = A_2 = A$, etc
	in the equation below)
	(a) For Oh, O, T_3 , D_6h , D_2 , C_6v , C_6h , C_6 , S_6 , D_2d , D_2h , D_3 , C_2 , C_3h , C_3 :
	$E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + B_2; B_1 \times E_2 = B_1 + B_2 + E_1$
	(b) For D_4h , D_4 , C_4v , C_4h , C_4 , S_4 , D_2d :
	$\mathbf{E} \times \mathbf{E} = \mathbf{A}_1 + \mathbf{A}_2 + \mathbf{B}_1 + \mathbf{B}_2.$
	(c) For D_6d :
	$E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + Eg$
	$E_2 \times E_2 = E_4 \times E_4 = A_1 + A_2 + Eg$
	$E_3 \times E_3 = A_1 + A_1 + B_1 + B_2$
	$E_1 + E_2 = E_4 + E_3 = E_1 + E_3 E_1 \times E_3 = E_3 \times E_1 = E_2 + E_1$
	$E_1 + E_4 = E_2 + E_3 = E_3 + E_3 E_2 \times E_3 = E_3 \times E_4 = E_1 + E_3$
	$E_1 + E_3 = B_4 + B_2 + E_4$, $E_2 \times E_4 = B_1 + B_2 + E_2$
	(d) D_5d , D_2h , D_3 , C_3v , C_3h , C_3
	$E_1 \times E_1 = A_1 + A_2 + E_2$, $E_2 \times E_2 = A_1 + A_2 + E_1$
	$E_1 \times E_2 = E_1 + E_2$
	(e) For D_4d , S_8
	$E_1 \times E_2 = E_2 \times E_2 = A_1 + A_2 + E_2$
	$E_1 \times E_2 = A_1 + A_2 + B_1 + B_2$
	$E_2 \times E_2 = R_1 \times R_2 \times E_1 + E_2$ $E_1 \times E_2 = E_1 \times E_2 = E_1 + E_2 = E_1 + E_2 + E_2$
5	Product involving the T (or F) representation of $Oh O Td$
э.	$\Delta_{1} \times T_{2} = T_{1} \Delta_{2} \times T_{2} = T_{2} \Delta_{2} \times T_{2} = T_{2} \Delta_{2} \times T_{2} = T_{1}^{2}$
	$A_1 \times 1 = 1, A_1 \times 12 = 12, A_2 \times 1 = 12, A_2 \times 12 = 11$ $E \vee T = E \vee T = T + T$ $T \vee T = A_1 + E + T + T$
	$E \times 1_1 - E \times 1_2 - 1_1 + 1_2, \qquad 1_1 \times 1_2 - K_2 + E + 1_1 + 1_2.$
	$I_1 \times I_1 - I_1 \times I_1 = A_2 + B + I_1 + I_2$

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6. To Complete result for O are

0	A ₁	A ₂	E	T ₁	T ₂	
A ₁	A ₁	A ₂	E	T ₁	T ₂	
A ₂	A_2	A1	E	T_2	T_1	
E	E	E	$A_1 + A_2 + E$	$T_1 + T_2$	$T_1 + T_2$	
T ₁	T_1	T_2	$T_1 + T_2$	$A_1 + E + T_1 + T_2$	$A_2 + E + T_1 + T_2$	
T ₂	T ₂	Tı	$T_1 + T_2$	$A_2 + E + T_1 + T_2$	$A_1 + E + T_1 + T_2$	

Character Table for O rotational group

0	E	6C ₄	$3C_2(=C_4^2)$	8C3	6C ₂		
A ₁	1	1	1	1	1		$x^{2}+y^{2}+z^{2}$
A ₂	1	-1	1	1	-1		
E	2	0	2	-1	0		$(2z^{2} x^{2} - y^{2}, x^{2} - y^{2})$
T ₁	3	1	-1	0	-1	$(R_x, R_y, R_z); (x, y, z)$	
T_2	3	-1	-1	0	1		(xy,xz,yz)

Correlation table for group Oh

Oh	0	Td	D4h	D ₂ d	C_{4V}	C ₂ v	D ₃ d	D3	C ₂ h
A ₁ g	A ₁	A ₁	A ₁ g	A	A ₁	A ₁	A ₁ g	A_1	Ag
A ₂ g	A_2	A_2	B ₁ g	B_1	B_1	A ₂	A_2g	A ₂	Bg
Eg	E	E	A_1g+B_1g	A_1+B_1	A_1+B_1	$A_1 + A_2$	Eg	E	Ag+ Bg
T ₁ g	T_1	T_1	A_2g+E_g	A_2+E	A ₂ +E	$A_2+B_1+B_1$	₂ A ₂ g+Eg	$A_2 + E$	Ag+ 2Bg
T ₂ g	T_2	T_2	B_2g_+Eg	$B_2 + E$	B ₂ +E	$A_1 + B_1 + B_1$	A_1g+Eg	$A_1 + E$	2Ag+Bg
A ₁ u	A_1	A_1	A ₁ u	B_1	A ₂	A ₂	A ₁ u	A_1	Au
A ₂ u	A_2	A_1	B_1u	A ₁	B_2	A ₁	A ₂ u	A_2	Bu
Eu	E	E	A_1u+B_1u	A_1+B_1	A_2+B_2	$A_1 + A_2$	Eu	E	Au+ Bu
T ₁ u	T_1	T_2	A ₂ u+Eu	$B_2 + E$	A ₁ +E	$A_1+B_1+B_2$	$_2 A_2 u + E u$	A ₁ + E	Au+ 2Bu
T ₂ u	T_2	T_1	B_2u_+Eu	$A_2 + E$	B ₁ +E	$A_2 + B_1 + B_1$	$B_2 A_1u + Eu$	$A_1 + E$	2Au+Bu

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M.Sc. - I

ORGANIC CHEMISTRY

CHO - 250 : Synthetic Organic Chemistry and Spectroscopy (2013 Pattern) (Semester - II) (5-Credit)

Time : 3 Hours/ Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answers to the two sections should be written in separate answer books.
- Figures to the right indicate full marks. 3)

SECTION - I

Q1) Answer any five of the following.

- Explain Hoffmann's degradation reaction of amide. a)
- **b**) Compare the reactivity of organolithium and organocuprates.
- What are sulphur ylides? Give any two applications. c)
- How will you convert acetic acid to propionic acid. d)
- Discuss the reaction of acetophenone with selenium dioxide. e)
- f) Electron donating substituents on aromatic ring accelerates the rate of Beckmann's rearrangement.
- **Q2)** Attempt any five of the following.
 - MPV Reduction. a)
 - Fries rearrangement. b)
 - Explain limitations of Frieda craft's alkylation. c)
 - How will you convert 2 butene in to trans 2, 3- dihydroxybutane. d)
 - Explain catalytic hydrogenation of olefins. e)
 - Give the applications of Birch reduction. f)

P.T.O.

[Total No. of Pages : 4

[Max. Marks: 50

SEAT No. :

[10]

Q3) Predict the products and suggest the mechanism (Any two)



$$\frac{1) Ph Mg Br}{ii) Hg 0^{\oplus}}$$

d)

$$i) M_{10} 0H$$

 $i) M_{10} 02$
 $ii) Et L'$

<u>SECTION - II</u>

Q4) Attempt any five of the following.

a) How will you distinguish the following pair of the compounds using IR.



b) Calculate λ_{max} for the following.





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c) How will you monitor the following reaction using PMR? Suggest the reagents.



- d) Explain α haloketo rule.
- e) Explain PMR spectrum of ethyl acetoacetate.
- f) How will you differentiate the following compounds by MS.

2



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[5]

- Q5) Deduce the structures of any five of the following using spectral data and justify your answer. [10]
 - a) MF = $C_3H_4N_2$ PMR : $\delta = 6.18 \,(\text{m}, 5 \,\text{mm})$ 7.47 (m, 10 mm) 12.5 (bs, 5mm)

b) MF =
$$C_7H_5ClO$$

IR = 3000, 2700, 1700, 1600, 1500, 700cm⁻¹
¹H NMR = 9.92 (S, 1H)
7.83 (d, J=6.5 Hz, 2H)
7.52 (d, J=6.5Hz, 2H)

c) MF =
$$C_4 H_8 O_2$$

IR = 1740 cm⁻¹
¹H NMR : 1.15 (t , J = 6 Hz, 3H)
2.02 (s,3H)
4.13 (q, J=6Hz 2H)

d) MF =
$$C_8 H_{10} O_2$$

IR = 1600, 1500, 1100, 1200 cm⁻¹
¹H NMR : δ = 7.27 (m,5H)
4.0 (s, 2H)
3.3 (s,3H)

e) MF = $C_{9}H_{12}O$ IR = No bands above 3100 and 2000-1650 cm⁻¹ region. PMR : $\delta = 1.15(t, J = 7.5 Hz, 3H)$ 3.5 (q, J = 7.5 Hz, 2H)4.4 (s, 2H)

 $MF = C_6 H_{10} O$ f) IR = $1700, 1620 \text{ cm}^{-1}$ PMR : $\delta = 1.90 (s, 3H)$ 2.10 (s, 6H) 6.0 (s,1H)

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- **Q6)** Attempt any two of the following.
 - a) Aromatic protons are deshielded. Explain.
 - b) Distinguish the following compounds by CMR



c) Explain the generation of molecular ions in mass spectrometry.



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SEAT No. :

[Total No. of Pages : 12

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M.Sc. - **I**

ANALYTICAL CHEMISTRY

CHA - 290 : General Chemistry - II

(New 4 Credits) (2013 Pattern) (Semester - II)

New Course Based on Credit and Semester System

- PART A : Modern Separation Methods and Hyphenated Techniques (2.0 Credit / 25 Marks)
- PART B : Basic Biochemistry (4.0 Credit / 50 Marks)
- PART C : Concept of Analytical Chemistry (2.0 Credit / 25 Marks)
- PART D : Industrial Methods of Analysis (2.0 Credit / 25 Marks)
- PART E : Organometallic and Inorganic Reaction Mechanism (2.0 Credit / 25 Marks)
- PART F: Mathematics for Chemists (2.0 Credit / 25 Marks)
- PART G : Pericyclic, Photochemistry and Free Radical Reactions (2.0 Credit / 25 Marks)

Time : 3 Hours]

Instructions to the candidates:

- 1) All questions of respective section / part are compulsory.
- 2) Figures to right hand side indicate full marks.
- 3) Neat labelled diagrams must be drawn wherever necessary.
- 4) Use of log table / nonprogrammable calculator is allowed.
- 5) Students should attempt any two parts from Part A, C, D, E, F and G or full paper of biochemistry (Part B).
- 6) Write the answers of <u>two parts</u> on separate answer books.

PART - A

Modern Separation Methods and Hyphenated Techniques

Q1) Answer the following:

- a) Explain the principle of GC-MS technique.
- b) Differentiate between normal phase and reverse phase chromatography.
- c) State any two methods of ionization in mass spectrometry.
- d) Explain the term gradient elution.
- e) Give any two applications of HPLC.

[Max. Marks : 50

- **Q2)** Attempt any two of the following:
 - a) Write a short note on FTIR-MS.
 - b) Explain the principle and applications of size enclusion chromatography.
 - c) With the help of a neat labelled diagram, explain the sample injection system in Gas chromatography.
 - d) Explain the different components used in HPLC with the help of a neat labelled diagram.
- *Q3)* Attempt any one of the following:
 - a) The following data were obtained by gas liquid chromatography on a 40 cm packed column.

Compound	t _R (min)	w (min)
Air	1.9	_
Х	10.0	0.76
Y	10.9	0.82
Ζ	13.4	1.06

Calculate :

- i) Average number of plates from the data.
- ii) Average plate height of the column.
- iii) Column resolution for X and Y.
- b) Name the detectors used in Gas chromatography and explain any one in detail.



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[5430]-204 M.Sc. - I CHEMISTRY (2013 Pattern; 5 Credits) (Semester - II) <u>PART - B</u> CH - 290 B : Basic Biochemistry

Time : 3 Hours] Instructions to the candidates: [Max. Marks : 50

[9]

[8]

[8]

- 1) All questions are compulsory.
- 2) Answer to both the sections should be solved in separate answer sheets.
- 3) Figures to the right indicate full marks.

SECTION - I

Q1) Attempt any three of the following:

- a) Draw the diagram of prokaryotic and eukaryotic cell wall.
- b) Explain how pharmaceutical science and biochemistry are co related.
- c) Give the classification of proteins with example.
- d) What is monosaccaride and disaccharide explain with example.

Q2) Answer any two of the following.

- a) Explain different types of fatty acids and give its biological role.
- b) Explain active and passive transport with example.
- c) How cell membrane helps in transport of drug explain with example.

Q3) Write short notes on any four of the following:

- a) Rough and smooth endoplasmic reticulum.
- b) Metabolism of starch and chitin.
- c) Glucose transport.
- d) Na+-K+ pump.
- e) Globular and fibrous protein
- f) Essential and nonessential amino acid.

SECTION - II

Q4)	Ansv	wer any three of the following:	[9]				
	a)	Explain Watson and Crick model of DNA.					
	b)	5) Explain how vitamins are classified based on their solubility.					
	c)	c) What are the different types of enzyme inhibition explain any two with example.					
	d)	Describe the effect of substrate concentration on enzyme activity.					
Q5)	Atte	mpt any two of the following:	[8]				
	a)	Explain the mechanism of DNA repair of damaged DNA.					
	b)	Give the chemical composition of genetic material.					
	c)	Describe translation process of eukaryotes.					
Q6)	Writ	e short notes on any four of the following:	[8]				
	a)	Enzymes as a therapeutic agent.					
	b)	Axons and introns.					
	c)	Role of nutrients and nutritional disease.					
	d)	Manufacturing of medicinal compounds by enzymatic reaction.					
	e)	Gene therapy.					

f) Pantothenic acid and lipoic acid.

P1156

[5430]-204 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry - II (2013 Pattern) (Semester - II) (2.0 Credit) <u>PART - C</u> Concept of Analytical Chemistry

Q1) Answer the following:

- a) Define the terms
 - i) Elution ii) Eluent
- b) Explain how samples of metals and alloys are obtained.
- c) Explain the rounding off rule used while expressing results with suitable examples.
- d) Give the expression for confidence limit of a measurement and explain the terms involved in it.
- e) State any two techniques used for characterization of nano materials.

Q2) Answer any two of the following:

- a) Explain the process of softening of hard water by using ion exchange chromatography method.
- b) Explain salt induced precipitation of proteins.
- c) What are significant figures? Give the number of significant figures in the following numbers
 - i) 200.00 ii) 9.308×10^{18}
 - iii) 0.00980 iv) 300
- d) Explain sampling of solids, liquids and gaseous sample.
- *Q3)* Answer any one of the following:
 - a) Replicate water samples are analyzed for water hardness for the following results; 102.2, 102.8, 103.1 and 102.3 ppm CaCO₃. Calculate
 - i) Standard deviation
 - ii) Standard deviation of mean
 - iii) Relative standard deviation
 - iv) Relative standard deviation of mean
 - b) Explain the 'student t' test of significance.

