

Total No. of Questions : 6]

SEAT No. :

PE-4548

[Total No. of Pages : 3

[6512]-31

M.Sc. - II

DRUG CHEMISTRY

**CHD-601-MJ : Drug Discovery and Development
(2023 Credit Pattern) (Semester - III) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Figures to the right indicate full marks.*
- 4) *Draw the neat label diagram wherever necessary.*

SECTION - I

Q1) a) Answer the following : **[8]**

- i) Define
 - A) Drug
 - B) Pharmacophore
 - ii) Define :
 - A) Pharmacodynamics
 - B) Pharmacokinetics
 - iii) Write a short note on Drug target,
 - iv) Explain LD₅₀.
- b) Give a commentary on how combinatorial chemistry. HTS and computers have aided the process of drug discovery. **[3]**

Q2) a) Answer any one of the following : **[6]**

- i) Give all the parameters used to study toxicological evaluation of new drugs,
 - ii) Define dosage forms. Discuss the liquid dosage forms with examples,
- b) How can we screened lead compounds from the following with the examples. (any two) **[6]**
- i) Natural Products.
 - ii) Animals
 - iii) Medical folklore

P.T.O.

Q3) a) Answer any one of the following : [6]

i) What is Lead? Discuss the different strategies involved in Lead discovery.

ii) Explain the following system of medicine.

A) Ayurveda

B) Homeopathy

b) Write a short note on (any two) [6]

i) Protein as a drug target.

ii) Phase I and II metabolism

iii) Nucleic acid as a drug target.

SECTION - II

Q4) a) Define the following : [8]

i) Placebo

ii) Lead compound

iii) Therapeutic index

iv) Pilot Plant

b) Make a comment on pre-clinical testing of a drug. [3]

Q5) a) Answer any one of the following : [6]

i) What are patents? What are the requirements of a invention to get a patent? What benefits a patent gets?

ii) Explain the pharmacokinetics of drug action in detail.

b) Discuss the following (any two) [6]

i) Scale up process

ii) GMP

iii) Dose ranging studies

Q6) a) Answer any one of the following : [6]

i) Give a brief account of the function performed by the following in a pharma industry.

A) R and D

B) GLP

C) Documentation

ii) Explain different routes of drug administration with examples.

b) Write a short note on (any two) [6]

i) Bioequivalence

ii) FDA

iii) Drug Excretion



Total No. of Questions : 6]

SEAT No. :

PE-4549

[Total No. of Pages : 6

[6512]-32

M.Sc. (Part - II)

DRUG CHEMISTRY

CHD-602 MJ : Spectroscopic Methods in Structure Determination
(2023 Pattern) (Semester - III) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

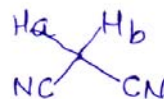
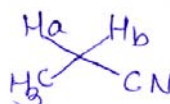
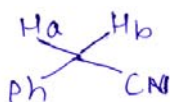
Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION - I

Q1) a) Answer the following (any four) : [8]

- i) DMSO- d_6 shows seven lines of unequal intensities in its CMR spectrum. Explain
- ii) Arrange the following compounds with decreasing order of δ . Explain your answer.



- iii) Base peak in mass spectrum of 2-butanol is at m/e - 45. Explain.
 - iv) A compound having molecular formula C_6H_8 shows only two signals in its CMR spectrum. DEPT shows presence of CH and CH_2 . Assign probable structure.
 - v) Acetylacetone shows one signal at 16.1 ppm in its PMR spectrum. Explain.
- b) A nitronaphthalene derivative $C_{11}H_9NO_4$ shows the following PMR data: [3]
- 3.8(S, 24mm), 5.4(S, exch. 8mm), 6.8(S, 8mm), 7.1(S, 8mm), 7.6-7.9(m, 16mm), 8.1(dd, 1.9 & 7Hz, 8mm)
- NOE Expt :
- Irradiation at 3.8 gives 21% enhancement at 7.1 Deduce the nature of the functional group and substitution pattern.

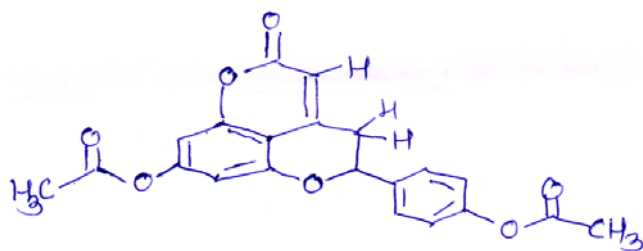
P.T.O.

Q2) Deduce the structure of the following (any four) :

[12]

- a) MF : $C_8H_{10}O_2$
CMR : 55(q), 133.5(s), 64(t, mod.) 159(s), 114(d, strong), 129(d, strong)
PMR : 2.0(bs, 1H, exch.), 3.8(s, 3H), 5.0(s, 2H), 6.5(d, $J = 7\text{Hz}$, 2H), 6.8(d, $J = 7\text{Hz}$, 2H)
- b) MF : C_5H_8O
IR : 1705, 1653, 2750 cm^{-1}
PMR : 1.1(t, 3H, $J = 7\text{Hz}$), 2.2(dq, 2H, $J = 4 \text{ \& } 7 \text{ Hz}$), 5.9(dd, 1H, $J = 6 \text{ \& } 13\text{Hz}$), 6.78(dt, 1H, $J = 4 \text{ \& } 13\text{Hz}$), 9.35(d, 1H, $J = 6\text{Hz}$)
- c) MF : $C_{10}H_{10}O_3$
IR : 1680, 1602 cm^{-1}
PMR : 3.1(t, $J = 6\text{Hz}$, 2H), 3.9(s, 3H), 4.5(t, $J = 6\text{Hz}$, 2H), 6.7(d, $J = 2\text{Hz}$, 1H), 6.9(dd, $J = 8 \text{ \& } 2\text{Hz}$, 1H), 8.05(d, $J = 8\text{Hz}$, 1H)
- d) MF : $C_{15}H_{14}O$
IR : 1680 cm^{-1}
PMR : 2.4(s, 6H), 7.2(d, 4H, $J = 8\text{Hz}$), 7.7(d, 4H, $J = 8\text{Hz}$)
CMR : 21, 129, 133, 136, 141, 190
- e) MF : $C_9H_{14}O$
Mass : m/e - 138, 95(100%), 81, 79
IR : 3290, 2115, 1710 cm^{-1}
PMR : 1.12(s, 6H), 2.02(t, 1H, $J = 3\text{Hz}$), 2.15(s, 3H), 2.20(d, 2H, $J = 3\text{Hz}$), 2.50(s, 2H)

Q3) a) Assign the signals to the different protons in the following compound and justify your answer. **[6]**



- 2.32(s, 6H), 3.09(ddd, 1H, $J = 12, 7 \text{ \& } 1.5\text{Hz}$)
3.11(ddd, 1H, $J = 12, 4 \text{ \& } 2\text{Hz}$), 5.18(dd, 1H, $J = 7, 4 \text{ \& } 1\text{Hz}$)
6.06(bd, 1H, $J = 2\text{Hz}$), 6.62(d, 1H, $J = 2\text{Hz}$)
6.69(d, 1H, $J = 2\text{Hz}$), 7.17(d, 2H, $J = 8\text{Hz}$), 7.46(d, 2H, $J = 8\text{Hz}$)

Decoupling Experiment :

