Time: 2 Hours **Marks-: 50**

N.B. -1) All questions are compulsory.

2) Figures to the eight indicate full marks.

Q.1) Answer the following (Any Two) (10)

1) What are three types of sources? Explain each with suitable example.

2) What is a search engine? Discuss any four types of search engine.

3) Write a short note on- Citation index and impact factor of journal.

4) What are the internet and the world wide concept?

Q. 2) Answer the following (Any Two) (10)

1) Define- Accuracy, Precision, Mean, Mode, and Median.

2) What is a scientific method? Give different steps involved in scientific method?

3) Write a short note on- Curve fitting.

4) What is ANOVA? Give its basic principle? Why is ANOVA method used? Give various types of ANOVA.

Q.3) Answer the following (Any Two) (10)

1) Give different types of scientific writing.

2) Discuss outline for writing of scientific papers?

3) Define plagiarism. How can be plagiarism avoided?

4) What is a research? Give various steps involved in scientific research?

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Q.4) Answer the following (Any Two) (10)

1) What are the safe working procedure and protective environment in laboratory?

2) What is chemical waste? Write a short note on- Recycling of laboratory chemicals

3) Discuss the methods for laboratory disposal of explosive?

4) What is a chemical hazard? Explain different types of chemical hazards?

Q.5 Answer the following (Any Five) (10)

1) Define H-index. If a researcher has published 66 articles and out of these 23 articles having minimum 23 citations then what is the H-index of the author?

2) How do you cite publication information?

3) Differentiate between correlation and Regression.

4) What is SI system? Give SI unit of mass?

5) Why publishing research article is important?

6) Write a short note on- Scientific poster.

7) What are the examples of protective clothing?

8) Mention the full form and three types of first aid.

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[Time: 2 hours] **[Total Marks: 50]**

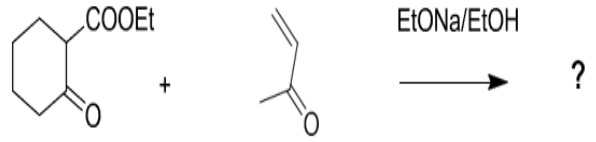
Please check whether you have the right question paper.

NB: 1. All the questions are compulsory.
2. Figures to the right indicate full marks.

Q.1) **Answer any two of the following:** **10M**

a Explain Knoevenagel amine catalysed condensation and give its mechanism with a suitable example **5**

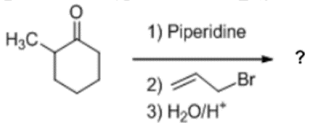
b Predict the products and give the mechanism of the following reaction **5**



c Discuss the mechanism of Mannich reaction with a suitable example. **5**

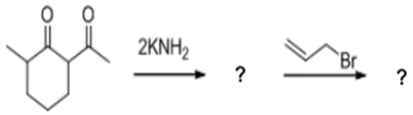
d Complete the following reactions: **5**

1.



.

2.

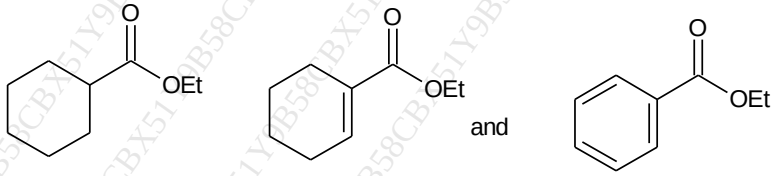


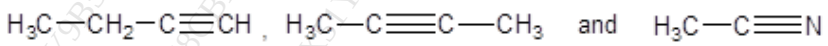
Q.2) **Answer any two of the following:** **10M**

a Draw the π − MO diagrams of diene (1, 3-dutadiene) and dienophile (ethylene) showing electron distribution. Label FMOs, show their interaction **5**

b How the following compounds are distinguished using IR spectroscopy? **5**

(i)

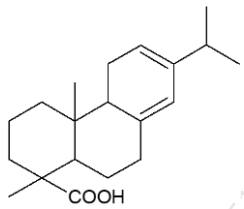


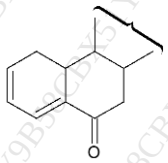


c Draw the MO diagram of ethene and butadiene. Using this diagram explain λ-max of ethene is 170 nm while that of 1, 3 butadiene is 217 nm. **5**

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d Using Woodward Fischer rules Calculate the λmax of the following compounds: **5**

i) 

ii) 

Q.3) Answer any two of the following: 10M

a What is Curtius rearrangement? Explain its mechanism. **5**

b Explain Passerini reaction with its mechanism. **5**

c Explain Dienone-Phenol rearrangement with suitable example. Explain its mechanism. **5**

d What is Baylis-Hilman reaction? Explain its mechanism. **5**

Q.4) Answer any two of the following: 10M

a Predict the number of signals and splitting pattern of the protons in the following molecules (PMR spectra): **5**
i) t-butyl alcohol ii) Isopropyl alcohol

b Give the fragmentation pattern of the following molecules: **5**
i) Pentanal ii) n-Butylbenzene

c An organic compound A (Molecular formula: $C_9H_{10}O_2$) exhibits the following spectral data: **5**
IR: 1745cm^{-1}(s), 1225cm^{-1}(br, s), 749cm^{-1}(s), 697cm^{-1}(s)
^1H NMR = δ 1.96 (3H, s); 5.00 (2H, s); 7.22 (5H, s)
Deduce the structure of the compound.

