PH 581.4 Reg. No. : | | | | | | |

St Aloysius College (Autonomous)

Mangaluru

Semester IV – P.G. Examination – M.Sc. Chemistry

April- 2019

ORGANIC SYNTHETIC METHODS

Time: 3 Hours **Max. Marks: 70**

PART - A

1. **Answer any FIVE sub divisions of the following:** **(5x2=10)**

a) Explain the selectivity or lack of it during catalytic hydrogenation reaction using metal and hydrogen.

b) Write mechanism of Birch reduction reaction.

c) How is peracids prepared? Compare the reactivity of substituted peracids for the epoxidation of alkenes.

d) Write the reagents used for allylic and benzylic halogenations. Explain their synthetic importance.

e) Describe the synthetic application of Robinson annulation reaction.

f) Explain the role of catalyst during Friedel Crafts reaction.

g) Write the importance of functional group interconversion in organic synthesis. Justify your answer by taking suitable example.

h) What is the criteria used to choose a protecting group from multiple options?

PART – B

Answer any FIVE of the following choosing at least one full question from each unit: **(5x12=60)**

UNIT – I

2.a) i) Differentiate the reduction reaction of alkene and carbonyl compounds.
ii) Write the synthetic applications of $LiAlH_4$ and $NaBH_4$. Comment on their differential reactivity. **(4)**

b) i) Write the mechanism of Birch reduction.
ii) Write a note on Wolf-Kishner reduction reaction and give its mechanism. **(4)**

c) Discuss the stereochemistry of reduction with $LiAlH_4$. **(4)**

3.a) Describe the reduction of nitro compounds by the following: $Pd\text{-}C/H_2$ and $LiAlH_4$. **(4)**

b) How is diimide prepared? Write their synthetic applications highlighting and stereochemistry and mechanism. **(4)**

c) Describe the mechanism of homogeneous catalytic hydrogenation using Ru-catlyst. **(4)**

UNIT – II

4.a) Describe the application of chromium based oxidation reactions in organic synthesis. How is selectivity improved with modified chromium reagents? **(4)**

Contd...2

b) How is osmium tetroxide useful as an oxidant? Write mechanism of oxidation reaction. What are the limitations of this reagent? (4)

c) Write the mechanism of addition of bromine to symmetrical and unsymmetrical alkenes. Comment on the major products formed. (4)

5.a) Describe the applications of manganese based oxidants used in organic synthesis. Explain the selectivity of such reagents using different substrates. (4)

b) Write the mechanism of ozonolysis of an alkene. Write the product of ozonolysis of 3-methyl – 2-pentene and cyclohexene. (4)

c) Write the synthetic application of t-butyl hydroperoxide. Explain how it is used in enantioselective epoxidation reactions. (4)

UNIT – III

6.a) Explain the factors affecting the rate of Diels-Alder reaction. Write two applications of Diels Alder reactions. (4)

b) Discuss the strategy employed for the synthesis of 7-methoxy tetralone. (4)

c) Explain the synthetic scheme for penicillin – V. (4)

7.a) i) Differentiate chemoselectivity from stereoselectivity using an example.

ii) Explain Thorpe condensation reaction. (4)

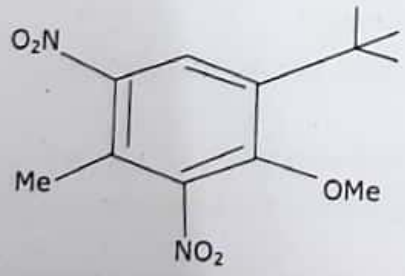
b) Provide the synthetic scheme for cubane. (4)

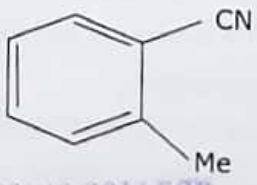
c) Illustrate the following statement by selecting two examples and also suggest mechanism for one of the reaction.

