Code	Subject Title	Cr. Hrs	Semester
CHEM-412	Analytical Chemistry (Sp. Theory-I)	4	VII

Year	Discipline
4	Chemistry

SYLLABUS OUTLINE:

Gas Liquid Chromatography / Gas Solid Chromatography:

Gas Chromatographs, Derivative Formation, Gas Chromatographic Columns, Liquid Phases and Column Selection, Detectors for Gas Chromatography, Optimization of Experimental Condition, Gas-Solid Chromatography, Interfacing Gas Chromatography with Mass Spectrometry, Interfacing Gas Chromatography with Infrared Spectrometry.

High Performance Liquid Chromatography:

Optimization of Column Performance, Gradient Elution and Related Procedures, Derivation, HPLC Instrumentation, Mobile-Phase Delivery System, Sample Introduction, Separation Columns, Detectors, Interfacing HPLC with Mass Spectrometry

Potentiometry:

Nernst equation; Electrode Potentials; different reference electrodes including glass and calomel electrode; working of a potentiometer and its applications including pH measurements and potentiometric titrations; ion-selective electrode systems; ion-exchange membrane electrode; gas-sensinig electrode; solid-state membrane electrode and bio membrane electrode.

Thermo gravimetric Analysis / Differential Thermal Analysis:

General Principle of thermal, instrumentation, types of measurements; TGA (thermogravimetric analysis), DTA (differential thermal analysis), DSC (differential scanning calorimetry), TT (thermometric titrations) and EGD (evolved gas detection), Principles, instrumentation and applications of these techniques.

RECOMMENDED BOOKS:

1. Electro Analytical Chemistry by J.J. Longane, Inter Science Publisher Inc. N.Y. London.
2. Vogels, text book of Quantitative chemical analysis byJ.mendham, RCDenny, JDBarnes, MJ KTHomas, Pearson education Ltd.

UNIVERSITY OF THE PUNJAB

Seventh Semester – 2019

Examination: B.S. 4 Years Program

Roll No. in Fig. .....

Roll No. in Words. .....

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Signature of Supdt.:

PAPER: Analytical Chemistry (Sp. Theory-I) **MAX. TIME: 15 Min.**

Course Code: CHEM-412 Part–I (Compulsory) **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.
Please encircle the correct option. Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1: Encircle the right answer, cutting and overwriting is not allowed. (1x10=10)

(i)- Which of the following phenomena taking place in DTA is exothermic?

(a)Reduction(b) Vaporization (c) Desorption (d) Chemisorption

(ii)- In thermo gravimetric analysis, the result obtained appears as a _____.

(a) Continuous chart (b) Continuous parabola

(c) Continuous circular positions (d) Discontinuous chart

(iii)- The radioactive β emitter usually used in electron capture detector is

(a) Zn^{64}. (b) Cu^{62}(c) Co^{59} (d) Ni^{63}.

(iv)- Which is not the quality of open tubular column?

(a) Shorter analysis time (b) Higher resolution measured

(c) Higher sample capacity (d) Greater sensitivity

(v)- Which gas possesses thehighest thermal conductivity?

(a) H_2 (b) O_2 (c) CO_2 (d) Ar

(vi)- Electrodes used in potentiometric titrations are?

(a) 2 (b) 3 (c) 1(d) 4

(vii) Which stationary phase is used for separation of basic compounds atpH 8–12 in HPLC?

(a) Silica gel (b) Alumina(c) Polystyrene (d) $MgSO_4$

(viii) Syringe pumps used in HPLC are most suitable for which of the following column

(a) Capillary column (b) Small bore column

(c) Short-fast column (d) Guard column

(ix)- Which one is the most common separation mode in HPLC?