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P1156

[5430]-204 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry - II (2013 Pattern) (Semester - II) <u>PART - D</u> Industrial Methods of Analysis

Q1) Answer the following:

- a) Explain continuous flow method.
- b) What is common ion effect?
- c) Explain the term, benefit of quality system.
- d) Define the term solubility and solubility product.
- e) Mention the various bulk properties used in process analyzer.
- *Q2)* Attempt any two of the following:
 - a) Explain what is automatic elemental analyser?
 - b) Write a note on Gas Chromatography.
 - c) Explain the concept of formation and step-wise formation constant.
 - d) Discuss the working of
 - i) Online potentiometric analysers
 - ii) Oxygen analysers

Q3) Attempt any one of the following:

- a) What is a basic buffer? Explain it's action with a suitable example.
- b) 0.4 gm of sample of steel was disintegrated by acid treatment. The solution was diluted to 100 ml. From 50 ml of aliquot, iron was removed as $Fe(OH)_3$. From the filtrate, Cr was precipitate as $PbCrO_4$ by using K_2CrO_4 . The amount of $PbCrO_4$ was found to be 0.140 gm. Calculate percentage of chromium in the sample.

[Given : At.wt. Pb = 207.2 gm, Cr = 51.99 gm, O = 16 gm].

[5]

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P1156

[5430]-204 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry - II (2013 Pattern) (Semester - II) <u>PART - E</u> Organometallic and Inorganic Reaction Mechanism (2.5 Credit)

Q1) Answer the following:

- a) Determine the valence electron counts for the transition metals in the following complexes.
 - i) $[\text{Re}(\text{CO})_5(\text{PF}_3)]^{\bigoplus}$
 - ii) $\operatorname{Co}_2(\operatorname{CO})_8$
- b) Define and give one example of reductive elimination reaction.
- c) Give the rate law for association reaction mechanism.
- d) State $Fe(CO)_5$ complex obeys $18e^{\circ}$ rule or not.
- e) Predict the type of reaction.



- **Q2)** Attempt any two of the following:
 - a) Explain the importance of CO as a Π -acid ligand in organometallic chemistry.
 - b) Write a note on :- Monsanto acetic acid synthesis.
 - c) Give an account of polymerisation using Zeigler Natta polymerisation.
 - d) Write a note on : Base hydrolysis.

Q3) Attempt any one of the following:

- a) Explain the difference in IR spectra of
 - i) Mo $(PF_3)_3$ (CO)₃ Vs Mo $(PMe_3)_3$ (CO)₃ $v_{co} = 2090, 2055 \text{cm}^{-1}$ $v_{co} = 1945, 1854 \text{ cm}^{-1}$
 - ii) MnCp (CO)₃ Vs MnCp^{*} (CO)₃ $v_{co} = 2023, 1939 \text{cm}^{-1}$ $v_{co} = 2017 \text{cm}^{-1}, 1928 \text{cm}^{-1}$
- b) Draw the following structures.
 - i) $Fe_2(CO)_9$
 - ii) $[V(Cp) (CO)_4]$
 - iii) $[PtCl_2(PPh_3)(NH_3)]$
 - iv) Os $(CO)_5$
 - v) Ferrocene



P1156

[5430]-204 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry - II (2013 Pattern) (Semester - II) <u>PART - F</u> Mathematics for Chemists

Q1) Answer the following:

a) i) If
$$A = \begin{bmatrix} 7 & 2 & 5 \\ 2 & 2 & 2 \end{bmatrix}$$
, 4A=?

ii) Add the following matrices

$$\begin{bmatrix} 7 & 5 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} 9 & 8 \\ 2 & 6 \end{bmatrix}$$

b) i) If
$$y = \frac{x^4}{4}, \frac{dy}{dx} = ?$$

- ii) Define independent variable.
- c) Give polynomial rule for differentiation.
- d) Define:
 - i) Permutation
 - ii) Square matrix
- e) Integrate $\int x^8 dx$.

- **Q2)** Attempt any two of the following.
 - a) Give equations and graphical representations for following with suitable illustrations.
 - i) Straight lines
 - ii) Slope and intercept
 - b) What is the equation for the following data.

	x	1 2 3 4 5 6 7
	У	1 4 9 16 25 36 49
c)	If A	$= \begin{bmatrix} 1 & 0 \\ 2 & -1 \end{bmatrix}, B = \begin{bmatrix} 3 & 7 \\ 4 & 8 \end{bmatrix}, C = \begin{bmatrix} -1 & 1 \\ 0 & 0 \end{bmatrix} $ then find
	i)	7A
	ii)	2C
	iii)	4A + 3C
	iv)	-3B

d) Explain types of double points in curves.

Q3) Attempt any one of the following:

- a) Write a short note on curve tracing.
- b) Differentiate the following functions w.r.t. *x*:

i)
$$\frac{\log x}{x}$$

ii) $\frac{\sin x}{\cos x}$

P1156

[5430]-204 M.Sc. - I ANALYTICAL CHEMISTRY CHA - 290 : General Chemistry - II (2013 Pattern) (Semester - II) <u>PART - G</u>

Pericyclic, Photochemistry and Free Radical Reactions

Q1) Answer any three of the following:

[9]

[4]

- a) What is Paterno-Buchi reaction? Explain with suitable example.
- b) Discuss the Di $-\pi$ methane rearrangement with suitable example.
- c) With the help of FMO approach explain whether suprafacial [1, 3] carbon shift is thermally or photochemically allowed.
- d) By using the concept of HOMO-LUMO interactions, show that cyclobutene undergoes ring opening by disrotatory manner.
- **Q2)** a) Predict the product/s and explain the mechanism <u>Any Two</u>: [4]



b) Answer any two of the following:

- i) Explain the photochemical reactions of 1, 3 butadiene.
- ii) What would be the configuration of the product of the following electrocyclic reaction.

cis - 3,4 dimethyl cyclobutene $\xrightarrow{\Delta}_{\text{ring opening}}$?

iii) Photo reduction.



- ii) Use of photosensitizers in photochemical reaction.
- iii) Synthetic application of Barton reaction.



[5430]-204

P1165

[5430]-3001

M.Sc.

PHYSICAL CHEMISTRY

CHP - 310 : Quantum Chemistry and Solid State Chemistry (2013 Pattern) (Semester - III) (New)

Time : 3 Hours/

Instructions to the candidates:

- 1) Answers to the TWO sections should be written in SEPARATE answer books.
- 2) ALL questions are COMPULSORY.
- 3) Figures to the RIGHT SIDE indicate FULL marks.
- 4) Use of logarithmic table/calculator is ALLOWED.
- 5) Neat diagrams must be drawn WHEREVER necessary.

Physico - Chemical Constants

1.	Avogadro Number	Ν	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	Ħ	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
			=	$1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$
			=	$6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$
			=	$1.602 \times 10^{-19} \mathrm{C}$
5.	1 eV		=	23.06 k cal mol ⁻¹
			_	$1.602 \times 10^{-12} \text{ erg}$
			=	$1.602 \times 10^{-19} \text{ J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^1 \text{ mol}^2$
			=	$8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
			-	$1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	=	96487 C equiv ⁻¹
8.	Speed of light	Ċ	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$
			=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	l cal		= .	$4.184 \times 10^{7} \text{ erg}$
			=	4.184 J
10.	1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m	=	9.11 × 10 ⁻³¹ kg

[Max. Marks : 50

[Total No. of Pages : 3

SEAT No. :

SECTION - I

Q1) Attempt the following:

- a) State the conditions for acceptable wave function.
- b) Define 'eigen function' and 'eigen value'.
- c) What is the need of approximate methods in quantum chemistry?
- d) Enlist the types of integrals.
- e) State Hückel (4n+2) rule.

Q2) Attempt any two of the following:

- a) Show that Hermitian operators have real eigen values.
- b) State variation theorm and discuss the various steps involved in the application of the method.
- c) Explain how schaad modified Hückel method to determine orbital energies of molecules.
- d) Comment, giving examples on postitive or negative nature of REPE value for a molecule.
- **Q3)** Attempt any one of the following:
 - a) Show that $[\hat{L}z, \hat{L}x] = i\hbar \hat{L}y$ for a set of angular momentum operators $\hat{L}x, \hat{L}y$ and $\hat{L}z$.
 - b) obtain the spectroscopic term symbols for the following configuration
 - i) 2p' 2d' and
 - ii) $2p^2 2d'$

SECTION - II

2

Q4) Attempt Precisely the following:

- a) Define defect and give its classification.
- b) State the principle of photographic process.
- c) What is P-n junction?
- d) Enlist the various types of crystal growth techniques.
- e) Explain the formation of colour centres in a crystals.

[5430]-3001

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- **Q5)** Attempt any two of the following:
 - a) Derive the expression for number of schottky defects present in a crystal at a given temperature.
 - b) 'The fast growing faces are eliminated whereas slow growing faces persist in a crystal'. Prove this statement on the basis of geometrical consideration.
 - c) Explain the thermal properties of a crystal.
 - d) State and explain the various methods of electrical breakdown in insulators.
- *Q6*) Solve any one of the following
 - a) Calculate the number of schottky defects in 1 cm³ Nacl single crystal if energy required to remove a pair of oppositely charged ions in 2 eV.
 [Given : ζ=2.165 g cm⁻³, M=58.5]
 - b) Calculate the dislocation density for a cubic crystal having 10⁻⁶ cm edge length and total dislocation length of 10⁻¹² cm.

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P1166

[5430]-3002

M.Sc.

PHYSICAL CHEMISTRY CHP - 311 : Nuclear, Radiation and Photo-Chemistry (2013 Pattern) (New) (Semester - III)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the two sections should be written in SEPARATE answer books.
- 2) ALL questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic table and calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1.	Avogadro Number	Ν	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	1 11	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
			=	$1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$
			=	6.626 × 10 ⁻³⁴ J s
4.	Electronic Charge	e	=	4.803×10^{-10} esu
			=	$1.602 \times 10^{-19} \mathrm{C}$
5.	1 eV			23.06 k cal mol^{-1}
				$1.602 \times 10^{-12} \text{ erg}$
			-	$1.602 \times 10^{-19} \text{ J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
			=	8.314 J K^{-1} mol ⁻¹
			-	$1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	=	96487 C equiv ⁻¹
8.	Speed of light	C	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$
			=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		= .	$4.184 \times 10^{7} \text{erg}$
			=	4.184 J
10.	1 amu		-	1.673 × 10 ⁻²⁷ kg
11.	Bohr magneton	β_		$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m	=	$9.11 \times 10^{-31} \text{ kg}$
		c		

[Max. Marks : 50

P.T.O.

SEAT No. :

[Total No. of Pages : 3

SECTION - I

Q1) Attempt the following: [10]
a) Draw the schematic diagram of Li-drifted detector.
b) Discuss the principle of PIXE.
c) What is critical energy for nuclear fission?
d) What is the role of Tl in NaI (Tl) scintillator?
e) What is RBE and REM?

a) Explain ionization and χ ray emission in PIXE technique.

- b) Discuss the construction & working of surface barrier detector.
- c) Discuss the merits & demerits of shell model of nucleus.
- d) Discuss the characteristics of thermal, fast and intermediate reactors.
- Q3) Solve any one of the following

Q2) Attempt any two of the following:

a) Find the thickness of Cu required to reduced an activity of γ -source from 6000 cpm to 3000 cpm.

Given: $\mu_{e} = 0.21$ b/e⁻, $\delta_{cu} = 8.96$ g/cm³.

b) If the number of uranium atoms fissioning per two second are 6.24×10^{17} . Find the power generated in MW.

Given: Energy released per uranium nuclear fission is 200 Me V.

[5]
SECTION - II

Q4) Attempt the following:

- a) State the Law of photochemical Equivalence.
- b) Explain briefly Ferrioxalate actinometer.
- c) Define the term Luminescence and incandescence with the help of example.
- d) Define effective light of photochemical change.
- e) Explain singlet and triplet states.
- Q5) Attempt <u>any two</u> of the following:
 - a) Discuss Einstein's treatment of absorption and emission phenomena.
 - b) Explain the spontaneous and stimulated processes of absorption and emission.
 - c) Explain the mechanism of delayed fluorescence
 - d) Derive the stern-volmer equation for the kinetics of collisional quenching.
- **Q6)** Attempt <u>any one</u> of the following
 - a) Explain the phenomenon of fluorescence and phosphorescence with the help of Jablonski Diagram.
 - b) On irradiation of propionaldehyde at 40° C with light $\lambda = 3000$ Å, the quantum yield for co is found to be 0.60. The intensity of the incident light is 17,000 erg/sec. What is the light intensity in Einstein's per second? Also find the rate of formation of CO.



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Total No. of Questions :6]

P1167

[5430]-3003

M.Sc.

PHYSICAL CHEMISTRY CHP - 312 : Physico-Chemical Methods of Analysis (2013 Pattern) (Semester - III) (New)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the TWO sections should be written in SEPARATE answer books.
- 2) ALL questions are COMPULSORY.
- 3) Figures to the RIGHT SIDE indicate FULL marks.
- 4) Use of logarithmic table/calculator is ALLOWED.
- 5) Neat diagrams must be drawn WHEREVER necessary.

Physico - Chemical Constants

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			=	$1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$
			=	6.626 × 10 ⁻³⁴ J s
4.	Electronic Charge	e	Ξ	$4.803 \times 10^{-10} \text{ esu}$
			=	$1.602 \times 10^{-19} \mathrm{C}$
5.	1 eV		=	23.06 k cal mol ^{-1}
			===	$1.602 \times 10^{-12} \text{ erg}$
			-	$1.602 \times 10^{-19} \mathrm{J}$
			=	8065.5 cm^{-1}
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^1 \text{ mol}^1$
			=	$8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
			-	$1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	=	96487 C equiv ¹
8.	Speed of light	Ċ	=	$2.997 \times 10^{10} \mathrm{~cm~s^{-1}}$
			=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		= .	$4.184 \times 10^{7} \text{ erg}$
			=	4.184 J
10.	1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β	-	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m	=	9.11 × 10 ⁻³¹ kg

[Max. Marks : 50

[Total No. of Pages : 3

SEAT No. :

- **Q1)** Answer precisely the following :
 - a) Define absorptive edge and state its use.
 - b) Explain the ways by which the excited ion relax in ESCA technique.
 - c) Draw a neat labelled diagram of an ESCA apparatus.
 - d) Define the terms short-wavelength cut-off and Bremsstrahlung.
 - e) Enlist the factors which affect the TGA curve.
- **Q2)** Answer any two of the following:
 - a) With a neat labelled diagram describe retarding potential analyzer used in ESCA.
 - b) Describe with an example neutralization thermometric titration.
 - c) Explain X-ray fluorescence and draw a neat labelled diagram of wavelengthdispersive and energy-dispersive instrument used in fluorescence technique.
 - d) Discuss the applications of DTA technique.
- **Q3)** Solve any one of the following :
 - a) The work function of a spectrometer is 35 eV. The binding energy of the of the emitted electron is 1.050 keV. If the kinetic energy of the electron is 1.75 eV. Find the wavelength of X-ray.
 - b) Estimate the thickness of foil of the alloy having absorption coefficient 450.55 cm²/g at 0.430 nm. The detector recorded 9,586 counts per two minutes of transmitted X-rays when foil was not in the path of X-rays and 856 counts per min when foil was placed in the path. The density of alloy is 8.01 g/cm³.