Statement-Carbon-carbon bond reactions are useful synthetically. (4)

UNIT - IV

8.a) Suggest retrosynthetic schemes for the following:





(4)

b) i) What is 1,3-diX relationship? Explain with an example.

ii) Give the retrosynthetic strategy for benzocaine. (4)

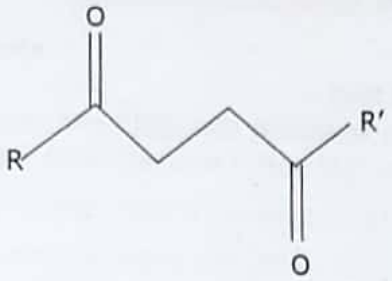
c) i) Explain the terms synthon and synthetic equivalents using suitable example.

ii) Provide the retrosynthetic scheme for phenacetin. (4)

9.a) i) Suggest a reagent for the protection of carbonyl compounds. Write the protection and deprotection reactions.

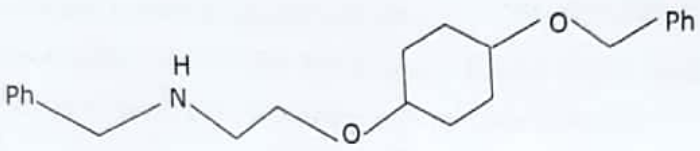
Contd...3

ii) Suggest suitable retrosynthetic strategy for following 1,4-difunctional compound.



(4)

b) Predict all the possible disconnections and suggest a synthetic scheme for the following molecule. Describe the rationale of your chosen synthetic method.



(4)

c) Provide the retrosynthetic analysis of 4-hydroxy-4-methylpentanone. (4)

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Semester IV – P.G. Examination – M.Sc. Chemistry
April- 2019
RADIATION AND PHOTOCHEMISTRY

Time: 3 Hours

Max. Marks: 70

PART - A

1. **Answer any FIVE sub divisions of the following:** (5x2=10)

a) What is magic number? How is it related to nuclear stability?

b) A freshly cut piece of wood gives 16100 counts of β ray emission/min/kg and an old wooden bowl gives 13200 counts/min/kg. Calculate the age of the wooden bowl. The half life period of ^{14}C is 5568 yrs.

c) Give the principle of Szilard-Chalmer process.

d) How is tracer ^{32}P used in agriculture?

e) State the laws of photochemistry.

f) How does laser emission occur?

g) Give reason: why benzophenone is a good triplet sensitizer?

h) What is exciplex? Illustrate with suitable example.

PART – B

Answer any FIVE of the following choosing at least one full question from each unit: (5x12=60)

UNIT – I

2.a) What are nuclear forces? Explain nuclear stability by liquid drop model. (4)

b) Explain radiation detection and measurement by Geiger-Muller counter. (4)

c) Briefly explain the principle and instrumentation of Breeder reactor. (4)

3.a) Describe how radiations are detected by scintillation detectors. (4)

b) Discuss the merits and demerits of liquid and shell models of a nucleus. (4)

c) What are the nuclear fission reactions? Discuss the release of energy in these reactions. (4)

UNIT – II

4.a) Explain the separation of radioactive isotopes by extraction and coprecipitation methods. (4)

b) Discuss the role of radioisotopes in medicine. (4)

c) Outline the principle of Frick and Ceric sulphate dosimeter. (4)

5.a) Discuss the isotopic dilution analysis with example. (4)

b) Write a note on radioactive waste management. (4)

c) Explain pulse radiolysis. Mention its advantages. (4)

Contd...2

UNIT – III

6.a) What are the various factors that affect the quantum yield? Explain. (4)

b) Explain excited state acidity constant. (4)

c) Briefly discuss the study of excited state by flash photolysis (4)

7.a) Describe various types of chemical actionometers. (4)

b) In the photochemical decomposition of HI with light at λ = 253.7 nm, absorption of 3070J of energy decomposed 1.3×10^{-2} mol HI. What is the quantum yield of the reaction? (4)

c) Explain the shapes of absorption band and emission spectra based on Frank-Condon principle. (4)

UNIT - IV

8.a) Explain photo isomerization reactions with examples. (4)

b) Derive rate constant for unimolecular photochemical reactions from triplet state. (4)

c) Write a short note on fluorescence and phosphorescence. (4)

9.a) Sketch the neat diagram of spectrofluorometer and explain its mode of working. (4)

b) Derive Stern-Volmer equation for quenching process. (4)

c) Outline the principle of solar energy conversion and storage. (4)

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St Aloysius College (Autonomous)
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Semester IV - P.G. Examination - M.Sc. Chemistry
April - 2019

