Q.No. | Question | CO | M.M.
--- | --- | --- | ---
1(a) | Obtain the expressions for ANY TWO of the followings: 
(i) Momentum Operator 
(ii) Hamiltonian Operator 
(iii) Angular Momentum Operator | (CO1) | [06]
1(b) | Write note on ANY ONE of the followings: 
(i) Postulates of Quantum mechanics 
(ii) Quantum Mechanical Tunelling | (CO1) | [06]
1(c) | Calculate the energy of an electron in first, second, third and fourth energy levels in one dimensional box of length 15 Å. (Given that, \( h = 6.626 \times 10^{-34} \) Js, mass of electron = \( 9.1 \times 10^{-31} \) kg). | (CO1) | [06]
2(a) | Discuss the ‘second order perturbation method’ for finding the approximate solution of the Schrödinger equation for the wave function and energy of a particle. | (CO2) | [12]

**OR**

2(a') | Discuss the ‘method of variation’ for finding the approximate solution of Schrödinger equation. | (CO2) |
2(b) | Explain the notations used in ‘term symbol’. Write down the terms arising for \( 3s^13p^1 \) electronic configuration. | (CO2) | [06]
3(a) | What are bonding and antibonding orbitals? Illustrate with the help of diagrams, the combinations of (i) \( s \) and \( p_x \) orbitals and (ii) two \( p \) orbitals. | (CO3) | [06]
OR

3(a') Give the Hückel secular equation for ethylene and express the energy of bonding and anti-bonding molecular orbitals with the help of Hückel molecular orbital diagram.

3(b) Write down the valence bond wave function for the hydrofluoric acid molecule in the following cases:
   (i) When molecule is purely covalent?
   (ii) When molecule is purely ionic?
   (iii) When molecule is 70% covalent and 30% ionic?

3(c) Describe ANY TWO of the followings:
   (i) Hamiltonian operator for H$_2^+$
   (ii) Overlap integral (S)
   (iii) Gerade and ungerade symmetry

4(a) Distinguish between C$_{xy}$ and D$_{ach}$ point groups.

4(b) What do you understand by equivalent configuration? How will you differentiate it from the identical configuration?

OR

3(b') How the infrared activity of a vibrational mode is determined?

4(c) Consider the given chemical species and answer the followings:
    SF$_4$, BH$_3$, PtCl$_4^{2-}$ and CH$_4$
    (i) What is the highest-order rotational axis present in each of them?
    (ii) Which of them will have center of inversion?
    (iii) Which of them will have dihedral plane?
    (iv) Which of them will be chiral?
    (v) Assign the point group to each one of them.
2018-19
M.Sc. POLYMERS SCIENCE AND TECHNOLOGY (Ist SEMESTER) EXAMINATION
ORGANIC CHEMISTRY-I
AC-1512

Maximum Marks: 70  
Credits: 04  
Duration: 2Hrs 30Min.

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

Q.No.  Question  CO  M.M.  
1(a)  Define aromaticity. Give the structural requirements to be met by an organic compound or ion to show aromaticity. Discuss the aromaticity of cyclohepta-1,3,5-triene, cyclohepta-1,3,5-trienyl cation and cyclohepta-1,3,5-trienyl anion in the light of the structural requirements for aromaticity.  CO1  8

1(b)  Why halogens are ortho- and para-directing but deactivating to benzene ring towards electrophilic substitution reaction? Give the major products of **ANY TWO** of the following chemical reactions.

i  \( \text{\( \text{\textcircled{O}} + \text{CH}_2\text{-CH(\text{CH}_3)}\text{-CH}_2\text{-Cl} + \text{AlCl}_3 \rightarrow \)} \)

ii  \( \text{\( \text{\textcircled{O}}\text{-CHO} + \text{Br}_2/\text{FeBr}_3 \rightarrow \)} \)

iii  \( \text{\( \text{\textcircled{O}}\text{-NO}_2 + \text{HNO}_3/\text{H}_2\text{SO}_4 \rightarrow \)} \)

1(c)  Describe the mechanism of **ANY ONE** of the following chemical reactions.  CO1  5

i  \( \text{\( \text{\textcircled{O}}\text{-NH-CO-CH}_3 + \text{HNO}_3/\text{H}_2\text{SO}_4 \rightarrow \)} \)

ii  \( \text{\( \text{CH}_3\text{-\textcircled{O}}\text{-Cl} + \text{NaNH}_2/\text{NH}_3 \rightarrow \)} \)