d Explain the following with respect to NMR spectroscopy: **5**
i) Karplus curve and its significance
ii) Spin-spin coupling

Q.5) Answer any FIVE of the following; 10M

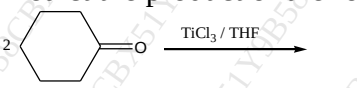
a Discuss in brief stability of enolate ions with suitable example. **2**

b Explain the reaction of acetophenone with excess iodine and NaOH. **2**

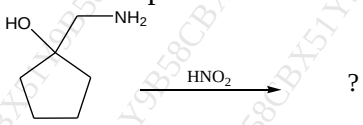
c Define hard and soft electrophiles. Give one example of each **2**

d Explain the term combination bond w.r.t. IR spectroscopy **2**

e Predict the product of the following reaction and give name of the reaction. **2**



f Predict the product of the following reaction and give name of the reaction. **2**



g Explain the following terms in mass spectrometry: **2**
i) Base peak
ii) Isotopic abundance

h Why is TMS used as a reference standard in NMR spectroscopy? **2**

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TIME: 2 HOURS **MAX. MARKS: 50**

NB:

1) **All questions are compulsory.**
2) **Figures to the right indicate full marks.**
3) **Use of logarithmic table/non-programmable calculator is allowed.**
4) **At. Wts: H=1, C=12,N=14,O=16,Na=23,Al=27,S=32, Cl=35.5, K=39, Ca=40,Ag=108 , Ba=137, Pb=207,Mg= 24.3,F=19,Cu= 63.5, Cr = 52, Sn=118.7 Fe = 55.8**

Q.1 Answer **any two** of the following: 10

A. Discuss performance characteristics of analytical method.

B. Write note on basic safety in laboratory.

C. Give classification of Analytical methods.

D. What is the principle of NABL accreditation?

Q.2 Answer **any two** of the following: 10

A. A buffer solution was prepared by mixing 0.05 mole acetic acid with 0.06 mole sodium acetate in distilled water to make 1 dm^3 solution. Calculate the pH of the solution. [Given Ka for acetic acid is 1.8×10^{-5}].

B. Calculate the volume of HCl (density 1.19 gm / cm^3, 38% HCl by weight) required to prepare 18 dm^3 of 0.02 N HCl.

C. 161 g of ethanol and 145 g of acetone are mixed together. Find the mole fraction of each compound in the mixture.

D. 100 g of Na_2CO_3 reacts with 100 g of HCl. Calculate the amount of NaCl formed, in moles and in grams. Which is the limiting reagent.

Q.3 Answer **any two** of the following: 10

A. Draw a labelled schematic diagram of Michelson's interferometer. Explain its working in FTIR

B. Name the Infra-red (IR) sources and describe any two in detail.

C. In what way the Fourier Transform (FT) instruments differ from the optical instruments?

D. With the help of block diagram describe the dual wavelength spectrophotometer. What type of samples can be analysed by it?

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Q.4 Answer **any two** of the following: 10

A. Explain the principle of Differential Scanning Calorimetry (DSC) and discuss any one of its application.

B. Differentiate between power-compensated and heat-flux DSC instruments.

C. Discuss the factors affecting DSC Curves.

D. Describe the role of multilayered films in automated analysis.

Q.5 Answer **any five** of the following: 10

A. What are determinate errors? Enlist two determinate types of error.

B. What is the meaning of government standards like HALLMARK and AGMARK?

C. Assign oxidation number to each element in $Cr(OH)_4^-$.

D. Solid $BaSO_4$ is dissolved in water at 25 °C. Its solubility is 1.04×10^{-5} mol/dm^3. Calculate the solubility product (Ksp) of the compound.

E. Explain the effect of temperature on the λ_{max} values in the UV-visible spectra.

F. What are the photoconducting transducers in FTIR?

G. Describe the quantity measured for each of the following techniques.
a) TGA b) DTA

H. Discuss the advantages of automated analyses.

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Duration-- 2 Hours **Max Marks: 50**

N.B. 1. All questions are compulsory.
2. Figures to the right indicate marks.

Q.1 Attempt **any two** of the following. 10

A. What is the difference between the columns, C8 and C18 used in an HPLC system?

B. The retention time of two components on column were found to 3.28 min and 5.26 min respectively. Calculate (i) HETP for each peak (ii) Resolution. If the width of the two peaks is 0.46 and 0.57 min., respectively and the time for mobile phase was 0.17min with the length of the column as 24.1cm.