Irradiation at	Change at
5.18	3.09(dd, J = 12 & 4Hz) 3.11(dd, J = 12 & 2Hz)
3.11	3.09(dd, J = 7 & 1.5Hz) 6.06(d, J = 1.5Hz) 5.18(d, J = 7 Hz)

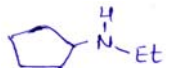
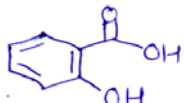
NOE Experiment

Irradiating 3.09, 7% enhancement is observed at 6.06

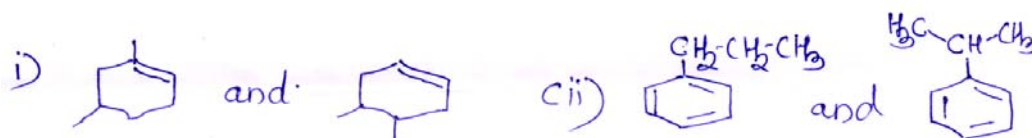
- b) Write short notes on the following (any two) : [6]
- Factors affecting vicinal coupling
 - Lanthanide shift Reagents
 - AB and AX spin systems

SECTION - II

Q4) a) Give the genesis of the fragmentations (any four) : [8]

- Cyclohexanol m/e - 99, 82, 57
- 1-Bromohexane m/e - 166, 164, 135, 107
-  m/e - 85, 84, 70, 56
-  m/e - 176, 161, 118, 91, 58, 43
-  m/e - 138, 120, 92, 64

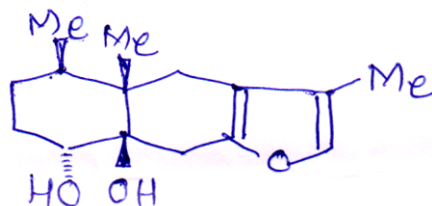
b) Differentiate following compounds by mass spectrometry. [3]



Q5) a) Answer any two of the following : **[6]**

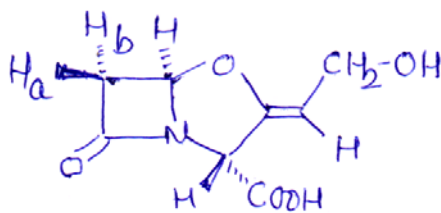
- i) Explain chemical ionization in brief.
- ii) A carboxylic acid (MF : $C_{10}H_{12}O_2$) exhibits ions at 164(M^+), 149(100%), 119, 105, 91, 79, 77. Deduce the structure.
- iii) A product of Friedel Crafts reaction of benzene and ethylene oxide shows a strong peak at m/e - 92. Deduce the product of the reaction and fragmentation of it.

b) i) Assign the chemical shifts to various carbons of the following compound. **[4]**



8(q), 17(q), 20(q), 28(t), 29(t), 34(t), 35(t), 49(s), 72(d), 82(d), 85(s), 123(s), 125(s), 135(d), 148(s)

ii) Clavulanic acid shows two signals of H_a **[2]**



and H_b protons as,

3.60(1H, dd, $J = 2.5$ & 18Hz)

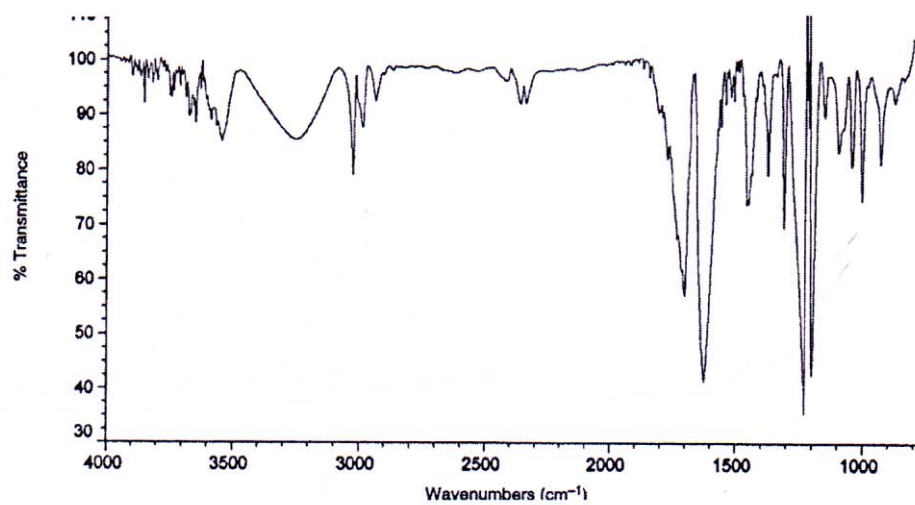
3.05(1H, d, $J = 18$ Hz)

Assign the signals

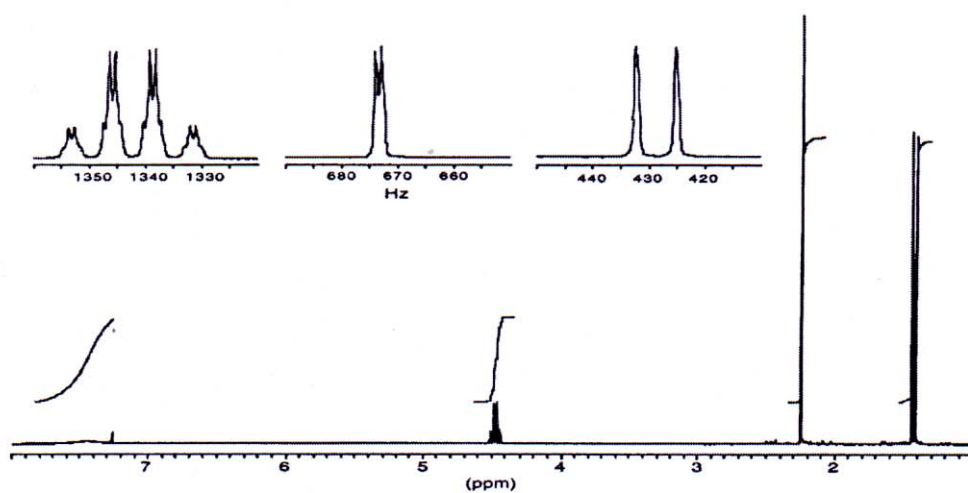
to H_a and H_b protons. Explain the coupling constant values.

Q6) Deduce the structure of the compound using the spectral data given on the attached sheet. Justify your answer. **[12]**

