# P. R. GOVERNMENT DEGREE COLLEGE (A), KAKINADA DEPARTMENT OF CHEMISTRY BOARD OF STUDIES: 2021-22 SECOND YEAR, SEMESTER- III

## Paper III (ORGANIC & SPECTROSCOPY) 60 h (4 h / w) ORGANIC CHEMISTRY 30 h (2h / w)

## UNIT I:

## 1. Chemistry of Halogenated Hydrocarbons:

Alkyl Halides: Methods of preparation and properties, nucleophilic substitution reactions– SN1, SN2 mechanisms with stereo chemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination, Williamson's synthesis. Aryl Halides: Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Additional Input: SNi mechanisms, SN Ar, Benzyne mechanism.

## 2. Alcohols & Phenols Alcohols:

Preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouveault-Blanc Reduction; Oxidation of Diols by Periodic Acid and lead Tetraacetate, Pinacol- Pinacolone Rearrangement; Phenols: Preparation and Properties; Acidity and Factors Affecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions.

Additional Input: Fries and Claisen Rearrangement with mechanism.

### UNIT II:

## **Carbonyl Compounds:**

Structure, reactivity, preparation and properties; Nucleophilic Addition, Nucleophilic Additionelimination reactions with ammonia derivatives, Mechanisms of Aldol and Benzoin Condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann Haloform Reaction and Baeyer-Villiger oxidation,  $\alpha$ - substitution reactions, oxidations and reductions (Clemmensen, Wolf–Kishner, with LiAlH4 & NaBH4).

Additional Input: Addition Reactions of  $\alpha$ ,  $\beta$  unsaturated carbonyl compounds: Michael Addition.

### **UNIT III:**

## Carboxylic Acids and their Derivatives:

General methods of preparation, physical properties and reactions of mono carboxylic acids, effect of substituent acidic strength. Typical reactions of carboxylic acids, hydroxy acids and unsaturated acids. Preparation and Reactions of Acid Chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group-Mechanism of acidic and alkaline hydrolysis of esters, Claisen Condensation, Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schmidt reaction.

Additional Input: Arndt- Eistert synthesis, halogenations by Hell- Volhard- Zelensky reaction.

#### SPECTROSCOPY 30 h (2h / w)

#### **UNIT IV:**

**Molecular Spectroscopy:** Interaction of electromagnetic radiation with molecules and various types of spectra;

Rotation spectroscopy: Selection rules, intensities of spectral lines.

**Vibrational Spectroscopy:** Classical Equation of Vibration, computation of force constant, Harmonic and anharmonic oscillator, Morse Potential curve, Selection rules for vibrational transitions.

**Electronic spectroscopy:** Energy levels of molecular orbitals ( $\sigma$ ,  $\pi$ , n). Selection rules for electronic spectra. Types of electronic transitions in molecules, effect of conjugation. Concept of chromophore. Bathochromic and hypsochromic shifts. Beer-Lambert's law and its limitations.

**Nuclear Magnetic Resonance (NMR) spectroscopy:** Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants. Applications of NMR with suitable examples – ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate and acetophenone.

Additional Input: Determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. Fundamental Frequencies and overtones.

#### UNIT V:

#### **Application of Spectroscopy to Simple Organic Molecules**

Application of visible, ultraviolet and infrared spectroscopy in organic molecules. Application of electronic spectroscopy and Woodward rules for calculating  $\lambda_{max}$  of conjugated dienes and  $\alpha$ ,  $\beta$  – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR Spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones and carboxylic acids.

#### **REFERENCE BOOKS:**

1. A TextBook of Organic Chemistry by Bahl and Arunbahl

2. A Textbook of Organic chemistry by I L FinarVol I

- 3. Organic chemistry by Bruice
- 4. Organic chemistry by Clayden
- 5. Spectroscopy by William Kemp
- 6. Spectroscopy by Pavia
- 7. Organic Spectroscopy by J. R. Dyer
- 8. Elementary organic spectroscopy by Y.R. Sharma
- 9. Spectroscopy by P.S.Kalsi

10. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)

11. Spectrometric Identification of Organic Compounds by Robert M Silverstein, Francis X Webster

12. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry,5th Ed. Pearson (2012)

13. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,

## LABORATORY COURSE -III 30hrs (2 h / w)

## Practical Paper-III (At the end of Semester-III)

## Organic Preparations and IR Spectral Analysis Lab: 50 Marks Course Outcomes

1. How to use glassware, equipment and chemicals and follow experimental procedures in the laboratory

2. how to calculate limiting reagent, theoretical yield, and percent yield

3. how to engage in safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents appropriately

4. how to dispose of chemicals in a safe and responsible manner

5. how to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.

6. how to create and carry out work up and separation procedures

7. how to critically evaluate data collected to determine the identity, purity, and percent yield of products and to summarize findings in writing in a clear and concise manner

## Organic preparations: 40M

i. Acetylation of one of the following compounds:

amines (aniline) and phenols ( $\beta$ -naphthol, salicylic acid) by any one method:

- a. Using conventional method.
- b. Using green approach
- ii. Benzoylation of amine (aniline)
- a. Nitration of any one of the following: Acetanilide/nitrobenzene by conventional method

b. Salicylic acid by green approach (using ceric ammonium nitrate).

