2016-17
M.Sc. (Polymer Science & Technology)
II SEMESTER
PHYSICAL CHEMISTRY-II
AC-2611

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions.

Q.No. Questions M.M.

1(a) What do you understand by degree of crystallinity? Name the various methods used for its determination and discuss one of them in detail.

1(b) Write notes on any TWO of the following:
(a) Tertiary structure of polymers
(b) Morphology of crystalline polymers
(c) Configuration with suitable examples

2(a) Explain the kinetic theory of glass transition temperature.

2(b) Giving suitable examples explain the role of ‘chain flexibility’ or ‘inter-chain attractive forces’ on the glass transition temperature.

2(c) Calculate $T_g$ of butadiene-styrene copolymer containing 20 vol% styrene. (Given $T_g$ of polybutadiene and polystyrene are – 80 and 100 °C, respectively)

OR

2(c') List the factors affecting the crystalline melting point of polymers and discuss one of them in detail.

3(a) Derive the expression for Entropy of mixing and Free energy of mixing using Flory-Huggins model of a polymer solution.

OR

3(a') A polyethylene molecule has a degree of polymerization of 2000. Calculate (a) the total length of the chain and (b) the contour length of the planar zigzag if the bond length and valence angle are 1.54 Å and 110°, respectively.

cont'd...
3(b) What do you mean by Newton’s Law of Viscosity? With suitable examples, explain Newtonian and Non-Newtonian Fluids.

3(c) Write a note on the factors on which the thermodynamic behavior of the dilute polymer solution depends.

4(a) Write short notes on any three of the followings:
(i) Classical Limit
(ii) de Broglie thermal wavelength
(iii) Characteristics rotational temperature
(iv) Symmetry Number

4(b) Write the mathematical expression of Entropy and Internal energy in terms of their thermodynamic partition functions.

4(c) The rotational constant for HCl, determined from microwave spectroscopy, is 10.60 cm⁻¹. Calculate the rotational partition function of HCl at 100K.
M.Sc. II Semester Examination  
(Polymer Science & Technology)  
Organic Chemistry II  
(AC-2612)  
Credits: 04

Maximum Marks: 60  
Duration: Two hours

Answer all the questions.  
Assume suitable data if missing.  
Notations used have their usual meaning.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Questions</th>
<th>M.M.</th>
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<tbody>
<tr>
<td>Q.1.(a)</td>
<td>Clarify the terms heterotopic, homotopic, enantiotopic and diastereotopic pairs of hydrogens with the help of suitable examples.</td>
<td>[5.0]</td>
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<td>(b) Describe the CIP rules of nomenclature of stereoisomers with the help of suitable examples.</td>
<td>[4.0]</td>
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<td></td>
<td>(c) Discuss optical activity in the absence of a chiral centre in biphenyls.</td>
<td>[6.0]</td>
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<td><strong>OR</strong></td>
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<td>(e') Explain the followings:</td>
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<tr>
<td></td>
<td>i) Neighbouring group participation</td>
<td></td>
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<td></td>
<td>ii) Conformations of cyclohexane</td>
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<td>Q.2.</td>
<td>Discuss the preparation, properties and uses of any two of the following reagents:</td>
<td>[15]</td>
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<tr>
<td></td>
<td>i) Dicyclocexylcarbodiimide (DCC)</td>
<td></td>
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<td></td>
<td>ii) 2,3-Dichloro-5,6-dicyano-1,4-benzoquinone (DDQ)</td>
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<td></td>
<td>iii) Selenium dioxide</td>
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<td>Q.3.(a)</td>
<td>What are electrocyclic reactions? Discuss their stereochemistry.</td>
<td>[5.0]</td>
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<td>(b) Describe any two of the followings with suitable examples:</td>
<td>[10.0]</td>
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<td></td>
<td>i) Group transfer reactions</td>
<td></td>
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<td></td>
<td>ii) Dess-Martin oxidation reactions</td>
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</tbody>
</table>

contd...
iii) Cope rearrangement of sigmatropic shift

Q.4.(a) Write down the reaction conditions, mechanism and name of the rearrangements of any two of the followings: [6.0]

\[ \text{i)} \quad \begin{array}{c}
\text{OH} \\
\text{OH}
\end{array} \quad \rightarrow \quad \begin{array}{c}
\text{OH}
\end{array}
\]

\[ \text{ii)} \quad \begin{array}{c}
\text{OH}
\end{array} \quad \rightarrow \quad \begin{array}{c}
\text{OH}
\end{array}
\]

\[ \text{iii)} \quad \begin{array}{c}
\text{CH}_3 \\
\text{Br}
\end{array} \quad \rightarrow \quad \begin{array}{c}
\text{Br}
\end{array}
\]