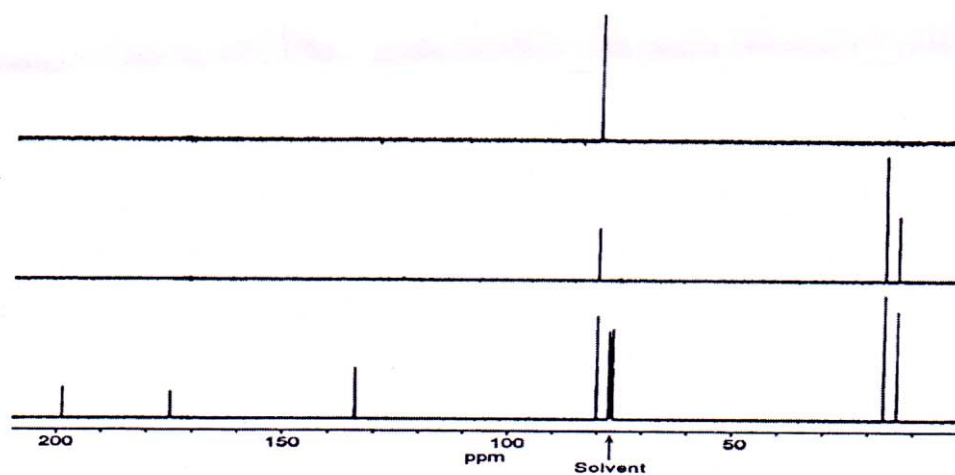
Mass Spectral data: 128, 85, 57, 43

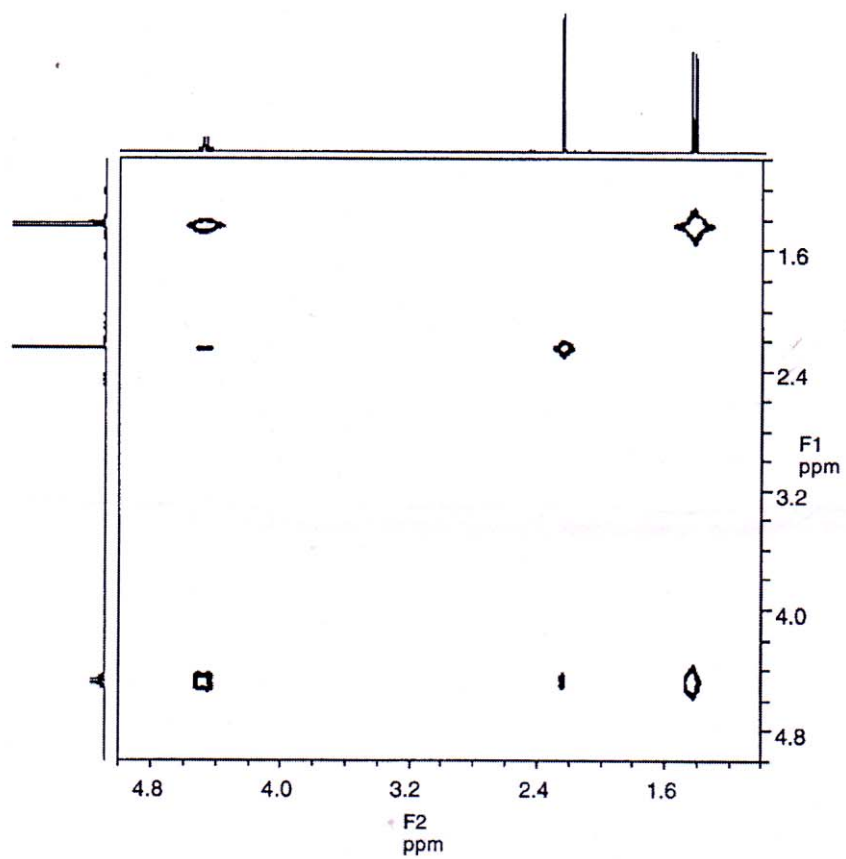


¹H NMR

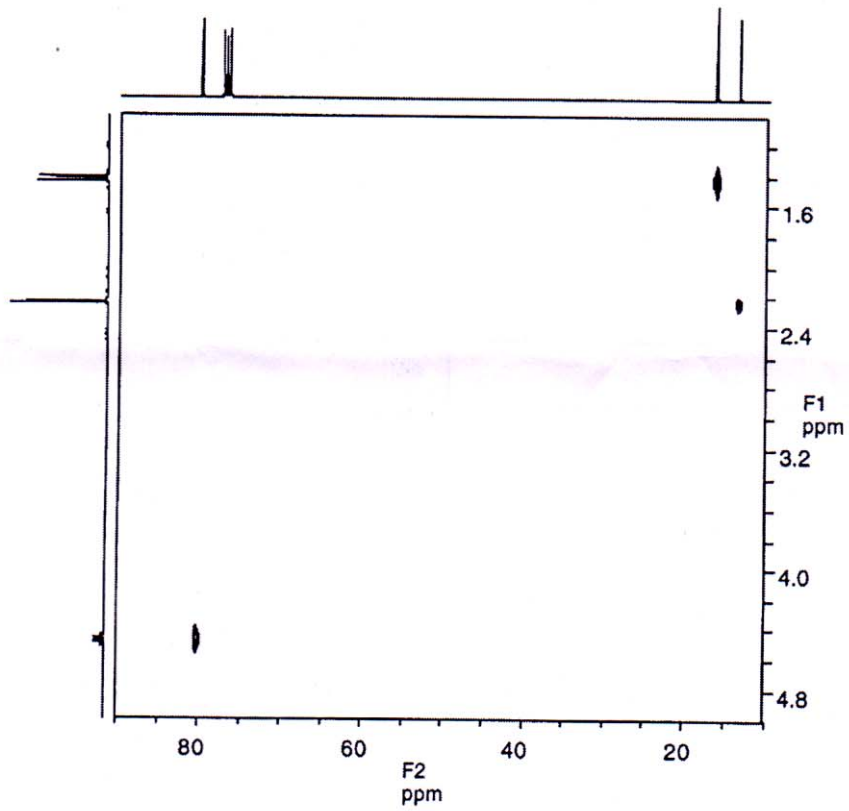


¹³C/DEPT





HETCOR



Total No. of Questions : 3]

SEAT No. :

PE-4550

[Total No. of Pages : 3

[6512]-33

M.Sc. - II

DRUG CHEMISTRY

CHD-603MJ : Stereochemistry

(2023 Pattern) (Semester - III) (2-Credits)

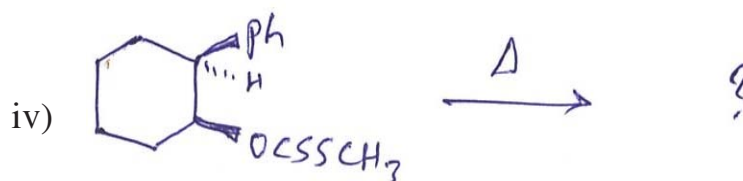
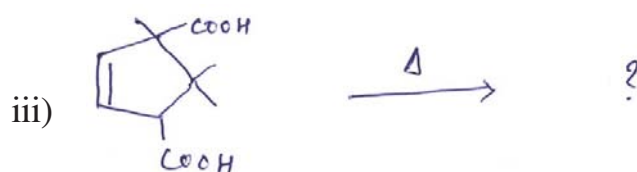
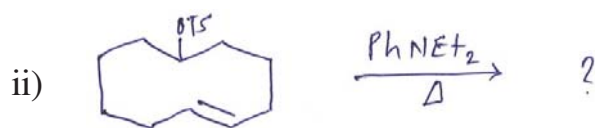
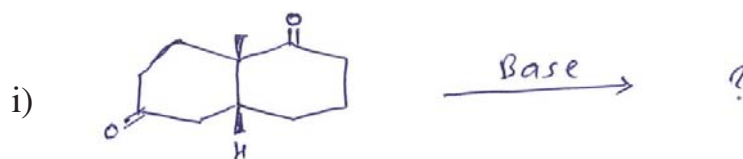
Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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- 3) Draw the neat label diagram wherever necessary.