CHEMISTRY OF POLYMERS AND NATURAL PRODUCTS

Time: 3 Hours **Max.Marks:70**

PART - A

1) Answer any FIVE sub divisions of the following **(5x2=10)**

a) Write the structure of the repeating unit for each of the following polymer: .
   i) Poly (ethylene terephtholate)
   ii) Teflon
   iii) Nylon 6,6
   iv) polypropylene

b) Calculate the degree of polymerisation of Nylon-6, 6 with a molecular weight of $1x10^4$g/mole.

c) Among polyethylene and polystyrene, which polymer exhibits a higher Tg value? Why?

d) Sketch the characteristic DSC curve of a semicrystalline polymer sample and mention the various features.

e) What happens when cinchonine is oxidized with chromic acid?

f) Reserpic acid gives γ- lactone on heating with acetic anhydride. What does it indicate?

g) Formulate the following reaction

$$\alpha - pinene \xrightarrow{cold.aq.KMnO_4} ? \xrightarrow{C_rO_3} \text{ketocarboxylic acid}$$

h) How morphine is converted into morphol and morphenol?

PART - B

Answer any FIVE of the following choosing at least one full question from each unit.

(5x12=60)

UNIT - I

2. a) Explain the use of GPC in isolation and purification of polymers. **(5)**

   b) With a suitable example, write the mechanism of ionic polymerisation. **(4)**

   c) Give an account of viscoelastic behaviour of polymers. **(3)**

3. a) Describe fractional precipitation of polymers. **(5)**

   b) *Explain how the structure of a polymer influences the following properties.* **(4)**

   i) tensile strength ii) crystallinity

   c) Solution viscosity measurement give an idea about the size and shape of polymer molecules in solution. Justify. **(3)**

Contd.2

UNIT - II

4. a) Explain osomometric method of determination of molecular weight of a polymer. (4)

b) How do you correlate that the glass transition temperature, crystallinity and melting point of a polymer with the structure of that polymer? Give suitable example. (4)

c) Outline the principle of visocometric method of determination of molecular weight of polymers. (4)

5. a) Discuss differential thermal analysis technique in polymer characterization. (4)

b) Explain the procedure for determining Tg employing DSC technique. (4)

c) Give an account of mechanical properties of polymers. (4)

UNIT - III

6. a) Describe the synthesis of Papaverine. (4)

b) When heated with dilute hydrochloric acid, thebaine rapidly undergoes rearrangement to Thebenine. Write down the mechanism involved in this conversion. (4)

c) Convert ethyl quininate to (I)-quinine. (4)

7. a) Suggest the suitable steps for the synthesis of reserpine from tryptamine. (4)

b) Outline the reactions that indicate (4)

i) Presence of methylenedioxy group in papaverine.
ii) Attachment of -CHOH group directly to the benzene ring in adrenaline

c) Discuss the evidences that led to the determination of structure of nicotine. (4)

UNIT - IV

8. a) Sketch the synthesis of Farnesol. (4)

b) Give evidences for the presence of cyclobutane ring in α-Pinene. (4)

c) Account for the position of hydroxyl and acid group in Abietic acid. (4)

9. a) Discuss how the structure of santonin was established by degradation studies. (4)

b) Formulate the steps involved in the synthesis of zingiberene. (4)

c) Give the evidences for the presence and position of the conjugated system in zingiberene. (4)

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Semester IV - P.G. Examination - M.Sc. Chemistry
April - 2019

SOLID STATE AND NANO CHEMISTRY

Time: 3 Hours Max.Marks:70

PART - A

1) **Answer any SEVEN sub divisions of the following** (7x2=14)

a) In a simple cube, draw the planes whose Miller indices are 111, 212 & 220.

b) Differentiate between crystal having maximum and minimum symmetry.

c) Electron diffraction technique is particularly useful for surface analysis of solids. Comment.

d) The presence of defects in a crystal is a thermodynamic requirement for stability. Justify.

e) How are oxide thin films prepared by anodic oxidation method?

f) Define piezoelectricity? Name any two piezoelectric materials.

g) Distinguish molecules, nanoparticles and bulk materials.

h) What are smart materials?

i) What is self assembly? Give two examples of metal based nanoparticle.