(b) Discuss the mechanism of any two of the following rearrangement reactions with suitable examples: [9.0]

i) Wolf rearrangement
ii) Hoffmann rearrangement
iii) Baeyer-Villiger oxidation
2016-17  
M.Sc. (II SEMESTER) EXAMINATION  
POLYMER SCIENCE & TECHNOLOGY  
POLYMER CHEMISTRY  
AC-2613  

Maximum Marks: 60  
Credits: 04  
Duration: Two Hours  

Answer all the questions.  
Assume suitable data if missing.  
Notations used have their usual meaning.

Q.No.  

1(a) Explain the reaction conditions for the synthesis of Low Density Polyethylene and High Density Polyethylene.  

OR

1(a) Explain industrial synthesis of polyester. Why methyl esters of dicarboxylic acids are preferred over dicarboxylic acids? Give some characteristics of polyesters.

1(b) Write short notes on any two of the followings:

(i) Tacticity in polymers
(ii) Copolymers
(iii) Difference between Thermoplastics and Thermosets  

[5×2]

2(a). Explain chain growth polymerization using free radicals and anions as catalyst.  
2(b). What is coordination polymerization? Give names and uses of some coordination catalyst.  

3(a) Explain the method of determination of weight average molecular weight of polymers by light scattering.  
3(b) Write short notes on any two of the followings:

(i) Molecular weight distribution and its significance
(ii) Determination of molecular weight by gel permeation chromatography method
(iii) Determination of molecular weight by osmotic pressure method

[5×2]

4(a) Explain the followings:

(i) Degradation of polymers
(ii) Antioxidants & Stabilizers

4(b) Explain the mechanism of oxidative degradation of saturated polymers.  

[5]
2016-17  
M.Sc. (Polymer Science & Technology)  
II Semester Examination  
General Spectroscopy  
(AC-2614)  
Maximum Marks: 60  
Credits: 04  
Duration: Two Hours  

Answer all the questions

<table>
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<th>Q. No.</th>
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<tbody>
<tr>
<td>1.(a)</td>
<td>Calculate the $\lambda_{\text{max}}$ for any two of the following compounds.</td>
<td>5</td>
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<tr>
<td></td>
<td><img src="image" alt="Molecules" /></td>
<td></td>
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<tr>
<td>1.(b)</td>
<td>Explain positive and negative Cotton effect.</td>
<td>5</td>
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<tr>
<td>1.(c)</td>
<td>A mixture of natural cholesterol and its enantiomer has a specific rotation (at 20°C) of -27°. Calculate the % enantiomeric excess of this mixture. What percentage of the mixture is natural cholesterol?</td>
<td>5</td>
</tr>
<tr>
<td>2.(a)</td>
<td>If the wave number of the $J = 3 \leftarrow 2$ rotational transition of $^1\text{H}^{35}\text{Cl}$ considered as a rigid rotor is 60.12 cm$^{-1}$, what is (a) the moment of inertia of the molecule and (b) the bond length?</td>
<td>5</td>
</tr>
</tbody>
</table>
| 2.(b) | Answer any two of the followings:  
(a) Stokes and Anti-Stokes shift  
(b) Zero point vibrational energy  
(c) Stretching and bending vibrations | $3 \times 2$ |
| 2.(c) | Which of the following molecule exhibit rotational and/or vibrational spectra? | 4 
|       | $\text{H}_2$, $\text{HF}$, $\text{CO}_2$, $\text{OCS}$, $\text{I}_2$, $\text{NH}_3$, $\text{CH}_4$, $\text{C}_6\text{H}_6$ |
| 3.(a) | Calculate the chemical shift in ppm ($\delta$) for a proton that has resonance at 126 Hz downfield from TMS on spectrometer that operates at 60 MHz. | 5 |
| OR | | |
| 3.(a') | A $^1\text{H}$ NMR spectrometer operates with a radiation of frequency 300MHz. At what magnetic field a free proton will show resonance? | contd... 2 |
3.(b) An organic compound with molecular formula, $C_3H_7Cl_5$ gave the following pmr data: a triplet (4.52 $\delta$) 1H and a doublet (6.07 $\delta$) 2H. Assign the structural formula of the compound consistent with its pmr data given above.

3.(c) Describe with examples the various factors which affect the magnitude of the chemical shift.

4.(a) What is the difference between Auger electrons and X-ray electrons?

4.(b) Draw the Fortrat diagram for the rotational fine structure of a vibrational electronic spectrum.