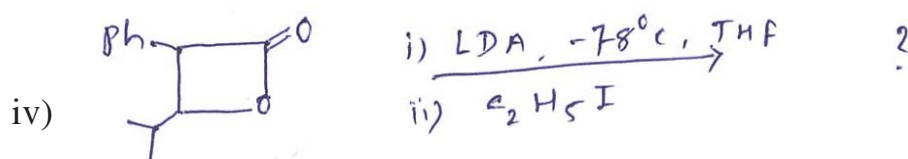
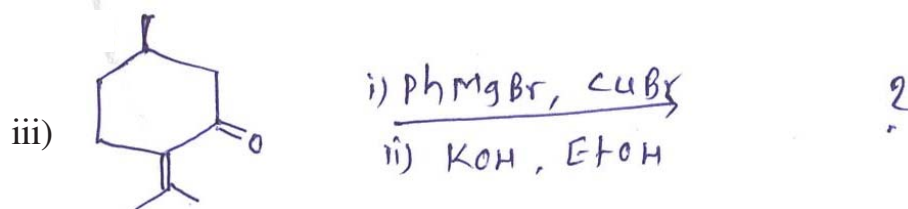
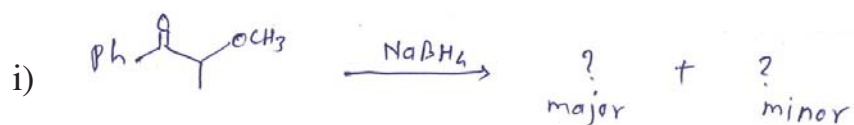
Q1) a) Predict the product of the following and explain the stereochemical principles involved. [8]



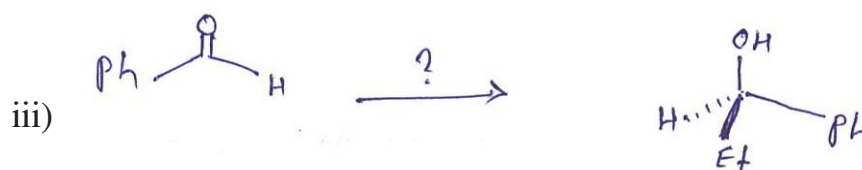
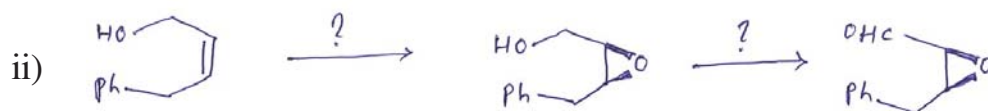
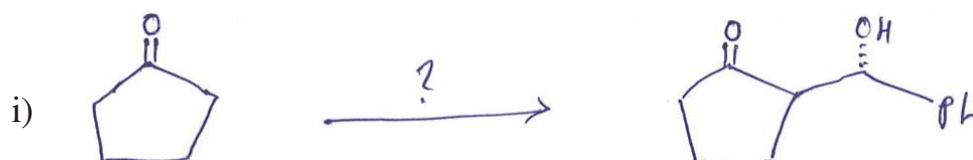
b) Half number of enantiomer's are observed in case of bridge ring systems. [3]

P.T.O.

Q2) a) Predict the product of the following and explain the stereochemical principles involved. (any three). [6]



b) Suggest the reagents and write mechanism of the following reactions. (any two) [6]



Q3) Answer any four of the following :

[12]

- a) Explain with examples 'transannular interactions'.
- b) Write a short note on Van Auwer's - Skita rule
- c) Why trans. decaline is more stable than cis-decalin? Explain with stereostructures.
- d) Write a short note on sharpless Asymmetric epoxidation.
- e) Write a short note on Asymmetric Aldol Condensation.



Total No. of Questions : 3]

SEAT No. :

PE-5410

[Total No. of Pages : 3

[6512]-34

M.Sc. (Part - II)

DRUG CHEMISTRY

CHD-610(A)-MJ : Advanced Heterocyclic Chemistry

(2023 Pattern) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

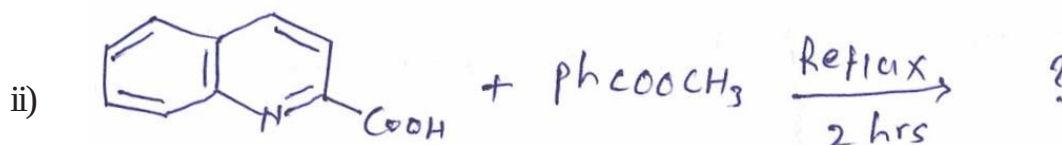
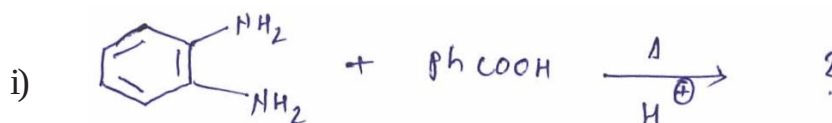
Q1) a) Explain the following :

[8]

- i) Explain the synthesis of benzoturan from salicylaldehyde.
- ii) Indole undergoes electrophilic substitution at C-3 position.
- iii) Quinoline undergoes reduction more easily than naphthalene.
- iv) 4 - chloropyridine easily undergoes hydrolysis in warm water.

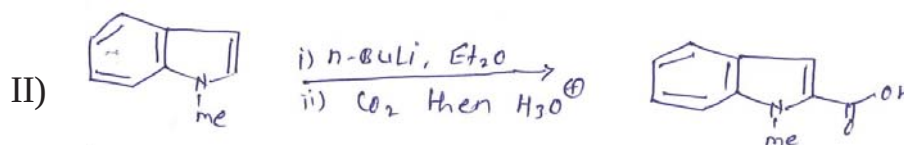
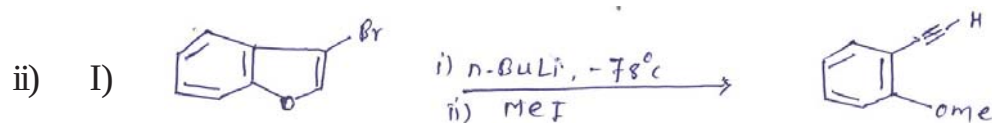
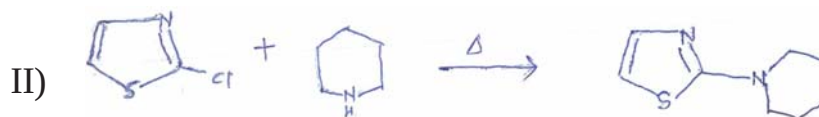
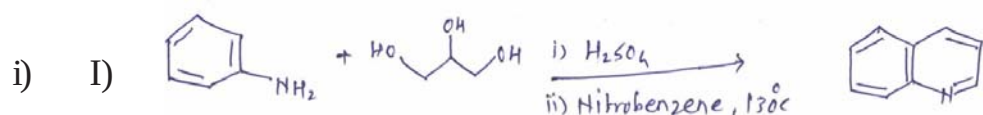
b) Predict the products in the following.

[3]



P.T.O.