PART - B

Answer any FOUR of the following choosing at least one full question from each unit.

(4x14=56)

UNIT - I

2. a) Discuss Laue method used for x-ray diffraction by crystals. Give their significance. (4)

b) Discuss the factors affecting X-ray intensities. (4)

c) Explain scattering factor? How is it related to electron density of an atom in a unit cell? (3)

d) Explain Weissenberg method used for determination crystal structure. (3)

3. a) Derive the Bragg's law of X-ray diffraction. (4)

b) Describe Debye-Scherrer power method of X-ray diffraction. (4)

c) What is meant by 'systematic absences' in XRD? Explain. (3)

d) Explain Low Energy Electron Diffraction (LEED) technique in the determination of surface structure. (3)

UNIT - II

4. a) Discuss the thermodynamics of Frenkel defect formation. (4)

b) Explain the origin of depletion region at p-n junctions. (4)

c) Explain ceramic method for the preparation of solids. (3)

d) Describe the growth of single crystals by flame fusion methods. (3)

Contd.2

5. a) Give an account of band theory of solids. (4)

b) Elaborate on dielectric & ferroelectric properties of solids. Mention their applications. (4)

c) Explain the structure of non-stoichiometric FeO. (3)

d) Write short notes on i) Hall effect ii) Hopping semiconductors. (3)

UNIT - III

6. a) Discuss hydrothermal synthesis of nano materials. (4)

b) Discuss briefly on electrical and optical properties of nanoparticles. (4)

c) Write explanatory notes on the application of nanomaterials in catalysis and medicine. (3)

d) Discuss the principle and applications of sol gel method. (3)

7. a) Explain the terms nanocrystals and nanocomposites. (4)

b) How do you classify nanomaterials? Explain in brief. (4)

c) What are the advantages of bottom-up synthesis methods? (3)

d) What is the principle of nanooptoelectronic devices? (3)

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St Aloysius College (Autonomous)

Mangaluru

Semester IV – P.G. Examination – M.Sc. Chemistry

April- 2018

ORGANIC SYNTHETIC METHODS

Time: 3 Hours **Max. Marks: 70**

PART – A

1. **Answer any FIVE sub divisions of the following:** **(5x2=10)**

a) Illustrate the use of PtO_2 in catalytic hydrogenation reactions.

b) Distinguish Wolf-Kishner reduction from Clemmensen reduction.

c) Give an account of halogenations of carbonyl compounds.

d) Explain how is S and Se useful in carrying out dyhydrogenation reactions.

e) Describe the limitation of Friedel Crafts reaction.

f) Justify the following statement using an example;
Protecting groups may be necessary for multistep organic synthesis.

g) Write a short note on 1,3-dipolar cycloaddition reactions.

h) Retrosynthetic analysis may provide multiple options. What criteria one may adopt to select most suitable synthetic route?

PART – B

Answer any FIVE of the following choosing at least one full question from each unit: **(5x12=60)**

UNIT – I

2.a) Give an account of selective reducing agents for functional groups esters, carbonyl and alkenes. **(4)**

b) Describe the mechanism hydrogenation reactions using Rh complexes. **(4)**

c) How is diborane prepared? What are hindered boranes? Write the general mechanism of reduction of alkenes using borane reagents. **(4)**

3.a) Describe the reduction reactions of organic substrates under the following conditions and comment on their selectivity.
$Pd\text{-}H_2$; $Pd\text{-}BaSO_4$; $Pd\text{-}CaCO_3$. **(4)**

b) Describe the synthetic applications of diimide based reagents. **(4)**

c) How is LAH prepared? Describe the mechanism of reduction of carbonyl compounds using LAH. Write a note on other hydrides used as reducing agents commenting on their selectivity. **(4)**

UNIT – II

4.a) Describe the preparation and application of the following;
i) Jones reagent
ii) O_sO_4 **(4)**

b) How is lead tetraacetate useful as an oxidant? Write the reaction mechanism. Mention the limitations of this reagent. **(4)**

c) Describe the reagents used to achieve benzylic and allylic brominations. **(4)**

Contd...2

5.a) Explain the selectivity or lack of it for the following oxidants; $KMnO_4$; MnO_2. Highlight the substrates and the reaction conditions used for such reactions. (4)

b) What is ozonolysis reaction? Write the product of ozonolysis of cyclohexene. Give the reaction mechanism. (4)

c) Write the synthetic applications of periodic acid providing suitable reaction mechanism. (4)