2  Discuss **ANY THREE** of the following topics using suitable examples.  CO2  18

i  Hammond postulate
ii  Nucleophilicity and basicity
iii  Stability of carbocations
iv  Leaving group effect and steric effect in substitution reactions

3(a)  Write the reaction mechanisms of **ANY TWO** of the following chemical reactions.  CO3  9

(i)  Knoevenegal condensation
(ii) Dieckmann condensation
(iii) Stobbe condensation

Contd... 2
3(b) Complete the following chemical reactions.

(i) \[ \text{CH}_3\text{CHO} + \text{HCN} \rightarrow \] 
(ii) \[ \text{CH}_3\text{COCH}_3 + \text{CH}_3\text{MgCl} + \text{H}_2\text{O} \rightarrow \] 
(iii) \[ \text{CH}_3\text{COCH}_3 + \text{C}_6\text{H}_5\text{COOH} \rightarrow \] 
(iv) \[ \text{CH}_3\text{COCH}_3 + \text{NH}_2\text{OH} \rightarrow \]

4(a) Attempt **ANY TWO** of the following topics.

(i) What are allenes? Describe the preparation of allenes.
(ii) Write the chemical reactions involved in the formation of an alcohol from an alkene by oxymercuration-demercuration process.
(iii) Discuss the similarities and differences between Suzuki reaction and Heck reaction.

4(b) Q. Predict the products of **ANY THREE** of the following chemical reactions.

(i) \[ \text{H}_2\text{C} \quad 1) \text{Hg(OAc)}_2, \text{H}_2\text{O} \quad 2) \text{NaBH}_4 \rightarrow ? \]

(ii) \[ \quad + \quad \text{COOH} \rightarrow \text{CH}_2\text{Cl}_2 \rightarrow ? \]

(iii) \[ \quad + \text{H}_2 \quad \text{Pd/C} \rightarrow ? \]

(iv) \[ \quad 1) \text{BH}_3, \text{THF} \quad 2) \text{H}_2\text{O}_2, \text{NaOH} \rightarrow ? \]
Maximum Marks: 70  
Credits: 04  
Duration: 2Hrs 30Min.

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

Q.No.  

1(a)  What is Wade’s rule? Give its important guidelines. Discuss the classification of boranes and carboranes on the basis of their skeletal structures using suitable examples.  

OR

1(a’) Write notes on the followings:  
  a) Silicones  
  b) Phosphazenes  
  c) Sulphur nitrogen compounds

1(b) Write the structure and hybridization of any four of the following compounds:  
  a) ICl₄⁻  
  b) IF₅  
  c) XeOF₂  
  d) XeO₃  
  e) XeF₆  
  f) XeO₂F₄

1(c) What are silicates? Give an account of different types of silicates with examples.

2(a) Explain Molecular Orbital theory and draw molecular orbital diagram of d⁴ octahedral complex and its possible electronic transition.  

OR

2(a’) Define isomerism and its types with suitable examples in coordination compounds. What are the conditions for octahedral complex with monodentate groups to be chiral?

2(b) Write a detailed account on Jahn-Teller Distortion.

2(e) What are Orgel diagrams? Draw the Orgel diagram for [Ni(NH₃)₆]²⁺ and explain the possible transitions.

3(a) Write the synthesis and properties of metal carbonyls and metal nitrosyls.
3(a') Write notes on any two of the followings:
   a) Synergic interaction
   b) Pi-acceptor ligands
   c) Fluxionality

3(b) Sketch the cyclic mechanism of any one of the followings:
   a) Conversion of methanol to acetic acid by Monsanto acetic acid process
   b) Catalytic addition of molecular oxygen to an alkene by Wacker process

3(c) How bond order of CO and π-back bonding in metal carbynls is determined by IR absorption spectroscopy. Explain it using suitable examples. Write the reasons for the following trend of ν_{CO} values of the given metal carbynls:

<table>
<thead>
<tr>
<th>Metal carbynls:</th>
<th>[V(CO)₆]⁻</th>
<th>[Cr(CO)₆]⁻</th>
<th>[Mn(CO)₆]⁰</th>
</tr>
</thead>
<tbody>
<tr>
<td>ν_{CO}:</td>
<td>1860 cm⁻¹</td>
<td>1980 cm⁻¹</td>
<td>2090 cm⁻¹</td>
</tr>
</tbody>
</table>

4(a) Discuss the role of metal ions in biology. Explain the mechanism of sodium/potassium ions transport across the cell membrane.