SECTION - II

- **Q4)** Answer precisely the following :
 - a) Draw the excitation signals for various voltammetry techniques.
 - b) State the principles of controlled potential coulometric analysis.

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- c) Define singlet, doublet and triplet states.
- d) Draw a neat labelled diagam of ICP-torch.
- e) Differentiate between fluorescence and phosphorescence.

[5430]-3003

[10]

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- **Q5)** Answer any two of the following :
 - a) Discuss the gas-phase titrations performed in chemilumenescence.
 - b) Describe various sample introduction techniques in ICP atomic emission spectroscopy.
 - c) Discuss briefly the technique of pulse voltammetry with its advantages.
 - d) Enlist the applications of constant potential coulometry.
- **Q6)** Solve any one of the following :
 - a) A controlled potential coulometric assay of 30 ml Cu²⁺ solution was performed with the following electrochemical reaction.

 $\mathbf{C}u^{2+} + 2e^{-} = \mathbf{C}u$

If the area under the current - time curve is 20.6 mA. min, calculate the concentration of Cu^{2+} in the solution,

[At.wt of Cu = 63.5]

b) During the forward scan of a triangular wave voltammogram at a disk electrode, a peak current of $30.0 \,\mu\text{A}$ was observed at scan rate of $0.250 \,\text{V/s}$. Estimate the peak current at a scan rate of $60.0 \,\text{mV/s}$ assuming a reversible electrochemical reaction.

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Total No. of Questions :6]

P1168

[5430]-3004

M.Sc.

PHYSICAL CHEMISTRY CHP-313: Polymer Chemistry (2013 Pattern) (Semester-III)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic tables and calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1.	Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
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			=	$6.626 \times 10^{-34} \mathrm{J \ s}$
4.	Electronic Charge	e	=	4.803×10^{-10} esu
			=	$1.602 \times 10^{-19} \text{ C}$
5.	1 eV		=	23.06 k cal mol ⁻¹
			=	$1.602 \times 10^{-12} \mathrm{erg}$
			=	$1.602 \times 10^{-19} \text{ J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg } \text{K}^{-1} \text{ mol}^{-1}$
			=	8.314 J K ⁻¹ mol ⁻¹
			=	1.987 cal K ⁻¹ mol ⁻¹
7.	Faraday Constant	F	=	96487 C equiv ⁻¹
8.	Speed of light	с	=	$2.997 \times 10^{10} \mathrm{cm \ s^{-1}}$
			=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		=	$4.184 \times 10^{7} \text{ erg}$
			=	4.184 J
10.	1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β.	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β	=	5.051 × 10 ⁻²⁷ J T ⁻¹
13.	Mass of an electron	m	=	9.11 × 10 ⁻³¹ kg
		-		

[Max. Marks : 50

P.T.O.

SEAT No. :

[Total No. of Pages : 3

SECTION-I

Q1)	Ansv	wer precisely the following:	[10]
	a)	State the WLF equation and explain the terms there in.	
	b)	Define glass transition temperature and state the relation between T_m .	Γ_{g} and
	c)	Define a thermal, regular and irregular solutions.	
	d)	Define flory temperature and give its importance.	
	e)	State the Mark-Houwink equation.	
Q2)	Ansv	wer any two of the following.	[10]
	a)	Compare Voigt and Maxwell elements with the help of diagram.	
	b)	Discuss the behaviour of polymer at high extensions.	
	c)	Write a note on temperature dependence of viscosity.	
	d)	Explain the assumptions of Flory theory.	
Q 3)	Atte	mpt any one of the following:	[5]
	a)	Discuss merits and demerits of the Krigbaum theory.	
	b)	Discuss stress- strain tensile curves in plastics.	
		SECTION-II	
Q 4)	Ansv	wer the following:	[10]
	a)	Define the term copolymerization.	

- b) What is a conducting polymer?
- c) Distinguish between homochain polymers and heterochain polymers.
- d) State the principle of vapour phase osmometry technique.
- e) What is meant by thermoplastic polymer?

[5430]-3004

- *Q5*) Answer any two of the following:
 - a) Explain the conduction mechanism in conducting polymers.
 - b) Derive copolymer equation.
 - c) Give an account of the steps involved in polymerization process.
 - d) Write a note on determination of molecular weight of a polymer by vapour phase osmometry technique.
- *Q6*) Answer any one of the following:
 - a) Three moles of vinyl acetate combines with one mole of vinyl chloride. Find the polymer composition. [monomer reactivity ratios:0.23 and 1.68 respectively].

At.wts: C=12, H=1, Cl = 35.5, O=16

b) Describe in detail the molecular forces and chemical bonding in polymers.



P1169

[5430]-3005

M.Sc.

PHYSICAL CHEMISTRY CHP-314: Modern Trends in Physical Chemistry (2013 Pattern) (Semester-III) (Optional)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answer to the two sections should be written in seperate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic tables and calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

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4.	Electronic Charge	e	=	4.803×10^{-10} esu
	_		=	$1.602 \times 10^{-19} \text{ C}$
5.	1 eV		=	23.06 k cal mol ⁻¹
			=	$1.602 \times 10^{-12} \mathrm{erg}$
			=	$1.602 \times 10^{-19} \text{ J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg } \text{K}^{-1} \text{ mol}^{-1}$
			=	8.314 J K ⁻¹ mol ⁻¹
			=	1.987 cal K ⁻¹ mol ⁻¹
7.	Faraday Constant	F	=	96487 C equiv ⁻¹
8.	Speed of light	с	=	$2.997 \times 10^{10} \mathrm{cm \ s^{-1}}$
	-		=	$2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		=	$4.184 \times 10^{7} \text{ erg}$
			=	4.184 J
10.	1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β.	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β	=	5.051 × 10 ⁻²⁷ J T ⁻¹
13.	Mass of an electron	m	=	9.11 × 10 ⁻³¹ kg
		C		-

[Max. Marks : 50

[Total No. of Pages : 3

SEAT No. :

SECTION-I

Q1) Answer precisely the following:

- a) State and explain lever rule used in phase diagram.
- b) Explain the term constituent of a system with example.
- c) Give the examples of application of diamond-anvil cell to study the transition of covalent solids to metallic solids.
- d) Write the proton condition for H_3PO_4 .
- e) Write the charge balance for 0.1 M NaHSe.
- **Q2**) Answer <u>any two</u> of the following.
 - a) Describe the temperature-composition diagram for hexane and nitrobenzene at one atmosphere.
 - b) Discuss a low boiling azeotrope with a neat labeled diagram.
 - c) Define 'upper consolute temperature'. Discuss the phase diagram for palladium and palladium hydride.
 - d) The pH of 0.2 M solution of oxalic acid is 6.9. Find the concentrations of $H_2C_2O_4$, $HC_2O_4^-$ and $C_2O_4^{2-}$

[Given: $K_{a_1} = 5.30 \times 10^{-2}, K_{a_2} = 5.37 \times 10^{-5}$]

- Q3) Solve <u>any one</u> of the following:
 - a) Draw a logarithmic concentration diagram for $0.1 \text{ M Na}_2\text{CO}_3$

[Given: $K_{a_1} = 4.47 \times 10^{-7}, K_{a_2} = 5.62 \times 10^{-11}$]

b) Calculate the pH and concentration of all species in 0.1 M NaHs.

[Given:
$$K_{a_1} = 4.46 \times 10^{-7}, K_{a_2} = 5.62 \times 10^{-11}$$
]

[5430]-3005

[10]

SECTION-II

Q4) Answer the following:

- Define the term magnetorheological and electrorheological fluids. a)
- How are secondary electrons generated in SEM? b)
- Calculate the wavelength of an electron emitted in cathode ray tube c) operating at 20kV.
- State properties and uses of smart polymers. d)
- Define the term degree of polymerization. e)
- **Q5**) Answer any two of the following:
 - Discuss the applications of nanomaterials in the field of defence a) and space.
 - Describe briefly the interations of electron with specimen in SEM. b)
 - Write note on smart ceramics. c)
 - Describe briefly pachinko machine. d)
- *Q6*) Answer any one of the following:

Discuss the treatment of biological specimen used in SEM. a)

b) Discuss the working of biosensor.

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* * *

[10]

[10]

[5]



3

P1170

INORGANIC CHEMISTRY

CHI-326 : Organometallic Chemistry and Homogeneous Catalysis (2013 Pattern) (Semester - III) (4 Credit)

Tim Inst	e : 3 ructi	Hours] [Max. Marks : 50 ons to the candidates:
	1) 2)	All questions are compulsory. Neat diagrams must be drawn wherever necessary.
Q1)) Aı	nswer the following: [20]
	a)	Draw the principle coordination modes of CO ligand.
	b)	Free propene shows C=C stretching frequency at 1652 cm ⁻¹ while in the complex [PtCl ₂ (CH ₂ CH=CH ₂)] it is seen at 1504 cm ⁻¹ . Why?
	c)	$\text{Co}_2(\text{CO})_8$ has bridged carbonyls while $\text{Mn}_2(\text{CO})_8$ does not. Explain.
	d)	Give difference between Fischer and Schrock carbenes.
	e)	Predict M in the complex $[M(\eta^3-C_5H_5)(CO)_5]$ if M is from first row transition element and it obeys 18 e ⁻ rule.
	f)	Define the concept of cone angle and bite angle and mention its importance in homogeneous catalysis.
	g)	Mention the general features of homogeneous catalysis.
	h)	Define enantioselectivity with suitable example.
	i)	Draw the structures of any two ligands which are commonly used in asymmetric catalysis.
	J)	Why the complexes of late transition elements are used as homogeneous catalysts?
Q2)) Att	empt any Two of the following: [10]

- Give the systematic classification of 6-bonded transition metal a) hydrocarbyls.
- With the help of catalytic cycle describe the mechanism of cativa process. b)

P.T.O.

[Total No. of Pages : 2

SEAT No. :

- c) What is Metathesis reaction? Describe the advancement w.r.t. catalysts in metathesis reaction.
- d) Predict the products in following reactions.
 - i) $[Ir (PPh_3)_2 (CO) (Cl)] + CF_3 I \longrightarrow ?$
 - ii) $(\eta^5 CpRh (CO)_{12}] + CF_3 CF_2 I \longrightarrow ?$
 - iii) $[Pd (PPh_3)_4] + Ph Br \longrightarrow ?$
 - iv) $[\eta^5 Cp (CO)_2 Ir] + CH_4 \longrightarrow ?$
 - v) $[\eta^5 Cp (CO)_2 RuCH_3] + Br_2 \longrightarrow ?$
- **Q3)** Answer the following (Any two):
 - a) Describe the use of organometallic compounds as electrophiles and nucleophiles.
 - b) Give an account of synthesis, bonding, properties of metal-axene compounds.
 - c) What is biphasic systems? What are its advantages? Discuss any one biphasic system in detail.
 - d) With the help of catalytic cycle describe the mechanism of Suzuki cross coupling reaction.
- *Q4)* Write notes on (Any Two)
 - a) Metallocenes
 - b) Fluxional behaviour of organometallic compounds.
 - c) Olefin Polymerization.
 - d) Reactions of organometallic compounds.

\$\$\$\$

[10]

Total No. of Questions :4]

P1171

[5430] - 3007

M.Sc. - II

INORGANIC CHEMISTRY

CHI - 330 : Inorganic Reaction Mechanism, Photochemistry and **Magnetic Properties of Coordination Compounds** (2013 Pattern) (Semester - III) (4 Credit)

Time : 3 Hours]

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Use of calculator is allowed.

Q1) Attempt the following.

- Thermodynamically stable complexes could be kinetically inert or labile. a) Illustrate with suitable example.
- Find out the magnetic moment value in B.M. for following metal 10ns. b)
 - i) $Ni^{+2} (Z = 28)$
 - ii) $Ti^{+3}(Z = 23)$
- Complete the following reaction sequence. c)
 - $[PtCl_4]^{-2} \xrightarrow{NH_3} ? \xrightarrow{C_2H_4} ?$ i)
 - $[PtCl_{4}]^{-2} \xrightarrow{C_{2}H_{4}} ? \xrightarrow{NH_{3}} ?$ ii)
- List out the main characteristics of outer sphere electron transfer reactions. d)
- Suggest the mechanism for following reaction. e)

 $[Co(NH_3)_5NCS]^{+2} \longrightarrow [Co(NH_3)_5SCN]^{+2}$

P.T.O.

[20]

[Max. Marks:50

[Total No. of Pages :3

SEAT No. :

- f) Define the terms:
 - i) Ferromagnetism
 - ii) Magnetic domain
- g) Arrange the following configuration in the increasing order of inertness. Justify your answer d⁴, d⁵, d³, d⁶.
- h) What do you mean by quantum yield in photo chemical reaction?
- i) The rate of substitution in complex $[pt (bipy)Cl_2]$ is faster than $[Pt(en)Cl_2]$. Justify your answer.
- j) Describe the mechanism for halogenation of coordinated nitrogen atom with example.

Q2) Attempt the following (<u>any Two</u>)

- a) How the solvent plays an important role in substitution of square planar complexes? Explain.
- b) Discuss the mechanism of structural isomerism in octahedral complexes with suitable example.
- c) How isotope labelling technique is useful in studying the mechanism of the reaction? Explain.
- d) Predict the magnetic exchange which occurs via the 90° exchange pathway. in the system. d^1-d^1 , d^2-d^2 , d^3-d^3 , d^8-d^8 and d^9-d^9 .
- **Q3)** Answer the following. (any Two).
 - a) Complete the following innersphere electron transfer reaction.

i)
$$[Cr (H_2O)_6]^{+2} + [Co(NH_3)_5H_2O]^{+3} \longrightarrow ? + ?$$

ii)
$$[Cr (H_2O)_6]^{+2} + [Co (NH_3)_5 (RCOO)]^{+2} \longrightarrow ? ? ?$$

Explain which reaction is faster.

[5430] - 3007

[10]

- b) Explain the chelate ring forming reaction involving thermodynamic template effect.
- c) What is anation reaction? Explain with suitable example.
- d) What do you mean by quenching of orbital angular momentum? Give the explaination with the help of VBT and CFT.

Q4) Write a note on: (any Two)

- a) Photochemistry of Co(III) complexes.
- b) Oxidative addition and Reductive elimination reaction.
- c) Applications of excited state outersphere electron transfer reaction.
- d) Magnetic properties of mixed valence complexes.



Total No. of Questions : 4]

SEAT No. :

P1172

[5430]-3008

M. Sc. - II

INORGANIC CHEMISTRY

CHI - 331 : Physical Methods in Inorganic Chemistry (2013 Pattern) (4 Credit System) (Semester - III)

Time : 3 Hours]

[Max. Marks : 50

[20]

[Total No. of Pages : 2

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Draw neat diagrams wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of logarithmic tables, and calculator's is allowed.

Q1) Answer the following :

- a) Which compound would have the largest quardrupole spitting for the Fe atom cis or trans $[Fe(CO)_4Cl_2]$?
- b) Write the detection limit of sample concentration in XPS.
- c) How many ESR lines would you expect in the spectrum hypothetical molecule SCl₃.