C. What are different ways of optimization of chromatographic conditions. Discuss in details.

D. Give ideal properties of the detectors to be used in GLC and GSC.

Q.2 Attempt any **two** of the following. 10

A. With the help of schematic diagram, describe lithium drifted silicon detector used in X-ray spectroscopy.

B. Write qualitative and quantitative applications of X-ray fluorescence spectroscopy.

C. Name ion sources used in molecular mass spectrometry. Discuss any one in details with its advantages.

D. Explain principle and theory of neutron activation analysis.

Q.3 Attempt **any two** of the following. 10

A. Discuss the principle of the scanning tunneling microscope (STM).

B. Draw a schematic diagram of scanning electron microscope (SEM) and discuss the process of obtaining SEM images.

C. With respect to transmission electron microscope (TEM), discuss:
i. Electron gun ii. Condenser lens and iii. Objective lens

D. Explain the appearance and temperature profile of the inductively coupled plasma source used in atomic emission spectrometer.

Q.4 Attempt **any two** of the following. 10

A. Write short note on enzyme-based biosensors with example.

B. Discuss effect of complex formation on the polarographic wave.

C. What is electrogravimetry? Discuss the factors that control the physical properties of electrolytic precipitates in electrogravimetry.

D. Calculate the time needed, in minutes, for a constant current of 0.96 A to deposit 0.5 g of Co(II) as elemental cobalt on the surface of a cathode.
(1 Faraday =96500 C, molar mass of cobalt = 58.93)

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Q.5 Attempt **any five** of the following. 10

A. Mention any two applications of thermionic detector.
B. Name the detectors used in HPLC and mention its use.
C. Describe powder method used in X-ray diffraction analysis.
D. Draw a schematic diagram of: 'Time of Flight Mass analyzer'.
E. Write the mathematical expression for magnification achievable in scanning electron microscope (SEM) images and explain the terms involved.
F. Mention the limitations of atomic absorption spectrometry (AAS).
G. State any two desired characteristics of ion selective electrodes.
H. State any two features of controlled potential coloumetry.

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[Time: 1hr] [Marks:25]

Please check whether you have got the right question paper.

N.B.: 1. All questions are compulsory.
2. Figure to the right indicates full marks.
3. Use of non – programmable scientific calculator is allowed.

Useful constants

$c = 2.998 \times 10^{8}$ m.s^{-1} | $e = 1.602 \times 10^{-19}$ C
$R = 8.314$ J.K^{-1}mol^{-1} | $k = 1.3811$ x 10-23 J.K^{-1}
$= 2.0$ cal.K^{-1} mol^{-1}
$h = 6.626 \times 10^{-34}$ Js | $1J = 6.24 \times 10^{18}$ eV
$m_e = 9.110 \times 10^{-31}$ kg | $1eV = 8.06 \times 10^{3}$ cm^{-1}
$NA = 6.022 \times 10^{23}$ mol^{-1} | 1 amu $= 1.66 \times 10^{-27}$ kg
Atomic mass of H = 1, C = 12, N = 14, O = 16, S = 32, Cl = 35.5

1. A) Attempt ***any two*** of the following:
   i) Derive thermodynamically the Kelvin equation of vapour pressure of droplets 04
   ii) What is meant by the term excess functions? Write an expression for a) Excess entropy b) Excess enthalpy 04
   iii) What is ATP and draw its structure? How is ATP synthesized from ADP? 04
   iv) At NTP 16g of O_2 was mixed with 14g of N_2. Calculate Δ_{mix} G and Δ_{mix} S 04

2. A) Attempt ***any two*** of the following:
   i) Derive the parabolic rate law equation for the reaction of a gas on the surface of solid particles. 04
   ii) Discuss the kinetics of regulatory enzymes. 04
   iii) Derive Lineweaver-Burk and Eadie analysis of the rate data of enzyme catalyzed reaction. 04
   iv) An enzyme hydrolysed a substrate concentration of 0.02 mmol dm^{-3}, the initial rate was 1.7 x 10^{-3} mmol dm^{-3} min $^{-1}$ and the maximum rate was 5.5 x 10 $^{-3}$ mmol dm^{-3}.min^{-1}. Calculate the Michaelis constant (K_m). 04

3. A) Attempt ***any three*** of the following:
   i) Derive an equation showing change in fugacity with respect to pressure 03
   ii) Write the postulates BET Adsorption isotherm. 03
   iii) Explain the structure of ATP molecule with diagram giving one example of biochemical reaction involving ATP. 03
   iv) Discuss the factors which affect the reactions in solid state. 03
   v) Derive an expression for the linear free energy relationship of reactions in solution. 03
   vi) Predict the effect of ionic strength on the rate constant for each of the 03

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following reactions.

i) $[PtCl_4]^{-2} + OH^- \rightarrow$ Product

ii) $[Cr(urea)_6]^{+3} + H_2O \rightarrow$ Product

iii) $Fe^{+2} + [Co(C_2O_4)_3]^{-3} \rightarrow$ Product

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