UNIT – III

6.a) Give a brief account of Ring cleaving reactions. (4)

b) Describe the synthetic methods used for the preparation of cubane. (4)

c) Explain the structural aspects of biotin. Write its importance. (4)

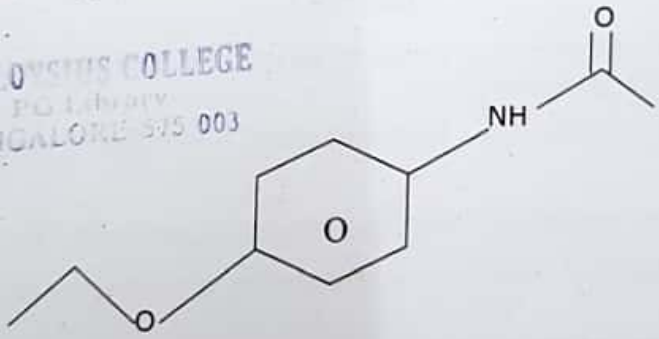
7.a) i) Explain stereo selective reaction using an example.
ii) Explain Retro Diels-Alder reaction. (4)

b) Write a note on Arndt-Eistert homologation and Dickman cyclization reaction. (4)

c) Illustrate the following statement by selecting two examples and suggest mechanism for one of the reaction.
Reactions involving C-C bond formation are useful systematically. (4)

UNIT - IV

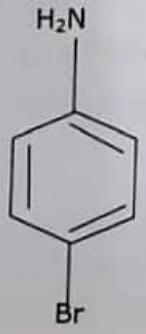
8.a) Suggest retrosynthetic schemes for the following. Rationalize your pick among the methods providing suitable reasons.



(4)

b) i) What is 1,3-diX relationship? Explain with an example.
ii) Provide synthetic route for bezocaine using retrosynthetic strategy. (4)

c) i) Why do we use synthetic equivalents when planning an organic synthesis though it might enhance the number of steps?
ii) Provide the retrosynthetic scheme for the for the following:

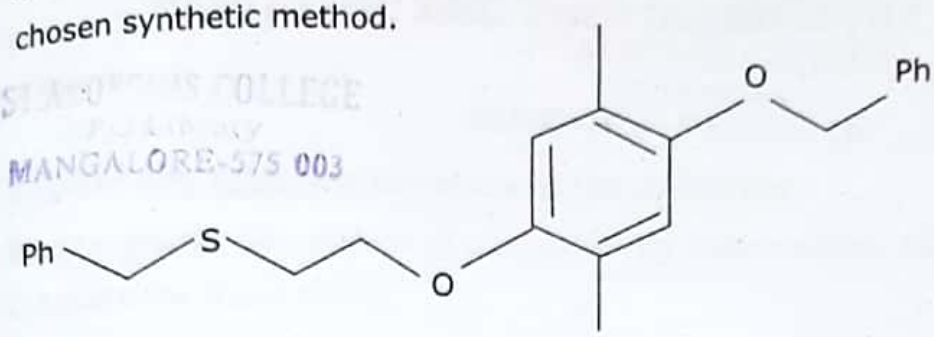


(4)

Contd...3

9.a) Discuss the general methods for the protection and deprotection of carbonyl and alcoholic groups. (4)

b) Predict all the possible disconnections and suggest a synthetic scheme for the following molecule. Describe the rationale of your chosen synthetic method.



(4)

c) Provide the retrosynthetic analysis of 6-methoxy indole-3-acetic acid. (4)

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Semester IV – P.G. Examination – M.Sc. Chemistry
April- 2018
RADIATION AND PHOTOCHEMISTRY

Time: 3 Hours Max. Marks: 70

PART - A

1. **Answer any FIVE sub divisions of the following:** (5x2=10)

a) Binding energy per nucleon of a nuclide with mass number 102 is 8.25 MeV. Calculate the mass defect.

b) What is the principle of scintillation counter?

c) Define the terms LET, Rad, Gray and Roentgen.

d) What is Frick dosimeter? Give its composition.

e) What is Einstein? Find the value of one Einstein of radiation at a given frequency 4000 A°.

f) State and explain Frank-Condon principle.

g) Give the selection rule for radiationless transition.

h) What are non-radiative transitions? Give their types.

