

# DHANAMANJURI UNIVERSITY

JUNE – 2021

Name of Programme : M.Sc. Chemistry  
Semester : Fourth  
Paper Code : CHE-618  
Paper Title : Physical Methods in Chemistry-II  
Full Marks : 40

*The figures in the margin indicate full marks for the questions.*

*Answer all questions*

1. Write the basic principle of gas chromatography. What are the basic components of a gas chromatograph? Explain why the elution peaks in the gas liquid chromatography are usually distorted in shape. 10

Or

What are ion exchange resins? Give one example of each type of ion- exchange resins. What are the factors affecting the ion- exchange equilibria? 10

2. What is DTA? Write the theoretical basis of DTA. 10

Or

What are the differences between DTA and DSC? Discuss the factors affecting DSC curves. 10

3. Find out the half-wave potential of the reaction, Oxidant +ne  $\leftrightarrow$  Reductant. Give reason the occurrence of polarography maxima in polarography. 10

Or

Give two reasons for using a supporting electrolyte in voltammetry. Calculate the diffusion coefficient of the reaction  $M^{2+} + 2e \leftrightarrow M$  (Hg). Given  $C = 0.003 \text{ mol L}^{-1}$ , rate flow of Hg =  $2 \text{ mg s}^{-1}$ , drop time = 3s, diffusion current =  $0.00012 \mu\text{A}$ . 10

4. Either,
- a) What are single-focussing and double focussing mass spectrometers? Deduce the basic mathematical principle that shows the resolution of ions according to mass/charge values in a single-focussing mass spectrometer.
- b) Explain how the peak at  $m/z, 92$  in the mass spectrum of n-butylbenzene is formed by McLafferty rearrangement of the molecular ion. 10

Or

- c) With a schematic diagram describe the basic instrumentation of a double focussing mass spectrometer.
- d) Using  $\text{CH}_3\text{CH}_2\text{Cl}$  as the experimental compound, show how molecular ion ( $m/z 64$ ) and daughter ion ( $m/z 29$ ) are produced in mass spectrometry. 10

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# DHANAMANJURI UNIVERSITY

JUNE – 2021

Name of Programme : M.Sc. Chemistry  
Semester : Fourth  
Paper Code : CHE-623  
Paper Title : Inorganic Special III  
Full Marks : 40

*The figures in the margin indicate full marks for the questions.*

*Answer all questions*

1. What are metal olefin complexes? Give one method for the preparation of an important metal olefin complex. Discuss the bonding in these complexes. 10

Or

Discuss the factors which make phosphines and arsines more effective than amines in stabilising low oxidation status of transition metal. 10

2. Discuss the preparation and structure of the following organometallic compounds. 10

- Dicyclopentadienyl iron
- Dibenzene chromium
- Trichloro (ethylene) platinum II chloride
- Bis (cyclopentadienyl) mercury

Or

Discuss the structure, bonding and magnetic properties of octachlorodirhenate  $(Re_2Cl_8)^{2-}$  10

3. a) How do the IR spectra intensify the different modes of bonding of  $SO_4^{2-}$  in sulphato complexes. 5+5=10
- b) Write the empirical criteria required to determine the bonding type of NCS group in metal complexes. 5+5=10

Or

a) Discuss the carbon dioxide laser source in IR instrumentation and give the advantages. 6+4=10

b) Calculate the vibrational frequency and wavelength of the fundamental absorption peak due to  $DCl$  molecule. (At. Wt.  $D=2$ ,  $Cl=35.5$ ) Force constant =  $5 \times 10^2 N/m$ .  
Speed of light =  $3 \times 10^{10} cm/sec$ . 6+4=10

4. a) What is lanthanide contraction? How would you account for it? What are its important consequences? 6+4=10
- b) Why does lanthanum exhibit only +3 oxidation state whereas certain other elements of f-block show +2 and +4 oxidation state also. 6+4=10

Or

a) Give a brief notes on the analytical applications of the lanthanide complexes. 5+5=10

b) Why the magnetic properties of lanthanides are different from those of transition elements. Give reasons. 5+5=10

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# DHANAMANJURI UNIVERSITY

JUNE – 2021

Name of Programme : M.Sc. Chemistry  
Semester : Fourth  
Paper Code : CHE-633  
Paper Title : Organic Chemistry Special - III  
Full Marks : 40

*The figures in the margin indicate full marks for the questions.*

*Answer all questions*

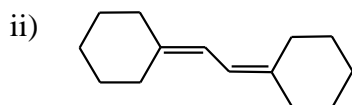
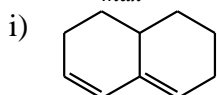
1. What is retrosynthetic analysis? Write the retrosynthetic analysis and show how the analysis can be used to synthesize Benzocaine. 10

Or

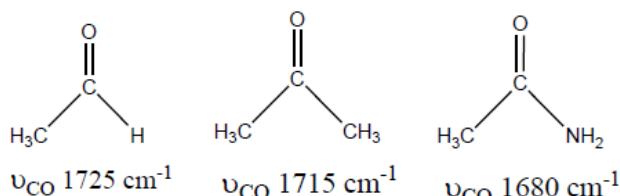
Explain with suitable examples, the concept of (i) functional group protection and (ii) order of events in organic synthesis.

2. Either,

- a) Calculate  $\lambda_{max}$  values of the following polyenes using Woodward-Hofmann rule

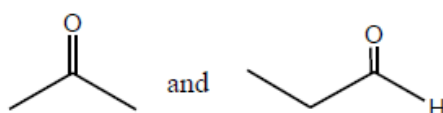


- b) The IR  $>C=O$  vibrational frequencies of the following functional groups are observed as follows. Explain the trends in observation. 5+5=10



Or

- c) How can you identify the following pair of compounds by  $^1\text{H}$  NMR spectroscopy?