[I for S=0 and Cl= $\frac{3}{2}$].

- d) Which standard compound used in cyclic voltammetry. Draw the structure of that compound.
- e) Write the difference between TGA and DTA.
- f) Draw the Miller Indices for $[1 2 4], [10\overline{1}]$
- g) Define superhyperfine splitting with suitable example.
- h) Write the equation for peak current in cyclic voltammetry.
- i) Write the selection rule for Mössbauer spectroscopy.
- j) What is DSC?

- **Q2)** Answer any two of the following :
 - a) The powder x-ray diffraction pattern (λ =1.54Å) collected from a sample of Radium (Ra) metal showed reflections at the following values of

2θ (degrees) = 24.45, 34.85, 43.04, 50.12, 56.33, 63.15, 73.60, 78.89, Index the data

Determine the lattice type and lattice parameter.

b) The thermal decomposition of metal borohydrides MBH₄ can proceed to give two different end products. The possible reactions are

 $MBH_{4(s)} \rightarrow M_{(s)} + B_{(s)} + 2H_{2(g)}$

and $MBH_4 \rightarrow MH_{(s)} + B_{(s)} + 3/2 H_{2(g)}$

Heating $LiBH_4$ to 800°C on a TGA result in a 13.9% weight loss determine the reaction pathway.

- c) Draw the structure of SnF_4 and explain why quardrupole splitting is observed in this compound but not in $SnCl_4$?
- d) How the cyclic voltammetry used to determine the one electron transper reaction? Give suitable example.
- **Q3)** Answer any two of the following :
 - a) Explain the instrumental factors affecting on the DSC curve.
 - b) Explain the ESR spectra for biphenyl radicals.
 - c) Discuss the component of XPS system.
 - d) Explain the DTA curve for the MgC_2O_4 . H_2O in presences of air. Write the reaction in each step.
- Q4) Answer any two of the following :
 - a) Explain relation between g_{II}, g_{\perp} and G in the ESR spectroscopy.
 - b) Explain any two application of thermogravimetry.
 - c) Explain the Mössbauer spectra for $Fe_2(CO)_q$ metal cluster.
 - d) Explain how cyclic voltammetry is used to determine the organic reaction with suitable example.

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P1173

[5430]-3009

M.Sc. -II

INORGANIC CHEMISTRY

CHI-332: Bioinorganic And Inorganic Medicinal Chemistry (2013 Pattern) (Semester-III) (4-Credits)

Time : 3 Hours] Instructions to the candidates:

- 1) All questions are compulsory.
- Figures to the right indicates full marks. 2)
- 3) Draw neat diagrams wherever necessary.

Q1) Answer the following:

- Why transition metals are involved in enzymatic reactions? a)
- Role of Gadolinium complexes as contrast agent in MRI. b)
- What is super oxide dismutase? Explain its role in biological system. c)
- What are oxidases? Give suitable examples. d)
- What are the differences between blue and non-blue protiens? Give e) suitable examples.
- What is the function of Mo-dependent nitrogenase? Give the overall f) reaction catalysed by molybdenum dependent nitrogenase.
- Which oxidation states of Mn are accessible in biology? Why Mn⁺² is **g**) biologically important?
- h) Write any two reactions which are catalysed by Nitrogenase.
- Write two important reactions of Vit B-12 i)
- Which reaction is catalysed by dopamine $-\beta$ mono oxygenase. i)
- Q2) Attempt any two of the following.
 - How does nitrogen fixation take place by moly b-denum? a)
 - Explain bone imaging agents. **b**)
 - Expain the role of Manganese in peroxidases. c)
 - Explain Glucose tolerance factor. d)

P.T.O.

[Total No. of Pages :2

[Max. Marks : 50

[20]

SEAT No. :

Q3) Attempt any two of the following:

- a) Draw the structures.
 - i) Zinc finger
 - ii) Deoxy hemocyanin
 - iii) Carboplatin
 - iv) Type-I, II and III copper centres
 - v) Methyl cobalamin.

b) Complete the table-

- Enzyme Function
- i) Plastocyanin
- ii) Nitrate reductase
- iii) Carbonic anhydrase
- iv) Con canvalin A
- c) Why is Tc considered as best nucleus in radiopharmaceuticals?
- d) Explain the structure and function of Fe-Mo cofactor.

Q4) Attempt the following (any two)

- a) Match the following.
 - Α
 - i) Carboxy peptidase
 - ii) $[Ru(py)_3]^{2+}$
 - iii) SOD
 - iv) Cytochrome
 - v) Vit. B-12

1) $O_2 \xrightarrow[-1\overline{e}]{+1\overline{e}} O_{\overline{2}}$

В

Metal present

- 2) Electron transfer
- 3) Reduction of Ribose to deoxyribose
- 4) Hydrolysis
- 5) DNA-Cleavage
- b) Explain the mechanism of Cu-PSTM trapping inside cells.
- c) Write note on: Antitumor agent
- d) Give an account of function of L.Dopa.



2

Total No. of Questions : 6]

P1174

[5430]-3010

M.Sc.-II

ORGANIC CHEMISTRY CHO-350 : Organic Reaction Mechanism (2013 Pattern) (Semester-III)

Time : 3 Hours Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- Answer to the two sections should be written in separate answer books. 3)

SECTION-I

Q1) Answer the following.

- Explain Damynov reaction with a suitable example. a)
- Write in brief about curtius rearrangement. b)
- Explain the wittig-Horner reaction with an example. c)
- Explain the regioselectivity of alkylation in cyclic ketone using enamine d) approach.
- Explain the favorasky rearrangement. e)
- *Q2)* A) Suggest suitable mechanism in any three



[Total No. of Pages : 3

SEAT No. :

[Max. Marks : 50

[10]

[6]

- B) Write short notes on any two.
 - **Wolf rearrangement** a)
 - Use of enol-silyl ether b)
 - Perkin condensation. c)

Q3) Predict the products in any Two



SECTION-II

Q4) Answer the following:

- Explain the role of AIBN as radical initiator with suitable example. a)
- Discuss the addition of oxygen to alkene with suitable example. **b**)
- Explain the regioselectivity of oxymercuration demercuration reaction. c)
- Give the different methods for carbene generation. d)
- Explain oxidative coupling with suitable example. e)



[5430]-3010

- B) Write short notes on any two.
 - a) Acyloin condensation
 - b) Dimerisation of 1, 3 butadiene
 - c) Pyridoxal transamination

Q6) Predict the product in any two.



$$\checkmark$$
 \checkmark \checkmark

[5430]-3010

Total No. of Questions : 6]

P1175

[5430]-3011

M. Sc. - II

ORGANIC CHEMISTRY

CHO - 351 : Spectroscopic Methods in Structure Determinations (2013 Pattern) (4 Credits) (Semester - III)

Time : 3 Hours]

Instructions to the candidates:

- All questions are compulsory. 1)
- 2) Answers to the two sections to be written on two separate answer books.
- Figures to the right indicate full marks. 3)

<u>SECTION - I</u>

Q1) Answer any four of the following :

- Comment on role of deuteriated solvents in ¹H NMR. a)
- The mass spectrum of ortho nitro toluene shows substantial peak at **b**) m/e=120. Justify.
- State and explain Nitrogen Rule with an example. c)
- Explain splitting pattern in vinyl system of styrene. d)
- Distinguish between following pairs by the indicated spectral method. e)
 - $\frac{CHO}{O} NO2 C'HNMR$ i) ii)
- **Q2)** Answer any three of the following :
 - A compound having molar mass 150; shows following spectral data. a) Deduce its structure from the data.

 $IR : 1690 \text{ cm}^{-1}$

¹ H NMR :2.5 (s) 3H	^{13}C NMR :	197
3.8 (s) 3H		165
6.9 (d) 8Hz 2H		130
7.8 (d) 8Hz 2H		129
		114
		56
		26

[Total No. of Pages : 5

SEAT No. :

[12]

[8]

[Max. Marks : 50



Q3) Assign the singnals to various protons in compound \underline{Y} . Use the decoupling data for the confirmations of the assignments. Justify your assignment and Draw the correct stereostructure of \underline{Y} - [5]