# IR Spectral Analysis: 10M

IR Spectral Analysis of the following functional groups with examples

- a) Hydroxyl groups
- b) Carbonyl groups
- c) Amino groups
- d) Aromatic groups

# P. R. GOVERNMENT COLLEGE, KAKINADA MODEL PAPER FOR SEMESTER – III (CHEMISTRY) Paper III (ORGANIC CHEMISTRY& SPECTROSCOPY)

Duration: 2hrs.30 Min

Max. Marks: 60

# PART-A

Answer any Four of the following questions. Each carries FIVE marks  $4 \times 5 = 20$  Marks

1. Question from Unit –I

2. Question from Unit -II

3. Question from Unit –III

4. Question from Unit – III

5. Question from Unit –IV

6. Question from Unit – IV

7. Question from Unit - V

8. Question from Unit - V

## PART-B

Answer ALL the questions. Each carries TEN marks

9. Question from Unit –I (OR)

Question from Unit -I

10. Question from Unit –II (OR)

Question from Unit - III

11. Question from Unit –IV

(OR)

Question from Unit – IV

12. Question from Unit - V

(OR)

Question from Unit – V

4 X 10 = 40 Marks

# WEIGHTAGE TO THE COURSE CONTENT Second Year Semester - III ORGANIC AND SPECTROSCOPY - III

Sl. No.	COURSE CONTENT	ESSAY	SHORTS	Total
				Marks
1	UNIT - I	2	1	25
2	UNIT - II	1	1	15
3	UNIT - III	1	2	20
4	UNIT - IV	2	2	30
5	UNIT - V	2	2	30
Total		8	8	120

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#### P.R. GOVERNMENT DEGREE COLLEGE (A), KAKINADA DEPARTMENT OF CHEMISTRY BOARD OF STUDIES: 2021-22

#### SECOND YEAR, SEMESTER-III

#### Paper: III- Organic and Spectroscopy

#### **Question Bank**

#### Unit-I

#### **Essay Questions**

- 1. Explain  $SN^1 \& SN^2$  reactions with mechanism?
- 2. Explain the following reaction mechanisms
  - a. Reimer Tiemann reaction b) Kolbe-Schmidt reaction
- 3. Explain the following reaction mechanisms
  - a. Fries rearrangement b) Pinacol Pinacalone rearrangement

#### Short answer questions

- 1. Explain the following terms
- a) Walden inversion b) Racemicmixture
- 2. Write any two preparation methods of Alcohols?
- 3. Write any two preparation methods of phenols?
- 4. Explain the identification tests of Primary, Secondary & Tertiary alcohols.

#### Unit-II

#### **Essay Questions**

- 1. Explain the following reactions with mechanism
  - a) Aldol condensation. b) Cannizaro reaction
- 2. Explain the following reactions with mechanism
  - a) Perkin reaction. b) Benzoin condensation
- 3. Explain the following reactions:
  - a) Haloform reaction b) Bayer villeger oxidation

#### Short answer questions

- 1. Write any two preparation methods of carbonyl compounds?
- 2. Explain the nucleophilic addition reactions of carbonyl compounds?
- 3. Explain the following reactions:
  - a) Clemensen reduction. b) Wolf-Kishner reduction.

## Unit-III

#### **Essay Questions**

- 1. Explain the following reactions with mechanism
- a) Huns diecker's reaction b) Schmidt reaction
- 2. Write any two preparation methods of carboxylic acids and write the chemical Properties?

#### Short answer questions

- 1. Write any two chemical properties of carboxylic acids?
- 2. Explain hydrogen bonding in carboxylic acid
- 3. Explain Claisen condensation with mechanism?

## Unit-IV

### **Essay Questions**

- 1. Explain Lambert's law and Lambert's Beers law.
- 2. Explain the selection rules for electronic spectra.
- 3. What are Electronic Transitions? Explain various types of Electronic transitions.
- 4. What is principle of NMR spectroscopy and Write the applications of NMR spectroscopy?

#### Short answer questions

- 1. Explain a) Chromophore b) Auxochrome.
- 2. Explain various types of Spectra?
- 3. What are equivalent protons and Non-equivalent protons?
- 4. Explain spin-spin Coupling?
- 5. What is Chemical shift? How it is calculated?
- 6. What is coupling constant?

### Unit-V

### **Essay Questions**

- 1. Explain the Various types of molecular vibrations?
- 2. Write Woodward rules for calculating  $\lambda_{max}$  of conjugated dienes?
- 3. Write Woodward rules for calculating  $\lambda \max$  of  $\alpha$ ,  $\beta$  unsaturated compounds.

### Short answer questions

- 1. Explain Fingerprint region of IR Spectroscopy?
- 2. Write the Applications of UV-Visible Spectroscopy?
- 3. Discuss about the IR Spectra of alcohols?
- 4. Discuss about the IR Spectra of Carboxylic Acids?