- d) An organic compound with Molecular formula,  $\text{C}_8\text{H}_8\text{O}$  is found to show the spectroscopic characteristic:

UV ( $\lambda_{max}$ ) : 246 nm ( $\epsilon$ , 9800), 320 nm ( $\epsilon$ , 500)

IR ( $\text{cm}^{-1}$ ) : 3060, 1690, 1580

$^1\text{H}$  NMR ( $\delta\text{H}$ ): 8.2 (2H, m) ; 7.7 (3H, m) ; 2.5 (3H, s)

Mass ( $m/z$ ) : 120, 105, 77, 51 and 43

Deduce the structure of the compound. 3+7=10

3. What are antimalarials? Give example. Explain the retrosynthetic analysis and full synthesis of either Aspirin, or L-Dopa. 10
4. What are peptides? Describe the Primary, Secondary and Tertiary structures of proteins.

Or

What are nucleosides and nucleotides? Describe replication and transcription in protein biosynthesis.

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# DHANAMANJURI UNIVERSITY

JUNE – 2021

Name of Programme : M.Sc. Chemistry  
Semester : Fourth  
Paper Code : CHE-643  
Paper Title : Physical Chemistry Special - III  
Full Marks : 40

*The figures in the right-hand side margin indicate full marks for the questions.*

*Symbols used in the questions have their usual meanings*

1. Derive the equation of Entropy of an ideal monoatomic gas and explain the shortcoming of the classical thermodynamics over the equation. 6+4=10

Or

Derive the general expression of the equilibrium constant ( $K_p$ ) at constant pressure for the dissociation of a diatomic molecule in terms of the partition function and find  $K_p$  of Iodine molecule with the given values.

$$g_{0,I} = 4; g_{0,I_2} = 1; \Lambda_I = 3.20 \times 10^{-12}m; \Lambda_{I_2} = 2.26 \times 10^{-12}m$$

$$q_R = 2773; q_v = 1.58; \epsilon_D = 12,461cm^{-1} \quad 5+5=10$$

2. What do you mean by critical micelle concentration and aggregation number? On which factors does the CMC depend? 10

Or

How micelles are formed? Discuss various factors which affect the formation of micelles and their size and shape. 10

3. Derive the relevant expressions of the basic electrodic equation (or the linear  $i$  versus  $\eta$  law) at low and high field approximations. 10

Or

Is it possible to understand the feasibility of corrosion thermodynamically? If so describe in brief the thermodynamic formulation of corrosion. 10

4. Define Vanishing integral. Do the integrals

a)  $\int (d_{xy})(z)d_{x^2-y^2}d\tau$  and  $\int (d_{xy})(l_z)d_{x^2-y^2}d\tau$  vanish in a  $C_{4v}$  molecule?

b) Does the integral  $\int (d_{x^2})(x)d_{xy}d\tau$  vanish in a  $C_{2v}$  molecule? 1+3+3+3=10

Or

Write the rules or Theorem of Direct Product. Find whether the direct product with the characters i.e.,  $(E) = 8, \chi(C_2) = -2, \chi(\sigma_{xz}) = -6,$  and  $\chi(\sigma_{yz}) = 4$  contains  $A_1$  irreducible representation in the  $C_{2v}$  point group. 5+5=10

Character tables

$C_{2v}$	E	$C_2(z)$	$\sigma_v(xz)$	$\sigma'_v(yz)$		
$A_1$	1	1	1	1	Z	$x^2, y^2, z^2$
$A_2$	1	1	-1	-1	$R_z$	xy
$B_1$	1	-1	1	-1	$x, R_y$	xz
$B_2$	1	-1	-1	1	$y, R_x$	yz

$C_{4v}$	E	$2C_4$	$C_2$	$2\sigma_v$	$2\sigma_d$		
$A_1$	1	1	1	1	1	$T_x$	$(x^2 + y^2); z^2$
$A_2$	1	1	1	-1	-1	$R_z$	
$B_1$	1	-1	1	1	-1		$(x^2 - y^2)$
$B_2$	1	-1	1	-1	1		(xy)
E	2	0	-2	0	0	$(T_x, T_y); (R_x, R_y)$	(xz, yz)

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# DHANAMANJURI UNIVERSITY

JUNE – 2021

Name of Programme : M.Sc. Chemistry  
Semester : Fourth  
Paper Code : CHE-644  
Paper Title : Physical Chemistry Special - IV  
Full Marks : 40

*The figures in the margin indicate full marks for the questions.*

*Answer all questions*

1. State Moor's law. Describe Top-down and Bottom-up approach for synthesis of nanomaterials. What are the advantages and disadvantages of these two methods? 10

Or

Describe the instrumentation and working of atomic layer deposition technique of synthesis of nanoparticles.

2. What are population inversions? Describe the construction and working of dye- laser. 10

Or

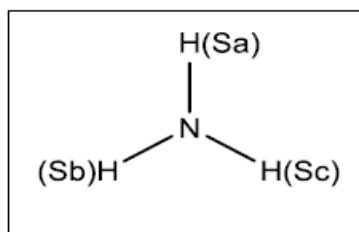
What is Raman effect? Discuss the quantum theory of Raman spectrum.

3. What are phosphoresces? Describe the kinetics of photochemical process. 10

Or

What is internal conversion? Giving a suitable diagram explain triplet-triplet energy transfer.

4. Construct the symmetry adapted linear combination (SALC) of atomic orbitals of  $\text{NH}_3$  with the help of projection operator taking the 1s orbitals of Hydrogen atoms as the basis set. 10



Or

Using group theory identify the number of vibrational modes of  $\text{H}_2\text{O}$  are IR active.

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