4(b) With the help of suitable diagrams, explain the oxygen transport by hemerythrin and hemocyanin.

4(c) Write short notes on any two of the followings:
   a) Carboxypeptidase
   b) Vitamin B₁₂
   c) Ferredoxins
2018-19
M.Sc. POLYMER SCIENCE AND TECHNOLOGY (1st SEMESTER) EXAMINATION
ANALYTICAL CHEMISTRY
AC-1514

Maximum Marks: 70  Credits: 04  Duration: 2Hrs 30Min.

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

Q.No.  Question  CO  M.M.

1(a)  Riboflavin (vitamin B2) is determined in a cereal sample by measuring its
fluorescence intensity in 5% acetic acid solution. A calibration curve was
prepared by measuring the fluorescence intensities of a series of standards
of increasing concentrations. The following data were obtained. Use the
method of least squares to obtain the best straight line for the calibration
curve and to calculate the concentration of riboflavin in the sample solution.
The sample fluorescence intensity was 10.4.

<table>
<thead>
<tr>
<th>Riboflavin (µg/mL), x_i</th>
<th>0.000</th>
<th>0.100</th>
<th>0.300</th>
<th>0.400</th>
<th>0.800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescence intensity, y_i</td>
<td>0.0</td>
<td>5.8</td>
<td>17.2</td>
<td>22.3</td>
<td>43.3</td>
</tr>
</tbody>
</table>

OR

1(a')  An agricultural research organization tested a particular chemical fertilizer to
try to find out whether an increase in the amount of fertilizer used would
lead to a corresponding increase in the food supply. Determine the
correlation coefficient for the data given below:

<table>
<thead>
<tr>
<th>Fertilizer, x_i</th>
<th>2</th>
<th>1</th>
<th>3</th>
<th>2</th>
<th>4</th>
<th>5</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food supply, y_i</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

1(b)  What is confidence interval? Discuss the factors which affect confidence
interval.

1(c)  You are developing a new colorimetric procedure for determining the
glucose content of blood serum. You have chosen the standard Folin-Wu
procedure to compare your results. From the following two sets of replicate
analysis on the same sample, determine whether the variance of your method
differs significantly from that of the standard method.

contd...
(Given: tabulated F value for v1 = 6 and v2 = 5 is 4.95)

2(a) Classify the chromatographic techniques on the basis of mechanism of separation. Explain the size exclusion chromatography. (CO2) [5]

2(b) Explain the 'selectivity coefficient' and 'separation factor'. (CO2) [6]

2(c) What are ion exchange resins? Giving suitable examples, discuss the different types of ion-exchange resins. (CO2) [6]

2(c') What do you understand by regeneration of ion exchangers? Discuss the preconcentration of metals by ion exchange chromatography. (CO2)

3 Write notes on any THREE of the followings:
   (i) Factors affecting efficiency of separation in column chromatography
   (ii) Theoretical plates
   (iii) van Deemter theory
   (iv) Flame ionization detector (CO3) [3×6]

4(a) A scrap of paper taken from the Dead Sea Scrolls was found to have a $^{13}$C/$^{12}$C ratio of 0.24 times that found in plants living today. Estimate the age of the scroll. (The half-life of carbon-14 is known to be 5720 years). (CO4) [5]

4(b) Explain the principle and working of neutron activation analysis (NAA). What are the advantages and disadvantages of NAA? (CO4) [6]

4(c) Calculate the iodine number of linoleic acid (C_{17}H_{31}COOH). (CO4) [6]
2018-19
M.Sc. POLYMER SCIENCE AND TECHNOLOGY (1st SEMESTER) EXAMINATION INSTRUMENTAL METHODS OF ANALYSIS AC-1515

Maximum Marks: 70 Credits: 04 Duration: 2Hrs 30Min.