4.(b') Write the electronic configuration and give the ground state term symbol for:

(a) $Ni^{2+}$ and (b) $S^{2-}$.

4.(c) Describe the application of the Franck-Condon Principle and give its wave mechanical description.

4.(d) Write short notes on any two the followings:

(i) Gerade and Ungeraade
(ii) Transition dipole moment
(iii) Born-Oppenheimer approximation
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.  Question  M.M.
1  Answer any TWO of the followings:
(a)  What are colloids? Write the features and applications of colloids.
(b)  Discuss the mechanism of colloid formation and explain the structure and size of colloids.
(c)  Explain the structure of electrical double layer and its role on the stability and coagulation of colloids.

2(a)  Define critical micelle concentration. Discuss various factors which influence the CMC values in aqueous medium.

2(b)  Explain ANY THREE of the followings:
(i)  Emulsion
(ii)  Phase Inversion Temperature (PIT)
(iii)  HLB Method
(iv)  Normal micelles

3  Discuss any THREE of the followings with suitable examples:
(a)  Polymer-Surfactant Interactions
(b)  Kraft Temperature
(c)  Surfactant Solubility
(d)  Cloud Point

4(a)  Distinguish between chemical and physical hydrogels.

4(b)  Write short notes on any THREE of the followings:
(a)  Polymer grafting
(b)  Cross linking of elastomers
(c)  Application of hydrogels
(d)  Classification and properties of gels

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2016-2017  
M.Sc. (Polymer Science & Technology)  
II-Semester Examination  
Green Chemistry (open elective)  
AC-2616

Maximum Marks: 60  
Credit: 04  
Duration: Two Hours

Answer all the questions.

Q.No.  
Questions  
M.M.

1.(a) Calculate the % atom economy of any two of the following reactions: (4x2)

i) 

\[
\begin{align*}
4 \text{PhCH}_2\text{CO}_2\text{H} + \text{NaBH}_4 + 4\text{H}_2\text{O} & \rightarrow 4 \text{PhCH}_2\text{OH} + \text{H}_3\text{BO}_3 + \text{NaOH} \\
3\text{PhCH(OH)CH}_3 + 2\text{Cr}_2\text{O}_7 + 3\text{H}_2\text{SO}_4 & \rightarrow 3\text{PhCOCH}_3 + \text{Cr}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O} \\
\text{PhCH(OH)CH}_3 + 1/2\text{O}_2 + \text{catalyst} & \rightarrow 3\text{PhCOCH}_3 + 6\text{H}_2\text{O}
\end{align*}
\]

1.(b) Explain the three dimensions of sustainability. (7)

2.(a) Show that when a diatomic gas adsorbs as atoms on the surface of a solid, the Langmuir adsorption isotherm becomes (8)

\[
\theta = \frac{(Kp)^\frac{1}{2}}{[1 + (Kp)^\frac{1}{2}]}
\]

where the symbols have their usual meanings.

OR

2.(a') If \(v\) is the volume of a gas (corrected to STP) adsorbed on the surface of a solid, then show that a plot of \(p/v\) versus \(p\), where \(p\) is the gas pressure in the Langmuir adsorption isotherm, gives a straight line. Also show that for small surface coverage, a plot of \(\ln(\theta/p)\) versus \(\theta\) gives a straight line. (8)

contd...
2.(b) A sample of charcoal weighing 6.00g was brought in contact with a gas contained in a vessel of one litre capacity at 27 °C. The pressure of the gas was found to fall from 700 to 400 torr. Calculate the volume of the gas (reduced to STP) that is adsorbed per gram of the adsorbent under the conditions of the experiment. The density of the charcoal sample was 1.5gcm⁻³.

3.(a) What are supercritical fluids? Write down the advantages and disadvantages of using supercritical CO₂ as a solvent. Discuss with examples the following reactions carried out in supercritical CO₂:

i. Palladium-catalyzed C-C bond forming reactions

ii. Hydrogenation reactions

OR

3.(a)' What are ionic liquids? Write down some examples of ionic liquids. What are the important features of ionic liquids that make them attractive reaction solvents? Discuss the synthesis of pravadoline in ionic liquid.

3.(b) Write a brief note on supercritical water oxidation (SCWO) for remediation and waste treatment applications.

4.(a) Give the classification of enzymes on the basis of reactions they catalyse.

4.(b) Discuss the advantages and disadvantages of biocatalysis in comparison with chemical catalysis.

4.(c) Give a brief account on any one of the followings:

i. Zeolites for solid acid catalysis

ii. Biocatalysis for the synthesis of catechol