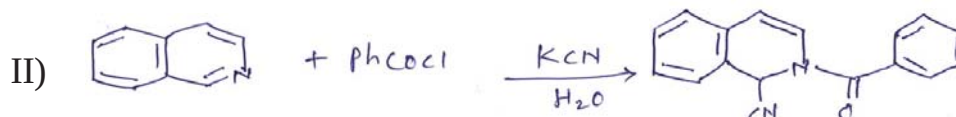
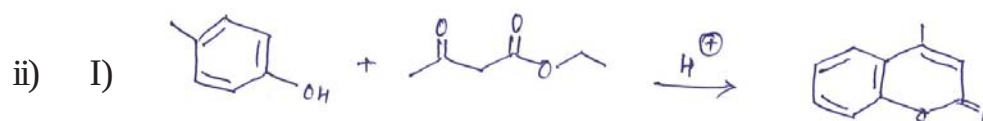
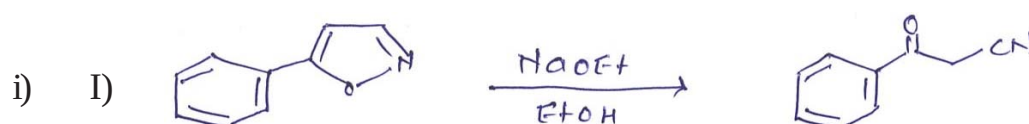
Q2) a) Suggest the suitable mechanism for any one of the following. [6]



b) Write a short note on any two of the following. [6]

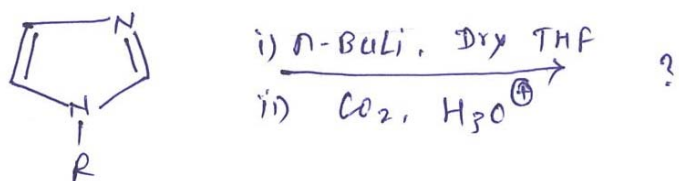
- Gabries thiazole Synthesis
- Fischer Indole Synthesis
- Skraup Quinoline Synthesis

Q3) a) Suggest the suitable mechanism for any one of the following. [6]



b) Answer any two of the following. [6]

- Electrophilic attack on pyrazole is hindered in acid medium. Explain.
- Write a short note on perkin synthesis of caumarin
- Predict the product in the following.



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**SEAT No. :**

**[Total No. of Pages : 4**

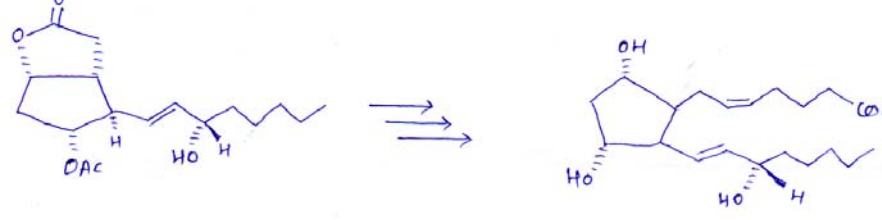
**M.Sc. (Part - II)**

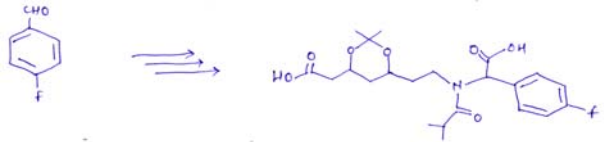
## **CHD-610(B) MJ : Synthesis of Biologically Active Molecules (2023 Pattern) (Semester - III)**

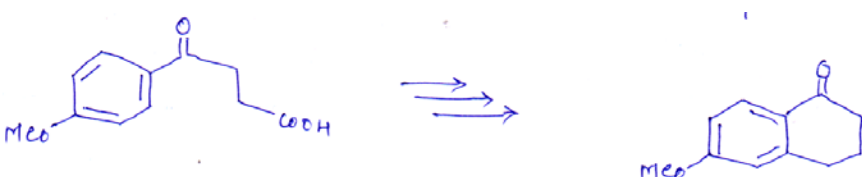
**[Max. Marks : 35**

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

i) 

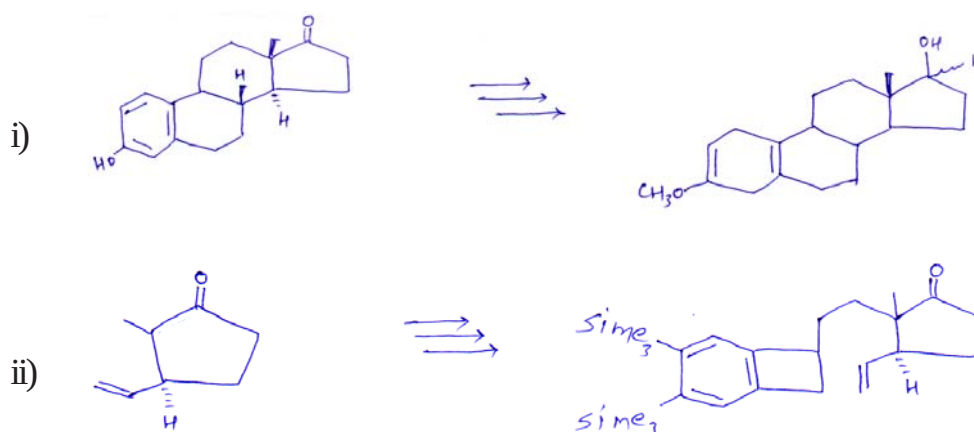
ii) 

iii) 

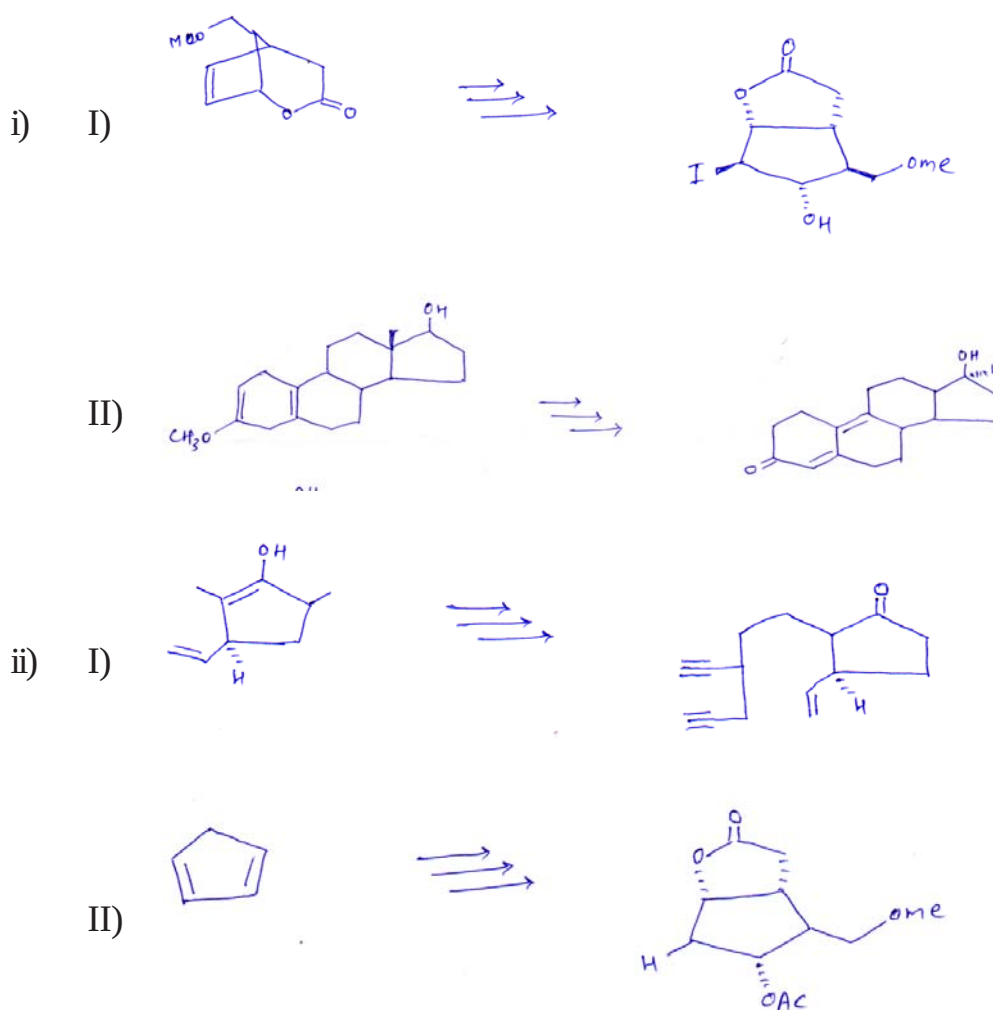
iv) 