Note :- Peaks for - OAC groups are not provided. ¹H NMR :5.5 (dd) 6Hz

```
5.3 (dd) 2.5, 6.5Hz

5.1 (dd) 6, 6.5Hz

4.71 (t) 2.5 Hz

4.63 (ddd) 2.5, 4.1, 4.8Hz

4.21 (dd) 4.1, 12Hz

3.83 (dd) 4.8, 12Hz

Irradiation Experiment : Irradiation at 4.63 changes

4.21 (dd) to d (12Hz)

3.83 (dd) to d (12Hz)

[5430]-3011

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- *Q4)* Write Short Notes on any three :
 - a) Applications of Isotopic peaks in mass spectrometry.
 - b) Nuclear Overhauser effect.
 - c) Factors affecting vicinal coupling.
 - d) EI process in mass.

Q5) Answer any four of the following :

a) Explain the genesis of ions in the following compounds.



- b) Explain how McLafferty rearrangement help to distinguish between isomeric carbonyl compounds.
- c) Deduce the correct structure of compound which shows following ¹³C DEPT(135) data. (M.F. = $C_5H_{10}O$) $\delta ppm - 30.2; 31.9; 61.8; 114.7$ (all Negative peaks) $\delta ppm - 130.4$ (positive peak)
- d) A compound having molecular formula C_4H_6 shows three peaks in ¹³C NMR and two negative peaks in DEPT (135). It shows two singlets in ¹H NMR at 5.35 and 1.01 δ ppm. Determine the correct structure.
- e) A compound having molecular formula $C_8H_8O_2$ shows following major peaks in mass. It also gives positive iodoform test. Deduce the structure. m/e : 136 (30%); 121 (100%); 94 (30%), 93 (42%), 43(65%).
- Q6) The spectra of an unknown compound are shown on the adjacent page. Analyse the spectral data and by using this data arrive at a correct structure of the unknown compound. Justify your assignments. [8]

[8]

[9]



//DEPT NMR 75.5 MHz





5

Total No. of Questions : 6]

P1176

[5430]-3012

M.Sc. - II

ORGANIC CHEMISTRY

CHO - 352 : Organic Stereochemistry (2014 Pattern) (Semester - III) (New 4 Credits)

Time : 3 Hours] Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION - I

Q1) Answer the following:

- a) Write a note on dipole rule.
- b) Why trans-decaline can not filip while cis can?
- c) Discuss the strains present in cyclopentane and comment on its stability and conformation.
- d) CIs-4-hydroxy cyclohexane carboxylic acid undergoes lactonization faster than its trans isomer. Explain.
- e) Write a note on 2-alkyl ketone effect.
- **Q2)** Attempt any two of the following:
 - a) Explain formation of product in following reactions giving suitable mechanism. Justify your answer.



b) Draw all possible conformations of compound A and B. Give names of both and calculate the energy of stable conformations in each.



P.T.O.

[Total No. of Pages : 4

SEAT No. :

[10]

[Max. Marks : 50

c) Write the respective products formed giving mechanism for the reactions of nitrous acid with compounds C, D & E.



d) Predict the products giving mechanism. Justify your answer.



- *Q3)* Answer the following (Any one):
 - a) Give reasons.
 - i) Camphor has only one dl pair inspite of having two asymmetric carbon atoms.

- ii) SP² to SP³ conversions are favoured in 3 membered rings. Give suitable example.
- b) Explain the following:
 - i) Axial hydroxyl is a major product during catalytic reduction of cyclohexanone.
 - ii) Explain the following observed rates during solvolysis.



- Q4) Answer Any three of the following :
 - a) Explain resolution using chiral chromotographic stationary phases.
 - b) Enumerate the chiral and achiral diastereomers of (I) trulillic acid and II truxinic acid.



c) Identify the diastereomers of the products that result from the following stereospecific transformations:

 $E - Pr - CH = CH - Si Me_3 \rightarrow Pr - CH = CH - Pr$ Reagents:

- i) PhCOO₂H
- ii) Pr₂CuLi
- iii) NaH
- d) Draw stereochemical diagram for
 - i) (E) 2 Bromopent 2 ene
 - ii) 2 methyl butadiene.

Q5) Answer any Four of the following :

- a) Explain resolution by formation of Diastereomers.
- b) Explain the term "Optical purity" with examples.
- c) Explain the use of shift reagents to determine the enantiomeric excess.
- d) Draw stereo chemical diagram for
 - i) 2 Z, 4E, hexa 2, 4 diene
 - ii) E.1 Bromo, 3Z, 4 phenyl butadiene
- e) The reaction of cyclohexene with performic acid followed by hydrolysis gives 1, 2 cyclohexanediol. Explain:
- *Q6)* a) How would you determine the stereochemistry of compound (A) and (B) using NMR and FTIR spectroscopy.[4]

3



[5430]-3012

b) Predict the product/s in <u>any two</u> of the following and explain stereochemical principles involved. Justify. [4]



 $\mathbf{O} \Diamond \mathbf{O} \mathbf{O} \Diamond \mathbf{O}$

Total No. of Questions :6]

P1177

SEAT No. :

[Total No. of Pages :3

[Max. Marks: 50

[5430]-3013

M.Sc. -II

ORGANIC CHEMISTRY

CHO-353: Photochemistry, Pericyclic Reactions and Heterocyclic Chemistry (2014 Pattern) (Semester-III)

Time : 3 Hours] Instructions to the candidates:

1) All questions are compulsory.

- 2) Figure to the right indicates full marks.
- 3) Answer to the two sections should be written in separate answer books.

SECTION-I

Q1) Explain the following (all sub questions are compulsory) [10]

- a) Explain the mechanism of photoreduction reaction with the example of photoirradiation of benzophenone using isopropanol as solvent.
- b) Synthetic application of Barton reaction.
- c) Predict the structure of 2, 4- hexadiene produced by the photochemical ring opening of trans 3,4 dimethyl cyclobutene
- d) Draw the π molecular orbitals of HC=CH- $\overset{\oplus}{C}$ H₂; Identify the HOMO and LUMO and find out their symmetry element.
- e) [1,3] Sigmatropic shift of hydrogen is thermally forbidden but photochemically allowed. Explain.
- *Q2*) Predict the product/s and suggest the mechanism. Any five: [10]



P.T.O.



Q3) Answer Any Two:

a) Explain photochemical reactions involved in synthesis of Isocomene.

[5]

[10]

- b) Explain the transition state aromaticity method [Huckel-Mobius] of analysis of [1,5] shift.
- c) Explain with the help of FMO approach $\pi^2 s + \pi^4 s$ cycloaddition reaction and predict whether this reaction will be thermally allowed or photochemically allowed.

SECTION-II

Q4) Answer all the questions in brief.

- a) In skraup synthesis of quinoline from aniline, nitrobenzene is used .
- b) Furan cannot be directly alkylated under friedel crafts alkylation condition.
- c) Imidazole is more acidic than pyrrole.
- d) Which position do quinoline and isoquindine undergo nitration?
- e) Salicylaldehyde is good starting material for benzofuran synthesis.
- Q5) Predict the product/s suggesting suitable mechanism for <u>any two</u> of the following. [10]

a)
$$E$$
 (H₃ i) 3 Na, Xylene,
 OH i) $O-95^{\circ}C$
ii) $Et-c-OEt, AcOH$
iii) Hcl , $AcOH$, reflux

[5430]-3013

2

b)
$$(1) + ($$

d)
d)

$$i_{N}$$
 i_{ether} i_{i} i_{N} i_{cH0}
 i_{i} i_{N} i_{cH0}
 i_{i} i_{N} i_{cH0}
 i_{i} i_{N} i_{d} i_{d}

Q6) Write short note on <u>any two</u> of the following.

- a) Knoor-Pyrrole Synthesis
- b) Skraup synthesis
- c) Fischer Indole synthesis.



P1178

[5430]-3014

M.Sc.-II

ANALYTICAL CHEMISTRY

CHA-390 : Electro Analytical and Radio Analytical Method of Analysis (2013 Pattern) (Credit System) (Semester-III) (4 Credit)

Time : 3 Hours] Instructions to the candidates:

- 1) Answer to the two section should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Neat diagram must be drawn wherever necessary.
- 4) Use of logarithmic table, non-programmable calculator is allowed.

SECTION-I

Q1) Answer the following.

- a) State the principle of constant current coulometry.
- b) Explain the terms with the help polarogram
 - i) Oxygen interference
 - ii) Polarographic maxima.
- c) Distinguish between chronopotentiometry and chronoam perometry.
- d) What is Ultramicro electriode? Give its type.
- e) Give advantages and disadvantages of dropping mercury electrode.

Q2) Attempt any two of the following.

- a) Explain the application of differential pulse voltametry in detecting vitamin-C.
- b) Explain the cyclic Voltamogram of K_3 [Fe(CN)₆].
- c) State the principle of amperometric titration. Draw and describe nature of amperometric titration curve where only titrant is electroactive.
- d) The diffusion current constant for bismuth is 3.09 in certain polarographic analysis of bismuth, the dropping rate mercury in DME is 2.5 mg.Sec⁻¹ and droptime is 2.2Sec. If diffusion current of Bi(III) is an unknown solution containing HNO_3 as a supporting electrolyte is found to be 2.5 uA. Calculate conentration of Bi (III).

[Total No. of Pages : 2

SEAT No. :

[10]

[10]

[Max. Marks : 50

Q3) Attempt any One of the following.

- a) What are applications of coulometric titration? List the advantages and limitations of coulometric titrations.
- b) A constant current of. 675A is used deposit copper at the cathode and oxygen at the anode of an electrolytic cell. Calculate the number of grams of each product formed in 12.7 min; assuming no other redox reaction. [Given: At:wt Cu=63;5, O=16 1F=96487]

SECTION-II

Q4) Answer the following:

- a) Define the terms: (i) Neutron flux (ii) Thermogram.
- b) Give two applications of isotope dilution analysis.
- c) Explain the principle and technique of radiometric titration based on complex formation.
- d) State and explain principle of differential scanning calorimetry.
- e) Give the different types of thermobalance.

Q5) Attempt any two of the following.

- a) What is neutron activation analysis? Explain schematic diagram of NAA and its advantages.
- b) Explain the radiometric titration. Give its application.
- c) Explain the principle of TGA. Describe the construction and working of modern thermobalance.
- d) 0.5gm of glycine labelled with ¹⁴c having a specific activity 250000 counts/min. is mixed with a unknown mixture of amino acid. from the mixture glycine is extracted and 0.4gm glycine gave an activity of 1250 counts/10 min. Back ground activity is 100 counts/5 min. What is the weight of unknown mixture?

Q6) Answer any one of the following.

- a) Draw a schematic diagram of DTA apparatus and explain the functions of different components of this technique.
- b) TGA of 20 mg Gypsum sample showed mass loss of 4.2 mg on complete dehydration at about 170°. Determine the number of water molecule present in gypsum.

[Given : At. Wt. of ca=40; S=32; O=16 & H=1]



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Total No. of Questions :6]

P1179

[5430] - 3015

M.Sc. - II

ANALYTICAL CHEMISTRY

CHA - 391 : Pharmaceutical Analysis

(2013 Pattern) (Semester - III) (4 Credit)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of logarithmic table, non programmable calculator is allowed.

SECTION - I

Q1) Answer the following:

a) Give the principle of microbiological assay.

- b) Define:
 - i) Drug
 - ii) Cosmetics.
- c) What is wet sterilization?
- d) Give limit test for chloride.
- e) What is a test organism and inoculum?

Q2) Attempt <u>any two</u> of the following:

- a) Discuss disintegration test for tablets.
- b) Explain in detail tube assay method used in microbial assay.
- c) How water content from pharmaceutical preparation is determined?
- d) What is limit test? Explain limit test for arsenic.
- Q3) Attempt <u>any one</u> of the following:
 - a) Describe different phases in the development of new drug.
 - b) Explain the procedure for biological assay of Heparin sodium.
- *P.T.O.*

[Total No. of Pages :2

SEAT No. :

[10]

[Max. Marks :50

[5]

Q4) Answer the following:

- a) Draw the structure of Ibuprofen and Isoniazid.
- b) What is foreign organic matter?
- c) Define cross contamination.
- d) Give any two applications of aerosols in pharmaceuticals.
- e) What is shelf life of pharmaceutical product?

Q5) Attempt <u>any two</u> of the following:

- a) Give a brief account of diluents and lubricants.
- b) Write a note on impurities in pharmaceutical preparations.
- c) Give an assay of Ferrous fumarate.
- d) 0.41g adrenaline (C₉H₁₃O₃N) sample was dissolved in 50 ml glacial acetic acid solution. It was titrated with 0.1 N acetous perchloric acid using two drops of crystal violet indicator. The burette reading was 14.2 ml. Determine the percentage of adrenaline in the sample. [At.wt. C=12, H=1, O=16, N=14]

Q6) Attempt<u>any one</u> of the following:

- a) What are Ointments? Give the classification of Ointment bases with suitable examples.
- b) 0.32 g sample of paracetamol $(C_8H_9NO_2)$ was dissolved in 30ml 2N H_2SO_4 . This solution was titrated with 0.1 N cerric ammonium sulphate using ferroin sulphate as an indicatior. This gave a burette reading 8.1 ml. Calculate the percentage of paracetamol. [At.wt. C=12, H=1, O=16, N=14]



[5430] - 3015

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P1180

[5430]-3016

M.Sc. - II

ANALYTICAL CHEMISTRY CHA - 392 : Advanced Analytical Techniques

(2013 Pattern) (Credit System) (Semester - III) (4 Credit)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of logarithmic table/ non-programmable calculator is allowed.

SECTION - I

Q1) Answer the following questions:

- a) What is head space SPME?
- b) What is SFE?
- c) Give the five stages of SPE.
- d) Give conditions for selection of an organic solvent for MAE.
- e) What is solvent extraction? Give classification of liquid-liquid extraction.

Q2) Attempt any two of the following:

- a) With a schematic diagram discuss the process of pressurized microwave assisted extraction.
- b) Describe automation and online SPE with diagram.
- c) Explain purge and trap technique for the extraction of volatile organic compounds from aqueous samples.
- d) Give the theoretical considerations of SPME.
- *Q3*) Attempt any one of the following:
 - a) Give any two applications of reverse phase SPE.
 - b) Explain major components of SFE instrument with diagram.

[5]

[Total No. of Pages : 2

[10]

[10]

[Max. Marks : 50

SEAT No. :

SECTION - II

- *Q4)* Attempt the following:
 - a) Give principle of internal standard method of analysis.
 - b) Define the terms:
 - i) Protective agent
 - ii) Releasing agent
 - c) What do you mean by the term LASER.
 - d) State and explain the principle of RIS.
 - e) Explain the term mass to charge ratio.
- **Q5)** Attempt any two of the following:
 - a) Mention importance of micronutrients for the growth of plants. Describe suitable method for determination of molybdenum.
 - b) What is ICP? Explain the construction and working of ICP-MS with diagram.
 - c) Explain energetic transitions occur during atomic fluorescence spectroscopy.
 - d) Describe cold-vapor method for mecury.
- *Q6*) Attempt any one of the following:
 - a) The mass spectrum of nitrogen produced air is characterized by the presence of peaks of isotopic forms of nitrogen ¹⁴N¹⁴N and ¹⁴N¹⁵N to 575 and 6 mm respectively. What is the percentage of nitrogen (¹⁵N) in the sample?
 - b) A 5.0 ml sample of blood was treated with trichloroacetic acid to precipitate proteins. After centrifugation, the resulting solution was brought to pH 3 and extracted with two 5.0 ml portions of methyl isobutyl ketone containing the lead complexing agent APCD. The extract was aspirated directly into an air/acetylene flame and yielded an absorbance of 0.502 at 283.3 nm. Five milliliter aliquots of standard solution containing 0.4 and 0.6 ppm of lead were treated in the same way and yielded absorbance 0.396 and 0.599 respectively. Find concentration of lead in ppm.

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[5430]-3016

Total No. of Questions :9]

P1181

[5430]-3017

M.Sc. -II

ANALYTICAL CHEMISTRY CHA-380: Analytical Method Development and Validation, Geochemical and Alloy Analysis and Laboratory **Automation and Sensor Based Techniques** (2013 Pattern) (Semester-III)

Time : 3 Hours]

Instructions to the candidates:

- *1*) Attempt any two sections.
- 2) Answer to the two sections should be written in separate answer books.
- 3) All questions from respective sections are compulsory.
- Neat diagrams must be drawn wherever necessary. *4*)
- 5) Use of logarithmic table, non-programmable calculator is allowed.

SECTION-I

Q1) Answer the following:

- Describe the term robustness. a)
- Give Noves-Whitney equation and explain the terms involved in it. **b**)
- Give the formula for slope and error in slope. c)
- d) What do you mean by term limit of quantitation?
- What is error? Define systematic error. e)

Q2) Attempt any two of the following:

- With the help of schematic diagram, describe USP type II apparatus for a) dissolution study.
- Write a note on analytical stability in sample matrix. b)
- c) Explain validation parameters with respect to accuracy and precision.
- Analysis of blood sample for its lead content gives 0.752, 0.752, 0.760, d) 0.751, 0.756 ppm of lead. Calculate mean, standard deviation, mean deviation, relative standard deviation and relative mean deviation.