(a) Reversed-phase mode (b) Normal-phase mode

(c) Ligand exchange mode (d) Ion exchange mode

(x)- . A glass membrane with a composition of 11% Na_2O, 18% Al_2O_3, and 71% SiO_2 is used as an ion-selective electrode for

(a) Al^{3+}(b)H^+(c) K^+ (d)) Na^+

UNIVERSITY OF THE PUNJAB

Seventh Semester – 2019

Examination: B.S. 4 Years Program

Roll No. .....

PAPER: Analytical Chemistry (Sp. Theory-I)
Course Code: CHEM-412 Part – II

MAX. TIME: 2 Hrs. 45 Min.
MAX. MARKS: 50

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

Q.2- Attempt allShort questions: (2x10=20)

(i)What are the advantages of thermal conductivity detector?

(ii)-What do you understand by temperature programming in gas chromatographic analysis?

(iii) -.What are the disadvantages of H_2 as carrier gas in gas chromatography?

(iv)-Define retention time. On what factors does it depend?

(v)Write down the principles of TGA and DTA.

(vi)-Give difference between normal phase chromatography and reverse phase chromatography.

(vii)What is the role of liquid junction potential in potentiometery?

(viii)- What are the Characteristics of an ideal reference electrode?

(ix)Briefly describe the principle involved in potentiometric titrations.

(x)What is DTA curve?Give its characteristics.

Q.3 (a)DiscussOpen Tubular Columns in gas chromatography. (5)

(b)Discuss the construction and working of saturated Calomel electrode (5)

Q.4 (a)Discuss various types of columns in HPLC. (5)

(b)Explain solid state membrane electrodes in potentiometry. (5)

Q.5 (a) Write down the applications of differential scanning calorimetry(DSC) (5)

(b) Explain the working of Electron Capture Detector in gas Chromatography. (5)

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B.S. 4 Years Program :Seventh Semester – 2020

Paper: Analytical Chemistry (Sp. Theory-I)

Course Code: CHEM-412 Part – I (Compulsory) Time: 15Min. Marks: 10

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Roll No. in Words. .....

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Signature of Supdt.:

Attempt this Paper on this Question Sheet only.
Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Encircle the right answer cutting and overwriting is not allowed. (10x1=10)

(i)- Which is a common carrier gas in gas chromatography?

(a) He (b) NH_3 (c) HCl (d) SO_3

(ii)- Which property is measured in Differential scanning calorimetry(DSC)?

(a)Thermal Expansion (b) Electrical conductivity

(c)Specific Heat (d) Impact Energy

(iii)- Calomel is?

(a) Mercuric chloride (b) Plumbic chloride

(c) Mercurous chloride (d) Plumbous chloride

(iv)- In which thermal analysis temperature difference between sample and inert reference material is measured?

(a) Differential scanning calorimetry (b) Thermogravimetric analysis

(c) Differential thermal analysis (d) Evolved gas analysis

(v)-In normal phase HPLC, there is?

(a) Non polar solvent/polar column (b) Polar solvent/non polar column

(c) Non polar solvent/non polar column (d) Any of the above

(vi)Which of the following is the disadvantage of hydrogen, when used as carrier gas in gas chromatography?

(a) Dangerous to use (b) Expensive (c) Reduced sensitivity (d) High density

(vii)Which of the following is not true about High pressure liquid chromatography (HPLC)?

(a) It requires high pressure for the separation (b) There is no need to vaporize the samples
e) It is performed in columns d) It has high sensitivity

(viii)Percentage of Silica in glass membrane is?

(a) 52% (b) 62% (c) 72% (d) 82%

(ix) For the separation of which of the following substances, Gas-solid chromatography is being used?

a) Thermally stable organic components b) Volatile organic components
c) Thermally stable inorganic components d) Low molecular weight gaseous species

(x) Differential scanning calorimetry is used to determine?

(a)Glass transition temperature (b) Enthalpies (c) Both a & b (d)None of these

UNIVERSITY OF THE PUNJAB

B.S. 4 Years Program :Seventh Semester – 2020

Roll No. .....