**P.T.O.**

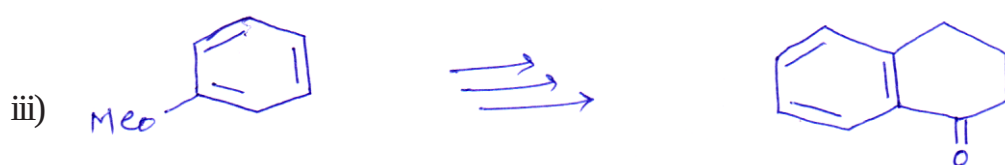
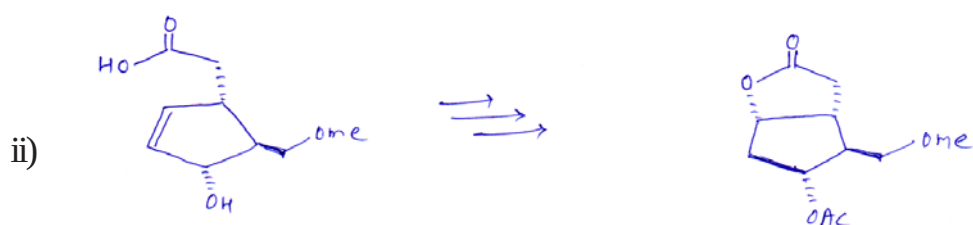
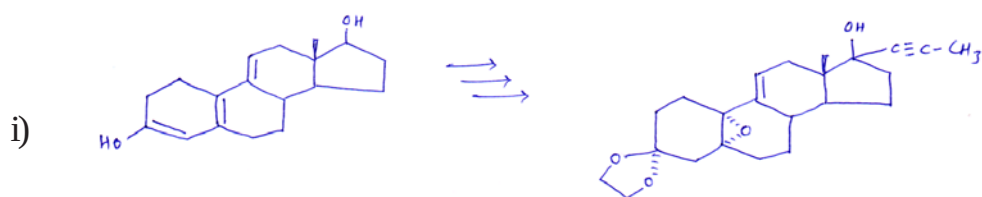
- b) Insert the missing reagents/product in the following sequences of reactions. Explain the steps with mechanism. [3]



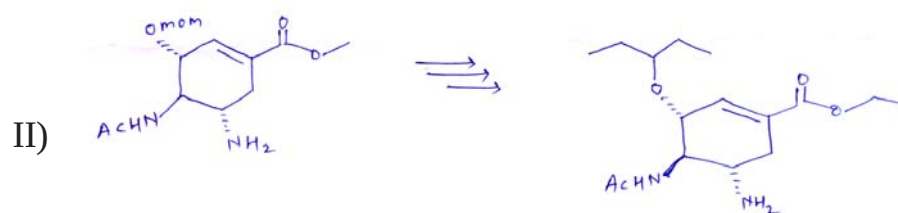
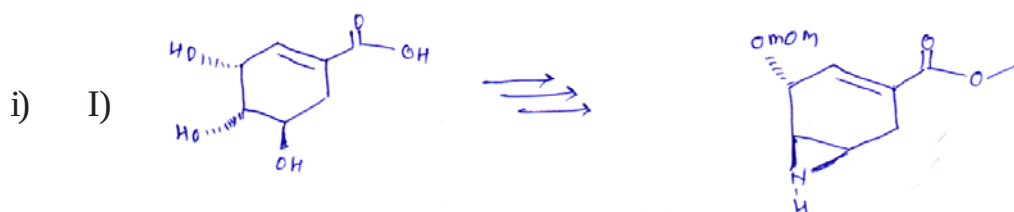
- Q2) a) Discuss the steps involved in the synthesis of the following molecules. Explain the stereochemistry & mechanism involved. (any one) [6]

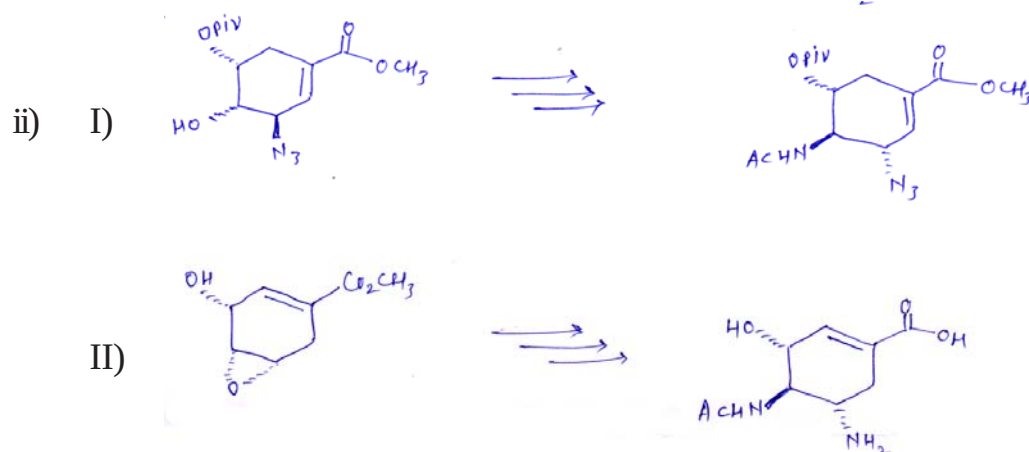


- b) Discuss the steps involved in the synthesis of the following molecules. Explain the stereochemistry and mechanism involved in all steps. (any two) [6]



- Q3) a) Describe the steps involved in the synthesis of following drug molecules. Explain the mechanism involved. (any one) [6]





b) Write a short note on (any two) :

[6]

- i) Mc-Murray pinacol coupling with example.
- ii) Corey's retrosynthetic analysis for PGf<sub>2</sub>α.
- iii) MCR based synthesis of Atorvastatin



Total No. of Questions : 3]

SEAT No. :

PE-3907

[Total No. of Pages : 1

**[6512]-36**  
**M.Sc. (Part - II)**  
**DRUG CHEMISTRY**  
**CHD - 610 (c) - MJ : Microbiology and Immunology**  
**(2023 Pattern) (Semester - III)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*

**Q1) a) Answer the following. [6]**

- i) What are the methods used for isolation of micro organism. Describe any one in detail.
- ii) Explain the morphological characters of bacteria.

**b) Write a short note on. [5]**

- i) T and B lymphocytes
- ii) Designing fermentation media

**Q2) Answer any three of the following. [12]**

- a) Differentiate between innate and adaptive immunities.
- b) How bacteria are classified based on requirement of 'C' and energy source.
- c) What is antimicrobial assay? How it is performed?
- d) Explain the following
  - i) Immunogen
  - ii) Antibodies

**Q3) Answer any four of the following : [12]**

- a) Describe the different parts of industrial scale fermenter.
- b) How will you screen the soil samples for antibiotic producers.
- c) Describe primary and secondary immune response.
- d) Explain ELISA technique.
- e) What are different methods for treatment of industrial effluent? Discuss any one of these.