[Total No. of Pages :3

[10]

[10]

[Max. Marks : 50

SEAT No. :

- *Q3*) Attempt any one of the following:
 - a) Give a brief account of method validation report.
 - b) The chromatographic interpretation of isooctene in hydrocarbon mixture gives following results. Determine the correlation coefficient of given data.

% of isooctene	0.352	0.803	1.080	1.750	1.380
peak area	1.09	1.78	2.60	4.01	3.03

SECTION-II

Q4) Answer the following:

a) Define alloy. Give two examples.

- b) What is fertility of soil?
- c) Describe method for determination of organic carbon in soil.
- d) Give percent composition of constituents present in Dolomite and Ilmenite ore.
- e) Give the principle for determination of copper in Bronze.

Q5) Attempt any two of the following

- a) Give the determination of nitrate nitrogen in soil.
- b) Describe a method for separation of cerium and thorium in monazite ore.
- c) Discuss method for determination of Nickel in nichrome alloy.

d) A 0.5 gm of bauxite ore was disintegrated for analysis of 'Al' by fusion with sodium peroxide in nickel crucible. The mass was extracted with dilute hydrochloric acid and was diluted to 250ml in a volumetric flask. A 25 ml of aliquot was taken for precipitation of aluminium with 8 - hydroxyquinoline to give the precipitate of the complex. Its weight was 0.857 gm. Calculate % of aluminium in the given sample of Bauxite.

[At. Wt. H=1, N=14 ,O=15.99, Al = 26.18]

[10]

- Q6) Attempt any one of the following:
 - a) Mention the constituents of steel. Give the method for determination of chromium in steel.
 - b) A sample of Nichrome containing chromium was disintegrated for the determination of chromium as lead chromate. A sample of 0.430 gm of this alloy gave 270 mg of lead chromate precipitate. Calculate % of chromium in the given sample alloy.

[Given At. Wt. O=15.99, Cr = 51.99, Pb=207.01]

SECTION-III

Q7)	Ans	wer the following:	[10]
	a)	Define chemical sensors.	
	b)	What is automatic titration?	
	c)	Describe polymer replication.	
	d)	What is microfabrication?	
	e)	Enlist the different types of analyzers.	
Q8)	Atte	mpt any two of the following:	[10]
	a)	Write a note on optical sensor.	
	b)	Discuss in detail biotransduction.	
	c)	Explain in brief centrifugal force analyzer.	
	d)	Give an account of calorimetric sensor.	
Q9)	Atte	mpt any one of the following :	[5]
	a)	Give brief account of piezoelectric quartz crystal resonator.	

b) Explain in brief electrochemical sensors and give its application.



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Total No. of Questions : 6]

SEAT No. :

P1182

[5430]-4001

M.Sc. - II

PHYSICAL CHEMISTRY

CHP - 410 : Molecular Structure and Spectroscopy (2013 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answer to the two sections should be written in separate answer books.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Figures to the right side indicate full marks.
- 5) Use of logarithmic tables / calculator is allowed.

Physico - Chemical Constants

1.	Avogadro Number	Ν	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	Ħ	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
			=	$1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$
			=	6.626 × 10 ⁻³⁴ J s
4.	Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$
	• .		=	$1.602 \times 10^{-19} \mathrm{C}$
5.	1 eV			23.06 k cal mol ⁻¹
			=	$1.602 \times 10^{-12} \text{ erg}$
			=	$1.602 \times 10^{-19} \text{ J}$
			=	8065.5 cm ⁻¹
6.	Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
			=	8.314 J K ⁻¹ mol ⁻¹
			-	$1.987 \text{ cal } \text{K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	-	96487 C equiv ⁻¹
8.	Speed of light	c	-	$2.997 \times 10^{10} \text{ cm s}^{-1}$
			=	2.997 × 10 ⁸ m s ⁻¹
9.	l cal		= .	$4.184 \times 10^{7} \text{ erg}$
	· .		=	4.184 J
10.	1 amu		=	1.673×10^{-27} kg
11.	Bohr magneton	β,	=	-9.274 × 10 ⁻²⁴ J T ⁻¹
12.	Nuclear magneton	β	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m	=	$9.11 \times 10^{-31} \text{ kg}$
		c		÷.

[Total No. of Pages : 3

SECTION - I

Q1) Attempt the following:

- a) Define chemical shift in nmr spectroscopy.
- b) Discuss factors affecting g-value.
- c) What is quadrupole moment?
- d) Explain the working of magic Tin esr.
- e) State applications of ¹⁹F nmr spectroscopy.

Q2) Attempt any two of the following:

- a) Explain the principle of esr. Why is the source from microwave region?
- b) Discuss the quantum theory of nmr.
- c) Define the terms :- Spin Hamiltonian and spin density in esr spectroscopy.
- d) State applications of nqr.
- Q3) Attempt <u>any one</u> of the following:
 - a) Predict the nature of esr spectra of ¹⁴NH₃ and ¹⁵NH₃. Given ¹⁴N, I = 1 A = 20 G for ¹⁴N–H ¹⁵N, I = $\frac{1}{2}$ A = 6 G for ¹⁵N–H ¹H,
 - b) Differentiate among the following butyl bromide isomers with the help of ¹³C nmr.
 - i) $CH_3-CH_2-CH_2-CH_2-Br$ ii) $CH_3-CH-CH_2-Br$ | CH_3

iii)
$$\begin{array}{c} CH_{3} \\ H_{3}C - C - Br \\ CH_{3} \\ CH_{3} \end{array}$$

[5430]-4001

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SECTION - II

Q4) Attempt the following :

- a) Define unit cell.
- b) Write Wierl equation for electron diffraction and explain the terms therein.
- c) Enlist the applications of neutron diffraction technique.
- d) Distinguish between paramagnetic and diamagnetic suceptibility.
- e) How is structure factor used to determine electron density distribution.
- Q5) Attempt any two of the following :
 - a) Explain how electron diffraction technique is more advantageous than XRD technique.
 - b) Derive the Langevin equation for magnetic suceptibility.
 - c) Discuss the advantages of Faraday method over Guoy method.
 - d) Compare single crystal XRD and powder diffraction XRD methods.
- *Q6*) Solve <u>any one</u> of the following :
 - a) XRD study of NaCl crystal yielded 564 pm unit cell length. Calculate the number of atoms in a cubic unit cell of NaCl [NaCl density 2165 kgm⁻³).
 - b) Calculate the magnetic suceptibility of molecule having 2 and 5 unpaired electrons at 27°C.

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Total No. of Questions : 6]

P1183

[5430]-4002

M.Sc.-II

PHYSICAL CHEMISTRY

CH P- 411 : Surface Chemistry and Electrochemistry (2013 Pattern) (Semester - IV) (New)

Time : 3 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answer to the two sections should be written in separate answer books.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Figures to the right indicate full marks.
- 5) Use of logarithmic table / calculator is allowed.

Physico - Chemical Constants

1)	Avogadro Number	Ν	$= 6.022 \times 10^{23} \text{ mol}^{-1}$
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
/			$= 1.38 \times 10^{-23} \text{ JK}^{-1} \text{ molecule}^{-1}$
3)	Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$
			$= 6.626 \times 10^{-34} \text{ J s}$
4)	Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$
<i>.</i>			$= 1.602 \times 10^{-19} \text{ C}$
5)	l eV		$= 23.06 \text{ k cal mol}^{-1}$
			$= 1.602 \times 10^{-12} \text{ erg}$
			$= 1.602 \times 10^{-19} \text{ J}$
			$= 8065.5 \text{ cm}^{-1}$
6)	Gas Constant	R	$= 8.314 \times 10^{7} \text{ erg K}^{-1} \text{ mol}^{-1}$
· ·			$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
			= 1.987 cal K ⁻¹ mol ⁻¹
7)	Faraday Constant	F	$= 96487 \text{ C equiv}^{-1}$
8)	Speed of light	С	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$
,			$= 2.997 \times 10^8 \text{ m s}^{-1}$
9)	1 cal		$=4.184 \times 10^{7} \text{ erg}$
,			= 4.184 J
10)	lamu		$= 1.673 \times 10^{-27} \text{ kg}$
11)	Bohr magneton	β.	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12)	Nuclear magneton	β,	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13)	Mass of an electron	m,	$=9.11 \times 10^{-31} \text{ kg}$

SEAT No. :

[Total No. of Pages : 3

SECTION-I

(Surface Chemistry)

Q1) Answer precisely the following:

- a) Write Gibbs adsorption equation and define the terms in it.
- b) Explain the term, 'States of monomolecular films.
- c) What is differential heat of adsorption? Write its equation.
- d) Draw a neat labelled diagram of B.E.T. model.
- e) What are porous solids? State their types.

Q2) Answer any two of the following:

- a) Describe the microtome method for verification of gibbs adsorption equation.
- b) What is chemical adsorption? Briefly discuss its mechanism.
- c) Discuss the potential theory for multi layer adsorption.
- d) Discuss the hysteresis of adsorption based on capillary condensation phenomenon.

Q3) Solve any one of the following.

- A 0.2M of an acid solution in benzene is dropped on a water surface, benzene evaporates and acid forms mono-molecular film of solid type. What volume of the above solution would be required to cover 500cm² surface area of water with monomoleculer layer acid? Area covered by single acid molecule is 0.2nm².
- b) At 25°c, the surface tension of solution of butyric acid uin ethanol can γ be represented. by equation.

 $\gamma = \gamma_o - x/n (1+yc)$ where γ_o is surface tension of water, x=12.8 and Y=20.1 are constants. Calculate the excess concentration of 0.2M solution.

SECTION-II

(Electro Chemistry)

Q4) Answer the following.

- a) Enlist the different types of cells in which chemical energy is converted to electrical energy.
- b) Write Dehye-Huckel equation of activity coefficient for appreciable concentration and explain the terms involved in it.

[5430]-4002

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- c) Define- i) drift velocity of ion
 - ii) absolute mobility of ion
 - iii) conventional mobility of ion
 - iv) diffusion coefficient of ion.
- d) What is zeta potential, Write the equation for it.
- e) Write equation for heat of hydration based on ion-dipole model and explain the terms involved in it.
- *Q5*) Answer any two of the following.
 - a) Explain the principles involved in the methods of preventing corrosion.
 - b) What are secondary calls? Describe any one secondary cell.
 - c) Describe the structure of water when ion present in it.
 - d) Compare Helmholtz model with Gouy-chapman model of electrical double layer.
- *Q6*) Solve any one of the following.
 - a) A 400 m1 of $0.2M \text{ Na}_3\text{PO}_4$ is mixed with 100 ml $0.4 \text{ M Z}_n\text{Cl}_2$. Calculate the ionic strength of a solution assuming complete dissociation.
 - b) The diffusion coefficients of H⁺ and Cl⁻ in a dilute solution at 25°c were measured as 9.3×10^{-9} m² 5⁻¹ and 2.3×10^{-9} m²S⁻¹. Calculate the equivalent conductance of dilute HCL solution at 25°c.



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Total No. of Questions : 6]

SEAT No. :

[5430]-4003 M.Sc. - II

PHYSICAL CHEMISTRY CHP - 412 : Materials Chemistry and Catalysis (2013 Pattern) (Semester - IV) (New)

Time : 3 Hours]

[Max. Marks : 50

[Total No. of Pages : 3

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to right side indicate full marks.
- 4) Use of logarithmic table/calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23} \text{ mol}^{-1}$
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			$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3).	Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$
			$= 6.626 \times 10^{-34} \text{ J s}$
4)	Electronic Charge	е	$= 4.803 \times 10^{-10} \text{ esu}$
			$= 1.602 \times 10^{-19} \text{ C}$
5)	1 eV		$= 23.06 \text{ k cal mol}^{-1}$
			$= 1.602 \times 10^{-12} \text{ erg}$
			$= 1.602 \times 10^{-19} \text{ J}$
			$= 8065.5 \text{ cm}^{-1}$
6)	Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
			= 8.314 J K ⁻¹ mol ⁻¹
			= 1.987 cal K ⁻¹ mol ⁻¹
7)	Faraday Constant	F	$= 96487 \text{ C equiv}^{-1}$
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9)	1 cal		$=4.184 \times 10^{7} \text{ erg}$
*			= 4.184 J
10)	lamu		$= 1.673 \times 10^{-27} \text{ kg}$
11)	Bohr magneton	β_	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12)	Nuclearmagneton	β	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13)	Mass of an electron	m	$=9.11 \times 10^{-31} \text{ kg}$
<i>4</i>		0	

SECTION - I

Q1) Attempt the following:

- a) What are the characteristics of 1-2-3 material?
- b) State the equation of Ginzburg-Landau equation for coherence length.
- c) Draw the schematic cross sectional diagram of the DC-Sputtering system.
- d) State two advantages of sol-gel method for synthesis of film.
- e) What are quantum dots?

Q2) Attempt any two of the following:

- a) Explain optical properties of solid devices material.
- b) What is capacitor? Explain the three types of capacitor on the basis of dielectric material.
- c) Explain sol-gel method for preparation of thin film.
- d) What are the applications of hitech material?

Q3) Attempt any one of the following:

- a) Explain the term photolithography using suitable diagram.
- b) Explain the pairing & multigap structure in hitech material.

SECTION - II

Q4) Attempt the following:

- a) Define the terms adsorbent and adsorbate with example.
- b) Define 'catalytic selectivity'.
- c) Explain 'catalytic' poisoning.
- d) What are zeolites? Give an example.
- e) Define the terms 'active sites' and 'inhibition'.

[5430]-4003

2

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- **Q5)** Attempt any two of the following:
 - a) Explain the factors which affects the activity of catalyst.
 - b) Discuss precipitation method of preparation of catalyst.
 - c) Describe the mercury porosity meter method to determine the size of the pore.
 - d) Describe the XPS method to determine solid particle size.
- *Q6*) Attempt any one of the following:
 - a) The data given below are for the adsorption of CO on charcoal at 273K. Confirm that they fit the langmuir isotherm, and find the constant K and the volume corresponding to complete coverage. In each case V has been corrected to 1.00 atm.

(101.325 kpa)

P/Kpa	13.3	26.7	40.0	53.3	66.7	80.0	93.3
V/Cm ³	10.3	19.3	27.3	34.1	40.0	45.5	48.0

b) How is ozone produced in the environment? Explain its attenruation by a catalyst.



[5]

Total No. of Questions : 6]

P1185

[5430]-4004 M.Sc. - II PHYSICAL CHEMISTRY CHP-413 : Biophysical Chemistry

(2013 Pattern) (Semester - IV)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicates full marks.
- 4) Use of logarithmic table/calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

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			= $1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$
	- 200) #2		$= 6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$
			$= 1.602 \times 10^{-19} \mathrm{C}$
5.	1 eV		$= 23.06 \text{ k cal mol}^{-1}$
			$= 1.602 \times 10^{-12} \text{ erg}$
			$= 1.602 \times 10^{-19} \text{ J}$
	-		$= 8065.5 \text{ cm}^{-1}$
6.	Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
	2 7 E		$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
*			$= 1.987 \text{ cal } \mathrm{K}^{-1} \mathrm{mol}^{-1}$
7. ·	Faraday Constant	F	$= 96487 \text{ C equiv}^{-1}$
8.	Speed of light	С	$= 2.997 \times 10^{10} \mathrm{cm s^{-1}}$
			$= 2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		$= 4.184 \times 10^7 \text{ erg}$
			= 4.184 J
10.	1 amu		$= 1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m,	$= 9 11 \times 10^{-31} \text{ kg}.$
	2		

[Max. Marks : 50

[Total No. of Pages : 3

SEAT No. :

P.T.O.

SECTION - I

Q1)	Atte	mpt the following :	[10]
	a)	Define RNA, DNA, Genome, Gene.	
	b)	State Bragg's law.	
	c)	Explain DNA sequencing.	
	d)	State and explain Henderson's equation.	
	e)	Define electrophoresis. Give its application.	
Q2)	Atte	mpt any two of the following :	[10]
	a)	Write a note on protein folding.	
	b)	Explain the role of ATP in human metabolism.	
	c)	Compare osmosis with reverse osmosis.	
	d)	Write a note on bilayer phase transition in lipids.	
Q3)	Atte	mpt <u>any one</u> of the following :	[5]
	a)	Explain the role of proteins in cell biology.	

b) Discuss the application of osmometry to determine molecular weight of a protein.

SECTION - II

Q4) Answer precisely the following :

a) Define the terms Myosin and Actin.

- b) Explain various types of nerves.
- c) State the characteristics of biopolymers.
- d) Explain competitive inhibition observed in enzyme inhibition.
- e) State the principle of optical rotatory dispersion.

- Q5) Answer any two of the following :
 - a) Describe with a neat labelled diagram the fluid mosaic model for cell membrane.
 - b) Describe the end-group determination method to determine the molecular weight of a biopolymer.
 - c) Draw and explain the graph showing various events of action potential.
 - d) Discuss the application of circular dichroism.
- *Q6*) Solve any one of the following :
 - a) A polymer sample has the following distribution of molecular weights :

Fraction	0.15	0.20	0.40	0.15	0.10
Molecular Weight	10,000	20,000	30,000	40,000	50,000