PART - B

Answer any FIVE of the following choosing at least one full question from each unit: (5x12=60)

UNIT – I

2.a) Outline the working principle of Geiger-Muller and Liquid scintillation counter. (4)

b) Explain the theory of α and β decay with examples. (4)

c) Briefly explain the principle and instrumentation of Breeder reactor. (4)

3.a) Discuss the merits and demerits of liquid and shell models of a nucleus. (4)

b) Explain the basic features and components of nuclear power reactor. (4)

c) Write a short note on ionization chamber and proportional counter. (4)

UNIT – II

4.a) What is activation analysis? Explain activation analysis by absolute method. (4)

b) Describe radiometric titration with example. (4)

c) Discuss the radiolysis of water. (4)

5.a) Outline the separation of radioisotopes by coprecipitation method. (4)

b) Discuss the application of radioisotopes in medicine. (4)

c) Explain pulse radiolysis technique of studying transient species. (4)

Contd...2

UNIT – III

6.a) Define the quantum yield of a photochemical raction. Describe the experimental method for its measurement. (4)

b) Explain the effect of solute solvent interactions on electronic spectra-spectral shift. (4)

c) Elaborate excited state dipole moment of electronically exited molecules. (4)

7.a) What is actionometry? Discuss various types of detectors employed in actionometry? (4)

b) Discuss the acidity constants of electronically excited molecules. (4)

c) Write a note on flash photolysis. (4)

UNIT - IV

8.a) Explain the chemistry of exited molecule using Jablonskii diagram. (4)

b) Derive rate constant for unimolecular photochemical reactions from triplet state. (4)

c) Discuss any two photochemical rearrangements with suitable examples. (4)

9.a) Obtain Stern-Volmer equation for quenching process. (4)

b) Discuss the photo dissociation reactions. (4)

c) Write note on the following:

i) Quenching of fluorescence

ii) Solar energy conversion (4)

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St Aloysius College (Autonomous)
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Semester IV - P.G. Examination - M.Sc. Chemistry
April - 2018

CHEMISTRY OF POLYMERS AND NATURAL PRODUCTS

Time: 3 Hours **Max.Marks:70**

PART - A

1) Answer any FIVE sub divisions of the following **(5×2=10)**

a) Differentiate between chain growth and step growth polymerization.

b) Calculate the average molecular weight of a polystrene sample with average degree of polymerisation of 1000.

c) Tq and Tm of polystyrene are higher than HDPE. PVC has still higher Tg and Tm Why?

d) Compare the basis between TGA and DTA.

e) What is the use of Emble degradation in alkaloid chemistry?

f) Piperonylic acid contains methylenedioxy group. Prove the statement.

g) Explain by means of structural formulae the following reactions.

Zingiberene $\xrightarrow[acetylenedicarboxylkate]{Dimethyl}$ product $\xrightarrow{pyrolysis}$?

h) State special isoprene rule. Identify the isoprene units in Abietic acid.

PART - B

Answer any FIVE of the following choosing at least one full question from each unit.

(12x5=60)

UNIT - I

2. a) Give the classification of polymers with examples for each class. **(4)**

b) A protein sample consists of an equimolar mixture of haemoglobin (M=15.5 kg/mole) ribonuclease (M=13.7 kg/mole) and myoglobin (M=17.2 kg/mole). Calculate the number average and mass average masses. **(4)**

c) What is crystallinity of a polymer? What are the requirements for the crystallinity of a polymer. **(4)**

3. a) Explain chain growth polymerization. **(4)**

b) Show that the weight average molar mass is generally twice the number average molar mass using polydispersity index. **(4)**

c) Discuss the Flory-Huggins theory of polymer dissolution. **(4)**

Contd.2

UNIT - II

4. a) Explain the experimental procedure of determination by molecular weight of polymers by viscometric technique. (4)

b) Define Glass transition temperature. Discuss the structural factors that influence the Tg. (4)

c) Discuss the method of vapour phase osmometry, in the determination of polymer molecular weight. (4)