Total No. of Questions : 6]

SEAT No. :

PE-4551

[Total No. of Pages : 2

[6512]-41

M.Sc. - II

DRUG CHEMISTRY

CHD-651-MJ : Drug Design

(2023 Credit Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answer to the two sections should be written in separate answer books.
- 3) Figures to the right indicate full marks.

**SECTION - I**

**Q1) a)** Define the following. **[8]**

- |                      |                                   |
|----------------------|-----------------------------------|
| i) Drug target       | ii) Antagonist                    |
| iii) Inverse agonist | iv) Signal transduction mechanism |

b) Discuss the types of receptors. **[3]**

**Q2) a)** Answer any one of the following. **[6]**

- i) Give a Comment on case studies of statins
- ii) Describe signal transduction mechanism for the tyrosine kinase receptor family

b) Explain any two of the following. **[6]**

- i) Equation of best fit
- ii) COMSIA
- iii) Pharmacophore identification

**Q3) a)** Answer any one of the following. **[6]**

- i) Discuss the various Drug-receptor interactions theories.
- ii) Explain the structure of 4-TM and 3-TM (Ion channel) receptor with well labelled diagram.

b) Answer any two of the following. **[6]**

- i) Free - Wilson approach
- ii) Hansch equation
- iii) Role of secondary messenger in GPCR.

**P.T.O.**

## **SECTION - II**

**Q4) a)** Define the following. **[8]**

- |              |                  |
|--------------|------------------|
| i) Agonist   | ii) Metabolomics |
| iii) Potency | iv) Linker       |

b) What is Docking? Explain its types **[3]**

**Q5) A)** Answer any one of the following. **[6]**

- i) Explain mix and split method used in combinatorial chemistry.
- ii) Explain the following recombinant DNA produced medicinal agents or products.
  - a) Enzymes
  - b) Vaccines
  - c) Tissue plasminogen activator

B) Discuss any two of the following. **[6]**

- i) Craig plot
- ii) Genetic Engineering
- iii) Molecular dynamics

**Q6) A)** Answer any one of the following : **[6]**

- i) Explain Hybridoma technology with well labelled diagram.
- ii) Explain the following computational methods
  - a) Molecular mechanics
  - b) Quantum mechanics

B) Write a short note on (Any two) **[6]**

- i) High throughput screening
- ii) Energy minimization
- iii) Topliss scheme



Total No. of Questions : 6]

SEAT No. :

PE-4552

[Total No. of Pages : 3

[6512]-42

M.Sc. - II

DRUG CHEMISTRY

CHD-652-MJ : Advanced Medicinal Chemistry  
(2023 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

**SECTION - I**

**Q1) a)** Give the uses and side effects of the following drug molecules. [6]

- i) Griseofulvin
- ii) Isoniazid
- iii) Chloramphenicol

**b)** Write short notes on the following : [5]

- i) Life cycle of malarial parasite.
- ii) Drug Resistance.

**Q2) Answer any four of the following :** [12]

- a) What are common classes of antifungal agents? Give one example of each. Explain the mechanism of action of polyene antifungals.
- b) Give a brief overview of therapeutic uses and mode of action of fluoroquinolones.
- c) Explain how aminoglycosides, macrolides and tetracyclines exert their antibiotic properties.
- d) Discuss the SAR of sulphonamides in brief.
- e) Explain the role of immunomodulators and vaccines in cancer treatment.

**P.T.O.**

**Q3) Answer any three of the following :** [12]

- a) Explain the mechanism of action of  $\beta$ -lactam antibiotics and their selective toxicity.
- b) Discuss the following classes of antiviral drugs in brief.
  - i) DNA polymerase inhibitors
  - ii) Protease inhibitors
- c) Discuss the following classes of anticancer drugs with their mode of action and side effects.
  - i) Alkylating agents
  - ii) Plant products.
- d) Explain the role of following classes of drug molecules in treatment of diseases mentioned.
  - i) Rifampin as antileprotic agent.
  - ii) Topoisomerase poisons in cancer treatment.

#### **SECTION - II**

**Q4) a)** Discuss the role of following drugs in disease management. [6]

- i) Omeprazole
- ii) Valporic acid
- iii) Diazepam

**b)** Write short notes on : [5]

- i) Treatment of ulcers
- ii) Diabetis

**Q5) Answer the Four of the following :** [12]

- a) What is pain? Discuss the pain pathways and management of pain.
- b) Explain heart failure and its treatment.
- c) Explain Angina pectoris giving at least two drugs used to treat it with their mechanism of action.
- d) Explain how the following groups of drugs help in disease management.
  - i)  $\beta$ -Blockers
  - ii) Diuretics
- e) Discuss the following in brief.
  - i) Vomiting
  - ii) Stroke

**Q6) Answer any three of the following :**

**[12]**

- a) Explain the role of endocrine system in maintaining healthy state of the body. Discuss the mechanism of thyroid hormone release and their role.
- b) Explain the mechanism of inflammation. Discuss any two classes of anti-inflammatory drugs giving their side effects.
- c) Explain how neuronal signal transmission is affected in Depression. Explain any two strategies to rectify it.
- d) Discuss the following in brief.
  - i) Arrhythmia
  - ii) Anticonvulsants.



Total No. of Questions : 3]

SEAT No. :

PE-4553

[Total No. of Pages : 2

[6512]-43

M.Sc. (Part - II)

DRUG CHEMISTRY

CHD-660(A) MJ : Advanced Synthetic Methods in Chemistry  
(2023 Credit Pattern) (Semester - IV) (2 Credits)

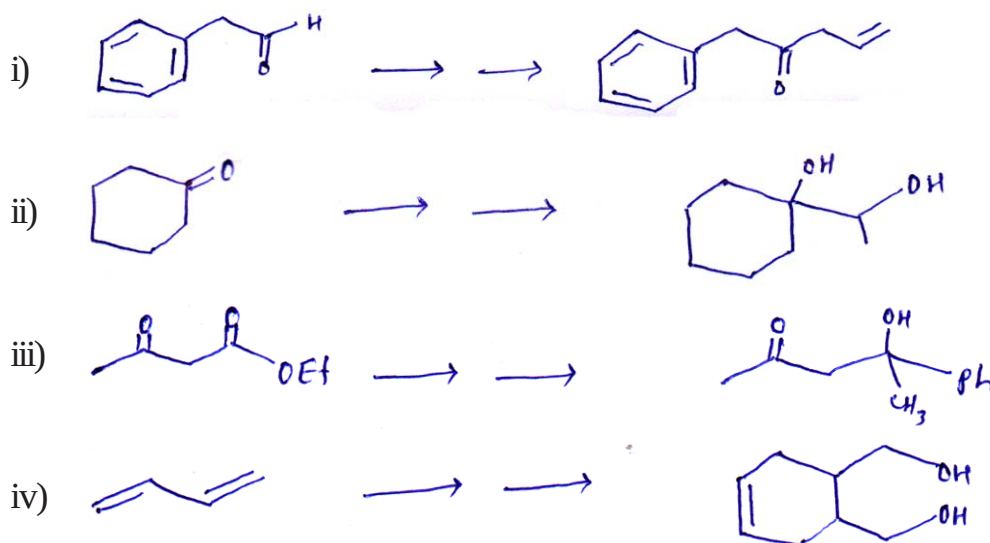
Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

Q1) a) How will you bring about the following transformation. [8]



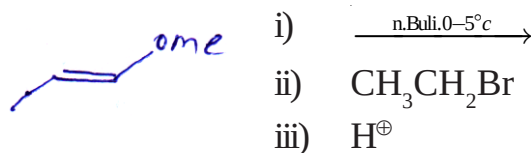
b) Explain why enamine approach is better than the base catalysed alkylation of ketone. [3]

P.T.O.