Calculate $\overline{\mathbf{M}}_n$ and $\overline{\mathbf{M}}_w$ of the sample.

b) Fractions of a polymer when dissolved in an organic solvent, gave the following intrinsic viscosities at 25°C.

M (g mol ⁻¹)	34,000	61,000	1,30,000
[η]	1.02	1.60	2.725

Determine ' α ' and 'k' in Mark-Houwink equation for this system.

* * * *

[5]

Total No. of Questions : 6]

P1186

[5430]-4005

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-414 : Special Topics in Nuclear and Radiation Chemistry (2013 Pattern) (Semester - IV)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicates full marks.
- 4) Use of logarithmic table and calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1.	Avogadro Number	Ν	$= 6.022 \times 10^{23} \mathrm{mol^{-1}}$
2.	Boltzmann Constant	k	= $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
			= $1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$
	42		$= 6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$
			$= 1.602 \times 10^{-19} \mathrm{C}$
5.	1 eV		$= 23.06 \text{ k cal mol}^{-1}$
			$= 1.602 \times 10^{-12} \text{ erg}$
			$= 1.602 \times 10^{-19} \text{ J}$
	*		$= 8065.5 \text{ cm}^{-1}$
6.	Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
	2 * 6		$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
*			$= 1.987 \text{ cal } \mathrm{K}^{-1} \mathrm{mol}^{-1}$
7. ·	Faraday Constant	F	$= 96487 \text{ C equiv}^{-1}$
8.	Speed of light	С	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$
			$= 2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		$= 4.184 \times 10^7 \text{ erg}$
			= 4.184 J
10.	1 amu		$= 1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m	$= 9 11 \times 10^{-31} \text{ kg}.$
	A	52525	2011 Sec. 201

[Max. Marks : 50

SEAT No. :

[Total No. of Pages : 3

P.T.O.

Q1) Attempt the following :

- a) Give an example of radionuclides used as radiopharmaceuticals tracers with their uses in specific diagnosis.
- b) Define the terms evaporation and spallation reaction with example.
- c) Explain the term annealing.
- d) Define reaction cross-section. Give expression which relates rate of reaction with reaction cross-section.
- e) Define the terms hot spots and cold spots with examples.
- **Q2**) Attempt <u>any two</u> of the following :
 - a) Write a note on conservation in nuclear reaction.
 - b) Explain the construction and working of Cockroft-Walton accelerator.
 - c) What are the various stages of interaction of radiations with biological cells?
 - d) Discuss the chemistry of recoil atoms.
- *Q3*) Solve <u>any one</u> of the following :
 - a) Evaluate Q-value for the reaction :

 $^{14}_{7}\text{N} + ^{4}_{2}\text{He} \rightarrow ^{17}_{8}\text{O} + ^{1}_{1}\text{H}$

Given: ${}_{2}^{4}$ He=4.00387 amu

¹⁴₇N=14.00753 amu

 $^{17}_{8}$ O=17.00450 amu

 $^{1}_{1}$ H=1.00814 amu

b) Give an account on thermonuclear reactions.

[5430]-4005

- *Q4*) Answer the following :
 - a) Explain the term radical scavenging.
 - b) What are the advantages of radiometric titration based on interaction of β -particles.
 - c) Draw the radiometric titration curve obtained when test solution is inactive and titrant is active for complex formation.
 - d) What is the objective of radioactive waste management?
 - e) Explain the term Supernova.
- Q5) Attempt <u>any two</u> of the following :
 - a) Given an account of experimental setup of neutralization reaction using radioactive Kryptonates.
 - b) Describe the radiolysis of aromatic hydrocarbons.
 - c) Write a note on radioactive waste disposal.
 - d) Discuss Sworski and Schwarz relationships for the yield of molecular products and the solute concentration.
- Q6) Attempt <u>any one</u> of the following :
 - a) 15 cm^3 of kCl labelled with ${}^{36}\text{Cl}$ was titrated with 0.01M AgNO₃. Addition of 1 ml of titrant followed by removal of precipitate showed a loss in the activity from 10,000 counts for 5 min to 1000 counts per min. Calculate the amount of kCl is the original solution. [Given : At. wts : K = 39.1, Cl = 35.5]
 - b) State the possible radiolysis reactions for organic compounds.

3

[5]

Total No. of Questions : 4]

P1187

[5430]-4006

M.Sc. - II

INORGANIC CHEMISTRY

CHI - 430 : Inorganic Polymers and Heterogeneous Catalysis (2013 Pattern) (Semester - IV)

Time : 3 Hours] Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicates full marks.
- 4) Use of logarithmic table and calculator is allowed.

Q1) Answer the following:

[20]

- a) Mention the importance of Si/Al ratio during zeolite synthesis.
- b) What are molecular sieves? Give their classification.
- c) What do you mean by forming of the catalyst? Enlist different methods of forming along with their advantages.
- d) How Raney-nickel catalyst is prepared.
- e) What are the steps involved in the phenomeno of heterogeneous catalysis.
- f) Discuss in brief use of Bi MOO_4 catalyst in ammoxidation of propylene.
- g) What is photocatalysis? Which materials are acting as a good photocatalysts?
- h) What are perovaskites? Mention their catalytic applications.
- i) Draw the structure of keggins heteropolyanion.
- j) What do you mean by Inorganic polymers? List out their important properties.

SEAT No. :

[Total No. of Pages : 2

[Max. Marks : 50

- *Q2)* Answer any two of the following:
 - a) What is adsorption? Discuss various types of adsorption phenomena alongwith Langmuir isotherms.
 - b) Discuss in detail the characteristics of zeolite framework structure.
 - c) Discuss the role of support in supported metal catalyst.
 - d) Give an account of the methods used for finding out the number and nature of acidic sites in solid catalysts.
- *Q3)* Attempt the following (Any two):
 - a) What are clays? How intercalated and pillered clays are prepared? Discuss their use as catalyst.
 - b) Give an account of temperature programmed techniques used for characterisation of heterogeneous catalysts.
 - c) Discuss the use of zeolite as shape selective catalyst.
 - d) How will you prepare S_4N_4 . Explain its properties and structure.
- *Q4)* Write notes on (Any two):
 - a) Heteropolyacids as a catalyst
 - b) Catalytic converter
 - c) MFI & MEL type zeolites
 - d) Chemical reactors

[10]

[10]

2

[5430]-4007

[Total No. of Pages : 2

M.Sc.-II

INORGANIC CHEMISTRY CHI-431 : Material Science-I : Inorganic Solid State Materials (2013 Pattern) (Semester - IV)

Time : 3 Hours] Instructions to the candidates: 1) All questions are compulsory. 2) Neat diagrams must be drawn wherever necessary.

3) Figures to the right indicate full marks.

Q1) Answer the following:

- What is point defect? Explain its types. a)
- Give four important applications of magnetic materials. **b**)
- What are diamagnetic materials? Explain with suitable example. c)
- Superconductivity and d) Define: i)
 - ii) Critical temperature for superconductor.
- What is domain? Explain the Magnetic interactions in spinel. e)
- Distinguish between hardwood and softwood. f)
- Give the full forms of C_3AF and C_25 . g)
- h) Give the applications of Biomaterials.
- What is concrete? Explain its composition. i)
- A piece of wood containing moisture weighed 94.3 gram and aftr oven i) drying showed constant weight of 78.4gram. calculate the percentage moisture in it.

Q2) Attempt any two of the following:

- What is Kirkendall effect? Explain with the help of pure copper and a) brass alloy.
- What is saturation magnetization? Explain how it is useful to determine b) magnetization.
- Explain BCS theory of super conductivity. c)
- Explain in detail curie law. d)

[Max. Marks : 50

Q3) Attempt any two of the following:

- a) What is hysteresis loop? Explain the hysteresis loop of ferromagnetic substances.
- b) Calculate the net magnetic moment per iron atom in crystal structure of Fe.
 - i) Fe has BCC structure with lattice parameter = 2.87Å
 - ii) 1.B.M= $9.273 \times 10^{-24} \text{ A/m}^2$
 - iii) Saturation magnetization is 1750 KA/m^2 .
- c) What are biomaterials? How they are classified?
- d) What are ceramic materials? Explain the process of manufacture of cement.
- *Q4*) Write short notes on (Any two)

- a) Sol-gel process.
- b) Oil-well cement.
- c) Meissner effect.
- d) Peizoelectric materials.



Total No. of Questions : 4]

P1189

[5430]-4008

M.Sc.-II

INORGANIC CHEMISTARY CHI - 432 : Material Science - II (Nanomaterials) (2013 Pattern) (Semester - IV) (4 Credites)

Time : 3 Hours]

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) All questions carry equal marks.
- *3)* Use of calculator is allowed.

Q1) Answer the following:

- a) What is nanocomposite? Give two examples of metal nanocomposites.
- b) Name the physical methods for synthesis of nanomaterials.
- c) What is a quantum wire? Give it's application.
- d) Define fermilevel equilibrium.
- e) What is graphene? Give its properties.
- f) Explain in brief photoconductivity.
- g) Explain the formation of microporous nanomaterials.
- h) Write the importance of sol-gel method for preparation of nanoparticles.
- i) What are biosensors? How do they function?
- j) Write the principle of Raman spectroscopy.
- **Q2)** Answer the following (Any two)
 - a) What are inorganic nanotubes? Give examples and describe the synthesis of any one?
 - b) Discuss the preparation method for the synthesis of Zero valent iron nanoparticle.
 - c) What is the difference between SEM & TEM?
 - d) What is gas-sensor? Write the application of gas sensor in industries.

[10]

[Total No. of Pages : 2

[Max. Marks : 50

[20]

SEAT No. :

- **Q3)** Answer the following (any two)
 - a) What is carbonnanotube? Classify the carbon nanotube and explain in brief.
 - b) Explain how UV-vis spectroscopy is useful in characterization of nanoparticles.
 - c) How do surfactants influence the growth of nanoparticles? Explain.
 - d) Explain the cavitation process occurs in the synthesis of nanoparticles?
- *Q4*) Answer the following (any two)

[10]

- a) What is rectifier? Explain the working of rectifier.
- b) Explain the solvothermal method for preparation of MgO nanoparticles.
- c) Explain the preparation of CdS nanowire by co-pricipitation method.
- d) Explain the size dependent properties of nanomaterials.

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Total No. of Questions : 9]

P1190

[5430]-4009

M.Sc. - II

INORGANIC CHEMISTRY CHI-445 : Inorganic Chemistry : Applications in Industry;

Environment and Medicine

(2013 Pattern) (Semester - IV)

Time : 3 Hours]

Instructions to the candidates:

Attempt any two sections of the following. 1)

- 2) Both sections should be written in the same answer book.
- All questions are compulsory. 3)
- *4*) Figures to the right indicates full marks.
- Neat diagrams must be drawn wherever necessary. 5)
- **6**) Use of logarithmic table and calculator is allowed.

SECTION - I

(Applications in Industry)

Q1) Answer the following :

- What is varnishes? Give two example of inorganic varnishes. a)
- What is electroplating and its uses? b)
- Draw the structure of Phthalocyanine dye. c)
- What is the composition of basic lead carbonate and write any two uses d) of basic lead carbonate.
- What are Formazons? Give two examples. e)

Q2) Answer the following (any two):

- What is extender pigment? Write the properties of extender pigments. a)
- Explain the chemical reaction involved in manufacturing of TiO₂ pigment. b)
- Explain the mechanism involved in synthesis of Cr(III)O,O' dihydroxyc) diarylazo dye complex.
- Discuss the surface modied metals by use of polymers in electroplating. d)

[Total No. of Pages : 3

SEAT No. :

[10]

[Max. Marks : 50

[10]

P.T.O.

Q3) Write a note on any one :

- Electrochemical luminances. a)
- b) Food pigments.
- Electroplating of Precious metals. c)

SECTION - II

(Environment)

Q4) Answer the following :

- How is biogas produced? a)
- b) How nitrogen can be removed is detected by spectrophotometrically from waste water?
- Will geothermal energy ever be a major source of energy world wide? c)
- d) Explain COD and BOD of waste water.
- Explain primary and secondary sludge? e)

Q5) Answer the following (any two):

- Explain the source and biochemical effect of As. a)
- Name the instrumental methods for determination of Hg, Cd, As and Pb. b) Explain XRF for the determination of Pb from polluted water.
- What does tertiary treatment in a sewage treatment plant remove from c) waste water?
- Draw a schematic diagram of Alkaline Fuel Cell (AFC). What reactions d) occuring at cathode and anode? Show overall reactions.
- *Q6*) Write a note on any one :
 - Solar energy. a)
 - Biorefractory organic pollutants. b)
 - Safe drinking water act. c)

[5]

[10]

[10]

2

<u>SECTION - III</u> (Applications of Metal Ions in Medicine)

Q7) Answer the following :

- a) Define Prodrug.
- b) Lithium is widely distributed in body cell. Explain.
- c) What are the several types of drugs used in the treatment of rheumatoid arthritis?
- d) Name any two model compounds of Vanadium.
- e) Cisplatin acts as an anticancer drug while transplatin does not Why?
- Q8) Answer the following (any two):
 - a) Explain the interaction of bismuth complexed with metallothionein and transferrin.
 - b) Explain the redox reaction of metal complexes with DNA mediates oxidation of nuclei acids.
 - c) Explain the types of groove binding with the help of neat diagram.
 - d) Discuss the role of vanadium in nitrogen fixation.
- Q9) Write a note on any one :
 - a) Crysotherapy.
 - b) Therapeutic role of lithium.
 - c) Enzyme inhibition activity of bismuth drugs.

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[10]

[5]

Total No. of Questions : 6]

P1191

[5430]-4010

M.Sc. - II

ORGANIC CHEMISTRY

CHO - 450 : Chemistry of Natural Products (2013 Pattern) (Semester - IV) (New Course)

Time : 3 Hours] Instructions to the candidates: [Max. Marks : 50

[10]

[Total No. of Pages : 4

tructions to the candidates: 1) All questions are compuls

- All questions are compulsory.
 Figures to the right indicate full marks.
- 3) Answer to the two sections should be written in separate answer books.

SECTION - I

Q1) Outline the steps involved in the following sequences:



P.T.O.

SEAT No. :

- **Q2)** Answer the following (Any two) :
 - a) Give evidence to prove the presence of the grouping $R \xrightarrow{CH_2} e = c \xrightarrow{L} e$ in Hardwickiic acid.

[10]

[5]

- b) Give evidences in support of
 - i) Presence of –OH group
 - ii) Presence of trimethoxy group in the benzene side chain in podophyllotoxin.
- c) Hydroxy campthothecin has the structure <u>2</u>. How can it be established that the hydroxyl group is present in A ring at given position.



- **Q3)** Attempt any one of the following:
 - a) Give evidence for the presence and stereochemistry of lactone ring in podophyllotoxin.
 - b) Write a short note on McMurry coupling.

OR

a) Complete the following reaction sequence.



b) Write a note on Shapiro reaction.

SECTION - II



Q5) Attempt any two of the following :

Complete the following biogenetic conversion a)



Give the biogenesis of **b**)



from squalene 2, 3-epoxide.



Q6) Attempt any one of the following :



The skeletons of the compounds shown below often co-occur. Give the **b**) biogenesis of these compounds from Farnesyl pyrophosphate.





 $\mathbf{O} \Diamond \mathbf{O} \mathbf{O} \diamond$

Total No. of Questions : 6]

P1192

[5430]-4011 M.Sc. - II ORGANIC CHEMISTRY CHO - 451 : Advanced Synthetic Organic Chemistry

(2013 Pattern) (Semester - IV)

Time : 3 Hours] Instructions to the candidates:

1) All questions are compulsory.

2) Figures to the right indicate full marks.

3) Answer to the two sections should be written in separate answer books.

SECTION - I

Q1) Predict the products of the following :

a) i) clco₂tBu, Et₃N, EtsH, cH₂ch₂ p ii) pdcl₂[pph₃]₂, EtznI

[Max. Marks : 50

[10]

P.T.O.

SEAT No. :

[Total No. of Pages : 4
Q2) Suggest the Mechanism in any four of the following :



Q3) Answer any two of the following :

- a) Discuss Noyori reaction.
- b) Organosilanes in organic synethesis
- c) Explain chiral boranes in asymetric synthesis.

Q4) Predict the products of the following :

a)
$$(i) HBr/H_0^2$$



c)
$$\frac{1}{3} = -H + \cancel{Co_2(0)_8}$$
 ?

d)
$$H_3N_3 + H = -CH_3 [CuBr, (PPh_3)_3] = \rho$$

neat.rt

e)
$$\xrightarrow{PPh_3, D \in AD}$$
 ?







[5430]-4011



Q6) Answer any two of the following :

[5]

- a) Discuss Shapiro reaction.
- b) Explain Passerini reaction.
- c) Discuss Bergman cyclization.

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P1193

SEAT No. :

[Total No. of Pages : 3

[5430]-4012

M.Sc. - II

ORGANIC CHEMISTRY

CHO - 452 : Carbohydrate, Chiron Approach, Chiral Drugs and Medicinal Chemistry

(2013 Pattern) (Semester - IV)

Time : 3 Hours]

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION - I