5. a) Explain differential scanning calorimetric technique of characterisation of polymers. (4)

b) Outline the principle of end -group analysis in determination of molecular weight of polymers. (4)

c) Explain the mechanical properties of polymers with suitable examples. (4)

UNIT - III

6. a) Explain the use of Hofmann's degradation in the determination of structure of an alkaloid. (4)

b) Outline the various reactions that lead to the structure of Papaverine. (4)

c) Give the synthesis of piperine. (4)

7. a) In brief explain how the following products are obtained from morphine. (4)

i) Morphol ii) methyl morphol iii) Morphenol

iv) Methylmorphenol

b) How is the structure of meroquinene established? (4)

c) Outline the synthesis of ephedrine. (4)

UNIT - IV

8. a) Indicate the reagents that are used to bring about the following conversions: (4)

Pinene glycol → Pinonic acid → pinic acid → is norpinic acid.

Give the structures of all these compounds.

b) How do you deduce the positions of the following in abietic acid? (4)

i) methyl groups ii) double bonds

c) Outline the synthesis of camphors. (4)

9. a) How do you fix up the positions of three double bonds in zingiberene ? Write the absolute configuration of it. (4)

b) Enumerate the evidences in support of the structure of Santonin. (4)

c) Write the synthesis of menthol. (4)

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St Aloysius College (Autonomous)
Mangaluru
Semester IV - P.G. Examination - M.Sc. Chemistry
April - 2018
SOLID STATE AND NANO CHEMISTRY

Time: 3 Hours Max.Marks:70

PART - A

1) Answer any SEVEN sub divisions of the following (7×2=14)

a) A first order reflection from the (111) planes of a cubic crystal was observed at a glancing angle 11.2^0 using CuK_α radiation. Calculate the interplanar distance of unit cell.

b) What is probable lattice type of crystalline substances that give the following observed reflections?
   a) 110, 200, 103, 202, 211
   b) 111, 200, 113, 220, 222

c) State wierl equation and define the terms involved.

d) What is Frenkel defect? Give an example.

e) What is the sol-gel method preparation of solids?

f) What are the differences between extrinsic and intrinsic semiconductors?

g) Mention any four salient properties of nanomaterials.

h) What are carbon nanotubes? Mention the types and uses.

i) Give two applications of nanomaterials in medicine.

PART - B

Answer any FOUR of the following choosing at least one full question from each unit. (4x14=56)

UNIT - I

2. a) Derive Bragg's condition for diffraction and illustrate how Bragg's method is used to determine the crystal structure. (4)
   b) Explain Debye- Scherrer powder method in X-ray Crystallography. (4)
   c) Describe Weissenberg method in detail. (3)
   d) Discuss the factors affecting X-ray intensities. (3)

3. a) Explain Laue method in X-ray cryptallography. (4)
   b) Derive the expression for scattering intensity of electrons. (4)
   c) Describe the identification of unit cells from systematic absences in X-ray diffraction. (3)
   d) Explain the structural elucidation of simple gaseous molecules by electron diffraction technique. (3)

UNIT - II

4. a) Discuss the thermodynamics of Schottky defect formation. (4)
   b) What are colour centres? Explain with an example. (4)
   c) What is Hall effect? Explain. (3)
   d) Write short notes on i) p-n junctions ii) Hopping semiconductors (3)

Contd.2

5. a) Discuss the chemical vapour deposition technique of crystal growth. (4)

b) Discuss the growth of single crystals by Czochralski and verneuil flame fusion methods. (4)

c) Explain the phenomenon of ferroelectricity. Name any two ferroelectric materials and applications of ferro electric materials. (3)

d) Explain the crystal structure of non-stoichiometric $Fe_{1-x}O$ and UO_{2+x}. (3)

UNIT - III

6. a) Discuss the classification of Nanomaterials in detail. (4)

b) Explain Chemical Vapour Deposition method of synthesis of nano materials. (4)

c) Write short notes on i) nano electronics ii) nano photonics (3)

d) Describe briefly the optical properties of nanoparticles. (3)

7. a) List any four bottom up approaches for synthesis of nano powders and explain any one of them in detail? (4)

b) Discuss the synthesis of nano materials by electro deposition method. (4)

c) Explain the importance of size and shape dependence of material properties at the nanoscale. (3)

d) Elaborate on surface properties of nanomaterials. (3)

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