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

Q.No. Question CO M.M.
1(a) Explain the working of detectors in atomic absorption spectroscopy using labelled diagram. (CO1) 05
1(b) Define the sensitivity of atomic absorption spectrophotometer. Silver exhibit an atomic absorption sensitivity of 0.050 ppm under the given set of conditions. Calculate the absorption for a 1.00 ppm solution? (CO1) 05
1(c) Write principle and working of any two of the followings:
   (i) Atomic absorption spectroscopy (AAS)
   (ii) Atomic emission spectroscopy (AES)
   (iii) Energy dispersive x-ray (EDX) spectroscopy
   (CO1) 4x2
2(a) What is Bragg's Law of x-ray diffraction? Gives its importance. Calculate the Bragg's angle of x-rays with wavelength 1.54 Å that are reflected from the planes of a cubic crystal for the second order of reflection with spacing between the planes is 4.24 Å. (CO2) 09
2(b) Write notes on any two of the followings:
   (i) Crystal systems and Bravais lattices
   (ii) Applications of Laue method
   (iii) Debye-Scherrer method of x-ray structural analysis of crystals
   (CO2) 4x2
3(a) Give a detailed account of the techniques and applications of thermometric (CO3) 09

Contd...
3(a') Draw a schematic diagram of scanning electron microscope. Explain its working principle and applications. (CO3)

3(b) Explain the basic principle and applications of the following:
   (i) Differential thermal analysis (CO3) 09
   (ii) Thermogravimetric analysis

4(a) Give a schematic diagram of polarography apparatus. Discuss the advantages and disadvantages of dropping mercury electrode (DME). (CO4) 06

4(a') Write the principle of coulometry. Calculate the atomic weight of a trivalent metal, if 1.071 g of metal get deposited at cathode when a current of 1.5 A is passed for 30 minutes through a solution of the metal salt. (CO4) 06

4(b) In experiment 1, a cyclic voltammogram was obtained from a 0.167 mM solution of Pb\(^{2+}\) at a scan rate of 2.1 V/s. In experiment 2, a second cyclic voltammogram is to be obtained from a 4.38 mM solution of Cd\(^{2+}\). What must the scan rate be in experiment 2 to record the same peak current in both experiments if the diffusion coefficient of Cd\(^{2+}\) and Pb\(^{2+}\) are 0.7 x 10\(^{-5}\) cm\(^2\)s\(^{-1}\) and 0.90 x 10\(^{-5}\) cm\(^2\)s\(^{-1}\) respectively? (CO4)

4(c) Explain cyclic voltammetry and discuss its voltammogram. 05
2018-19
M.Sc. POLYMER SCIENCE AND TECHNOLOGY
(1ST SEMESTER) EXAMINATION
Corrosion and Corrosion Control
AC-1516

Maximum Marks: 70  Credits: 04  Duration: 2Hrs 30Min.

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

Q.No.  Questions  CO  M.M.
1(a)  State and explain Kohlrausch' law. Give its significance and applications.  (CO1)  07
1(b)  Describe Debye-Hückel theory of strong electrolytes.  (CO1)  04

OR

1'(b)  Calculate the pH of a buffer solution prepared by mixing 100 ml of 0.01M acetic acid and 100 ml of 0.1M sodium acetate solution. K_a of acetic acid is 4.8x10^-5.  (CO1)

1(c)  Explain any two of the followings:
(i) Electrochemical cell  (ii) Nerst equation  (iii) Electrode potential

2  List different laboratory corrosion measurement methods. Discuss the non electrochemical laboratory corrosion measurement methods.  (CO2)  18

OR

2'(a)  Define electrochemical series and discuss its importance. How is it different from galvanic series?  (CO2)  10

2'(b)  Define electrochemical corrosion. What are the necessary conditions for electrochemical corrosion to occur? Give the mechanism of corrosion of iron in HCl solution.

3  Discuss any three of the followings:
(i) Pitting corrosion  (ii) Galvanic corrosion  (iii) Stress corrosion cracking  (iv) Erosion corrosion

4(a)  Describe the various designing principles to minimize corrosion.  (CO4)  05
4(b)  Write a note on the toxicity of corrosion inhibitors.  (CO4)  06
4(c)  Differentiate between anodic and cathodic metallic coatings.

OR

4'(c)  Discuss the cathodic protection by impressed current method.  (CO4)