- *Q1*) a) "Carbohydrates are preferred as Chiral templates in Chiron approach"-Explain.
 - b) Give the retrosynthesis of (-) Shikimic acid (X)

How will you prove the presence of conjugated system in (-) – Shikimic acid using IR spectroscopy?

- c) "D-(+) Glucose and D-(+)– Mannose can be distinguished on the basis of products formed by reaction with concentrated HNO₃" Explain.
- d) Write a short note on mutarotation.
- e) Define 'Distomer'. Write one example each for distomer with
 - i) no side effect and
 - ii) undesirable side effect.

[10]

P.T.O.

[Max. Marks : 50

Q2) a) Answer any two of the following:

- i) Explain the pharmacological activity of (S)-captoril.
- ii) Write the complete synthesis of R-Epichlorohydrin from D-mannitol.

iii) `



(X) is subjected to Ruff degradation to yield the product (Y). Write the complete sequence of reactions and predict if the compound (Y) is a D sugar or (L) sugar?

- b) Answer any two of the following:
 - i) What are Chiral drugs? Explain with suitable examples.
 - ii) Complete the following sequence of reactions



- iii) Write pharmacological activity of (S)-Ibuprofen.
- Q3) Complete the following sequence using appropriate reagents and suggest possible mechanism. [5]



Metoprolol

Write the absolute configurations of 2 & 2' positions in the mixture of metoprolols produced.

[5430]-4012

[4]

Q 4)	Ansv	Answer the following: [10]					
~ /	a)	Expl	ain the term selective toxicity.				
	b)	Defi	ne chemotherapeutic and therapeutic index.				
	c)	Give	e an account of history of antibiotics.				
	d)	Expl	ain antifungal agents.				
	e)	Give mode of action of chloroquine.					
Q5)	a)	Answer any two of the following: [
		i)	Discuss mode of action of antiviral agents with suitable example	les.			
	ii) What are tetracyclins and give their S action.		What are tetracyclins and give their SAR. Explain their mode action.	e of			
		iii)	Write note on pharmacodynamics.				
	b)	Explain the following. (any two) [4]					
		i)	Lipnski Rule of five.				
		ii)	Prontosil as a prodrug.				
		iii)	Mode of action of cephalosporins.				

Q6) What are penicillins? Discuss how semisynthetic penicillins were synthesized to overcome the problems associated with penicillin-G. [5]

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P1194

[5430]-4013

M.Sc. - II

ORGANIC CHEMISTRY

CHO - 453 : Designing Organic Synthesis and Asymmetric Synthesis (2013 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 50

[10]

[Total No. of Pages : 4

SEAT No. :

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION - I

Q1) Answer the following :

- a) Explain the trityl ether protection for alcohol with suitable example.

 $COOH, CH_3 - CH_2$

- c) Enamine approach is preferred over the conventional method for effecting the monoalkylation of cyclic ketones. Explain.
- d) What are the advantages of convergent synthesis? Explain with suitable example.
- e) Use of 1, 3 dithiane in umpolung.
- Q2) a) How will you bring about following transformations? (any two): [5]



P.T.O.

b) Predict the product/s in any two of the following :



$$2$$
 Ph CHO
3. H $_30^+$

Q3) a) Using retrosynthetic analysis, suggest suitable method to synthesise any one of the following : [3]





b) You are provided reagents for the following conversion. Arrange them in proper order to achieve the conversion. Write the structures of the intermediates. [2]

li)



HClO₄; HCN, Et₃Al; LiAlH₄; HO // OH, H⁺

Q4) a) Explain the following transformations with respect to stereochemical outcome of the reaction. (any two) [6]



b) Name the suitable reagent for the following transformations and comment on the formation of the product (any two) : [4]



Q5) a) Write a short note on (any two) :

[6]

- i) Felkin Anh model.
- ii) Evan's Chiral auxiliary controlled aldol reaction.
- iii) CBS catalyst.

[5430]-4013

b) Predict the product/s and comment on the following transformations (any two): [4]



Q6) a) Answer the following (Any one):

[2]

- i) Explain kinetically controlled Iodolactonization reaction.
- ii) Asymmetric Diels Alder. Reaction.
- b) Complete the following multistep synthesis by using appropriate reagents or intermediates. [3]



P1195

[5430]-4014

M.Sc. - II

ANALYTICAL CHEMISTRY CHA - 481 : Analytical Toxicology and Food Analysis (2013 Pattern) (Semester - IV)

Time : 3 Hours] Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of logarithmic tables non programmable calculator is allowed.

SECTION - I

Q1) Answer the following:

- a) Define the terms :
 - i) Cannabis
 - ii) Addict
- b) What is protective agents?
- c) Give the principle of isolation and identification of Amphetamine and Metamphetamine, Type A procedure.
- d) Explain "Depressants".
- e) Give the principle of isolation and identification of caffeine from urine, procedure Type C.
- **Q2)** Attempt <u>any two</u> of the following:
 - a) Write a note on "Illicit traffic".
 - b) How heroin is isolated from urine sample? Give detail procedure for its adsorption and elution.
 - c) State the principle for determination of barbiturates by procedure A. Explain its procedure in detail.
 - d) Outline the procedure for determination of benzodiazepines.

[Total No. of Pages : 2

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[Max. Marks : 50

[To

SEAT No. :

- **Q3)** Attempt <u>any one</u> of the following:
 - a) Explain colour test fo Poison.
 - b) Urine sample is analysed for caffeine content by gas chromatography method. It gave following results:
 - i) Concentration of caffeine in reference standard = 27 mg/ml.
 - ii) Peak height of caffeine in sample = 59 min.
 - iii) Peak height of caffeine in reference standard = 84 min calculate the concentration of caffeine in given sample.

- *Q4)* Answer the following :
 - a) What are food preservatives? Give any two examples.
 - b) Define Rancidity of an oil seed.
 - c) What are sweetening tablets? Give its types.
 - d) How casein from milk is estimated?
 - e) Give the principle for estimation of protein by Lowry method.
- Q5) Answer any two of the following :
 - a) Describe the Tanner method for estimation of SO_2 from food sample.
 - b) How total carbohydrates are estimated by using anthrone method?
 - c) Outline the procedure for the estimation of peroxide value of oil.
 - d) Discuss the steps involved in identification of coal tar dye present in food stuff.
- **Q6)** Attempt <u>any one</u> of the following :
 - a) Biological sample was determined for net protein utilization, digestibility and biological value gives following results.
 - i) In take nitrogen (I) = 17.1 mg
 - ii) Faecal nitrogen (F) = 8.1 mg
 - iii) Endogenous faecal nitrogen $(F_k) = 4.1 \text{ mg}$
 - iv) Urinary nitrogen (U) = 7.1 mg
 - v) Endogenous urinary nitrogen $(U_k) = 4.3$ mg calculate net protein utilization, digestibility and biological value.
 - b) Calculate the amount of lactic acid in given sample of milk 10.9 ml if it required 2.8 ml of 0.1M NaOH.

(Given : Molecular weight of lactic acid = 90)

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M.Sc.-II

ANALYTICAL CHEMISTRY CHA-490 : ANALYTICAL SPECTROSCOPY (2013 Pattern) (Semester - IV)

Time : 3 Hours] Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of logarithmic table / non-programmable calculator is allowed.

SECTION-I

Q1) Answer the following questions.

- a) State and explain the principle of Auger electron. Spectroscopy.
- b) What is absorptive edge method?
- c) Explain the sources used in X-ray method of analysis.
- d) State and explain the principle of TEM.
- e) Give the applications of ESCA.

Q2) Attempt any two of the following

- a) Explain the X-ray powder camera method for qualitative analysis.
- b) What are ESCA Satellite peak and chemical shift? Discuss the electron shake up and electron shake off.
- c) Explain with schematic diagram the difference between the wavelength dispersive and Energy dispersive X-ray fluorescence.
- d) What is X-ray microscopy? Explain any one solid surface analysis method.

Q3) Solve any of the following.

- a) The 1s electron has binding energy 407.4 eV. calculate the kinetic energy of measured electron, if the incident radiation is K_{α} line of Mg (9.89 Å) and the work function of electron spectrometer is 6.8 eV.
- b) The mass absorptive coefficient of an alloy was found to be $51.0 \text{cm}^2/\text{g}$, which consists of 37% Ni and 59% of Cu at wavelength corresponding to K_a radiation of copper. The mass absorptive coefficient at the same wavelength is 49.3 cm²/g for Ni. Calculate the mass absorptive coefficient for Cu.

[Total No. of Pages : 2

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[Max. Marks : 50

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SEAT No. :

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SECTION-II

Q4) Answer the following questions:

- a) What is liquid phase chemiluminescence titration?
- b) Discuss electron transition during photoluminescence.
- c) Explain the term relaxation.
- d) What is inner filter effect?
- e) Explain spin-spin splitting with suitable example.

Q5) Attempt any two of the following.

- a) How are non-Luminescent compounds studied with fluorescence technique.
- b) Explain gas-phase chemiluminescent analysis with suitable example.
- c) With the help of a suitable block diagram, explain the components involved in NMR apparatus.
- d) Determine the ratio of the number of hydrogen nuclei in the upper energetic level to those in the lower energetic level at 27°C in a magnetic field with a flux density of 14092 G.

 $\begin{bmatrix} \text{Given} : \mu = 2.7927, \ \beta = 5.0505 \times 10^{-31} \text{J/G} \\ \text{Bo} = 14092 \text{ G}, \ \text{K} = 1.38 \times 10^{-23} \text{ J/K} \end{bmatrix}$

- **Q6)** Attempt any one of the following:
 - a) Write a note on ¹H NMR and ¹³C NMR.
 - b) The ¹H NMR of a compound with empirical formula $C_5H_{10}O$ shows quartet at δ 2.5 and triplet at δ 1.2. The integration of each peak shows 6:4 ratio respectively. Identify the compund.

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M.Sc. - II

ANALYTICAL CHEMISTRY

CHA-491: Analytical Methods for Analysis of Fertilizers, Detergents, Water and Polymer, Paint and Pigment (2013 Pattern) (Semester - IV)

Time : 3 Hours]

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Draw neat diagrams wherever necessary.
- 4) Use of logarithmic tables, non-programmable calculators is allowed.

SECTION - I

Q1) Answer the following.

- a) What is chlorine demand?
- b) Give general scheme for detergent analysis.
- c) Define titer test.
- d) Define total phosphorus and available phosphorus.
- e) Give one test to estimate dissolved oxygen in water analysis.

Q2) Attempt any two of the following.

- a) Give a detailed account of biodegradability of detergents.
- b) What is total Nitrogen? How is it estimated from mixed fertilizer by Kjeldahl's method.
- c) Discuss aerobic treatment process for waste water.
- d) Orthophosphate was determined by weighing as ammonium phosphomolybdate $(NH_4)_2 PO_4 \cdot 12 MoO_3$. Calculate the percentage of phosphorus and phosphorus pentaoxide if 1.678g precipitate was obtained from 0.315g of sample.

[Given : Atomic mass, g mol⁻¹: H = 1.00, N = 14.00, O = 15.99, P = 31.00, Mo = 95.94].

[Total No. of Pages : 2

SEAT No. :

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[Max. Marks : 50

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- **Q3)** Answer any one of the following.
 - Discuss the following. a)
 - Determination of germicides in soaps and detergents. i)
 - Determination of equivalent combined SO_3^{2-} in detergent. ii)
 - 0.45g detergent containing phosphate was ignited to red hot to destroy b) organic matter. The residue was then dissolved in hot HCl which gave $\rm H_{3}PO_{4}$, the phosphate was precipitated as $\rm MgNH_{4}~PO_{4}\cdot~6H_{2}O$ by addition of Mg²⁺ ions followed by ammonia. After filtration, washing, drying and ignition weight of residue was 0.392g. Calculate percentage of phosphorus in given sample.

[Given : At.wt. P = 30.97, Mg = 24.31, O = 15.99, N = 14, H = 1]

SECTION - II

- *Q4*) Answer the following:
 - a) Define lacquers and extenders.
 - Enlist the colligative properties used for molecular weight measurement. b)
 - Explain the terms: c)
 - i) Vapour permeability.
 - Weathering. ii)
 - Give classification of polymers. d)
 - Explain what is dielectric constant and loss factor. e)
- **Q5)** Attempt any two of the following:
 - Explain optical properties of polymers. a)
 - How are binders identified and analysed in pigments? b)
 - c) The intrinsic viscosity for a polymethylacrylate is 275.5cm³/g. Calculate the concentration of polymethylacrylate in benzene solution with relative viscosity = 1.999.
 - d) Explain the cryoscopic method for number average molecular weight determination of polymer.
- *Q6*) Answer any one of the following:
 - Outline general procedure for total lead and titanium pigments. a)
 - b) 0.598g of CTAB was dissolved in 25ml mixture of ethyl alcohol and toluene [1:3]. The solution was titrated with 0.12N alc. NaOH. The burette reading was 5.5ml. Calculate \overline{M}_n of polymer sample.

[Given: functionality = 2].

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M.Sc. - II

ANALYTICAL CHEMISTRY CHA - 492 : Methods of Analysis and Applications (2013 Pattern) (Semester - IV)

Time : 3 Hours] Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answer books.
- 2) All questions of respective sections are compulsory.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of log tables / non-programmable calculator is allowed.

SECTION - I

Pollution Monitoring and Control

Q1) Attempt the following :

- Enlist the methods used for separation of particulate matter. a)
- Mention the commonly used recovery techniques for heavy metals. b)
- Describe the principle for working of electrostatic precipitators. c)
- What are the hazards of SO_2 ? d)
- Define : i) Particulate Matter e)
 - Industrial Effluent. ii)

Q2) Answer any two of the following :

- Describe the importance of control and removal of nitrogenous a) compounds.
- b) Explain the safety measures for worker analysing the particulate matter.
- Explain the procedure for the determination of lead and chromium. c)
- d) Write a note on photochemistry of air pollutants.
- Q3) Answer <u>any one</u> of following :
 - Explain the working of cyclon separator. a)
 - Outline the method for determination of urea nitrogen from wastewater. b)

[Total No. of Pages : 3

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[Max. Marks : 50

SEAT No. :

SECTION - II Analysis of Body Fluid

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Q4) Attempt the following.

- a) What is glucose tolerance test ? What are factors affecting it.
- b) Comment on function and deficiency of vitamin $B_1 B_2$ and B_6 .
- c) Give the principle estimation of ascorbic acid.
- d) What are anticoagulants ? Give its example.
- e) What is the composition of faeces ? How it is collected !

Q5) Answer <u>any two</u> of the following :

- a) Outline an analytical method for the estimation of serum xanthuric.
- b) Describe caraway's method for the determination of uric acid from urine.
- c) Write a note on radioimmuno assay of insulin.
- d) The readings obtained during analysis of urea clearence of two patient is tabulate below.Calculate the urea clearance for each patient and comment on results.

Patient No :	Blood Urea	Urinary Urea	Volume of Urine excreted
	Mg %	Mg %	/ 24 hrs
1.	80	1000	1000
2.	70	2200	1500

Q6) Answer <u>any one</u> of the following :

- a) Write a note on ELISA technique.
- b) Explain the photometric determination of sodium from blood serum.

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Corbon Nanostructures and Applications of Nanotechnology

- Q7) Attempt the following : [10]
 a) What are the major routs for entry of NP'S.
 b) Describe the applications of quantum dots.
 c) What is intercalation ?
 d) What do you mean by term field emission CNT'S ?
 e) What are the digital imaging devices.
- Q8) Answer <u>any two</u> of the following :
 - a) Write a note on DNA based Nanomaterials as biosensors.
 - b) Explain the terms :
 - i) Structure of C_{60} & it crystal.
 - ii) Superconductivity in C_{60} .
 - c) Write a note on photodynamic therapy in targeted drug administration.
 - d) Describe the nanoparticle toxicology with respecte to Number concentration, surface area and particle shape.
- Q9) Answer any one of the following :
 - a) Explain in brief the role of yeast in nanoparticle synthesis.
 - b) Explain the following :
 - i) Vibrational properties of carbon nanotubes.
 - ii) Electrochemical sensors.

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