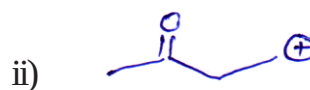
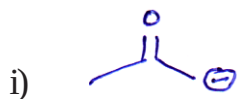
**Q2)** Answer any four of the following :

**[12]**

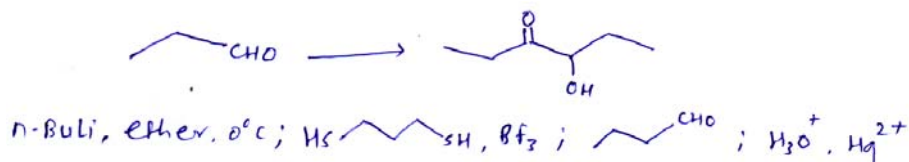
- Convergent synthesis is better than linear synthesis.
- What is Umpolung of reactivity? Predict the product and suggest the mechanism of the following :



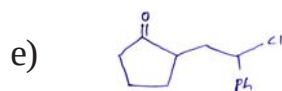
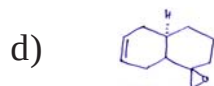
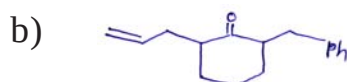
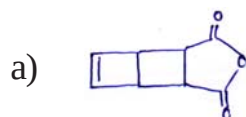
- The substituted ylides may be converted to trans-alkene in Wittig-Horner reaction.
- Give one reaction with a reagent for each synthon given below.



- Arrange the given reagents in proper order to accomplish the following conversions. Write the structures of the intermediates.



**Q3)** Using retrosynthetic analysis suggest a suitable method for the synthesis of any four of the following : **[12]**



||||

Total No. of Questions : 3]

SEAT No. :

PE-4554

[Total No. of Pages : 2

[6512]-44

M.Sc. - II

## DRUG CHEMISTRY

### CHD-660(B)MJ : Organometallic Reagents in Organic Synthesis (2023 Pattern) (Semester - IV) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

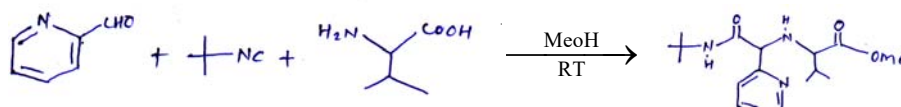
Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

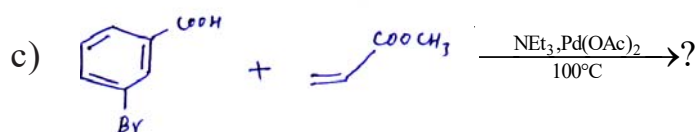
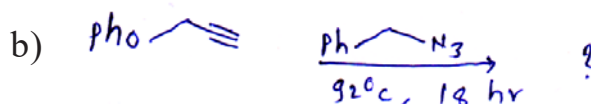
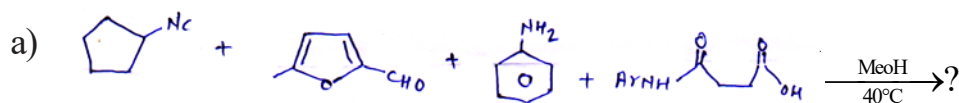
Q1) a) Answer any four of the following : [8]

- i) Give applications of organoborane in organic synthesis.
- ii) How will you prepare ketone from thioester.
- iii) Secondary amine preferentially used in the Mannich reaction.
- iv) Addition of an organolithium species to an alkene gives cyclization.
- v) Enlist the green principles involved in multicomponent reactions.

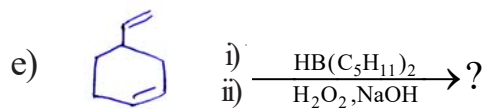
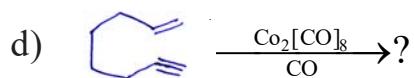
b) Suggest the mechanism for the following reaction : [3]



Q2) Predict the product with mechanism. (Any four) [12]



P.T.O.



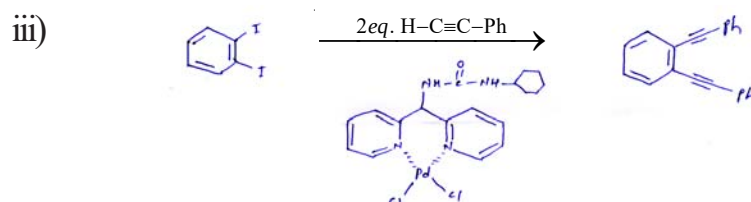
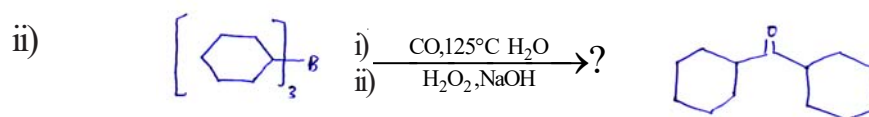
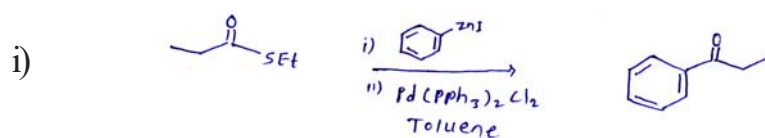
**Q3) a)** Write short notes on the following. (Any two)

[6]

- i) Heck reaction
- ii) Nazarov cyclization
- iii) Click chemistry

b) Suggest the mechanism of any two of the following :

[6]



Total No. of Questions : 3]

SEAT No. :

PE-4555

[Total No. of Pages : 2

**[6512]-45**  
**M.Sc. (Part - II)**  
**DRUG CHEMISTRY**  
**CHD - 660 (C) MJ : Forensic Chemistry**  
**(2023 Credit Pattern)(Semester - IV) (2 - Credits)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates:*

- 1) *All Questions are compulsory.*
- 2) *Figures to the right indicate full marks.*

**Q1)** a) Answer the following : **[6]**

- i) What are the steps involved in forensic drug analysis.
- ii) What are the different pathways of the drug metabolism? Discuss their significance in forensic analysis.

b) Write a short note on **[5]**

- i) Classification of Narcotic drugs.
- ii) Solvent abuse.

**Q2)** Answer any Four of the following : **[12]**

- a) Give a brief overview of cheiloscopy.
- b) Discuss the principle for isolation and determination of amphetamine and methamphetamine from urine sample.
- c) Discuss drug abuse in brief.
- d) Explain invisible fingerprint development using powder and fuming methods.
- e) Discuss the spot tests used in analysis of opioid analgesics.

**P.T.O.**

**Q3)** Answer any Four of the following :

**[12]**

- a) Write a short note on poroscopy.
- b) Discuss in brief Edgeoscopy.
- c) Discuss following classes of drugs. Explain problems associated with their use.
  - i) Narcotics
  - ii) Stimulants
- d) Explain urine analysis with suitable example for forensic investigation.
- e) Explain the importance of footprints in forensic analysis. Explain how footprints can be preserved.