Paper: Analytical Chemistry (Sp. Theory-I) Time: 2 Hrs. 45 Min. Marks: 50

Course Code: CHEM-412 Part – II

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

Q.2. Give short answers of the following: **(10x2=20)**

(i)What are the main advantages High Performance Liquid Chromatography?

(ii)Write a note on flame ionization detector?

(iii)What are the advantages and disadvantages of Ag/AgCl

(iv)Whatis Gradient Elution?

(v)Write a note on UV detectors used in HPLC?

(vi) What is glass transition temperature?

(vii)What is alkaline error inpotentiometry?

(viii)Write note on gas sensing probes?

(ix)How TGA can be used to evaluate the thermal stability of a material?

(x)What is the basic theory of DTA?

Answers the following questions. **(3x10=30)**

Q.3 (a)Write a note on instrumentation used for Thermometric titration.

(b) Discuss the factors affecting differential thermal analysis.

Q.4 (a) Discuss Calomel electrode and its advantages?

(b)Write a note on Electron Capture Detector.

Q.5 (a) Write a note on open tubular columns in Gas Chromatography?

(b)Write a note on potentiometric acid base titration.

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B.S. 4 Years Program : Seventh Semester – Fall 2021

Roll No. .....

Paper: Analytical Chemistry (Sp. Theory-I) Course Code: CHEM-412 Time: 3 Hrs. Marks: 60

Q.1. Answer the following short questions: (15x2=30)

i. Give three types of open tabular column in gas chromatography.
ii. Differentiate between gradient elution and Isocratic elution.
iii. What are selection criteria for gas in GC?
iv. What merits and demerits of derivatives by alkylation.
v. Write three characteristics of ideal reference Electrode.
vi. Describe principle involved in potentiometric titration.
vii. Name four indicator electrodes.
viii. Describe disadvantages of ion selective electrode.
ix. What is principle of TGA?
x. Write characteristics of DTA curve.
xi. What is glass transition temperature?
xii. Differentiate between heat Flux DSC and power compensated DSC.
xiii. Name adsorbents used in HPLC column.
xiv. Describe four advantages of HPLC.
xv. Describe principle of HPLC.

Answer the following questions. (3x10=30)

Q.2: a) Describe construction and working of Silver-Silver chloride Electrode. (5)
b) Describe potentiometric titration in case of weak acid with strong base with the help of graph. (5)

Q.3: a) Describe instrumentation of gas chromatography with the help of diagram (5)
b) How is liquid sample injected in Gas chromatography? (5)

Q.4: a) Describe instrumentation of TGA with the help of diagram. (5)
b) Describe various types of column in HPLC. (5)

UNIVERSITY OF THE PUNJAB

B.S. 4 Years Program / Seventh Semester – Spring 2022

Roll No. .....

Paper: Analytical Chemistry (Sp. Theory-I) **Course Code: CHEM-412** **Time: 3 Hrs. Marks: 60**

THE ANSWERS MUST BE ATTEMPTED ON THE ANSWER SHEET PROVIDED

Q.1. Answer the following short questions: (15x2=30)

i. Define Van Deemter Equation.
ii. Define retention time. On what factor does it depend?
iii. Differentiate between Normal phase chromatography and Reverse phase chromatography.
iv. Differentiate between split mode injectors and splitless mode injectors.
v. What is liquid junction potential in potentiometry?
vi. Differentiate between primary and secondary reference electrode.
vii. How is calomel electrode represented?
viii. Define standard electrode potential.
ix. What is thermocouple?
x. Give two differences between DSC and DTA.
xi. What is thermal analysis?
xii. Define thermometric titration.
xiii. What is pre column in HPLC?
xiv. Why is derivatization required in HPLC?
xv. What is reverse phase mode in HPLC?

Answer the following questions.

Q.2: a) Derive Nernst Equation. (5)
b) Give applications of Nernst Equation. (5)
Q.3: a) Why is derivatization carried out in gas chromatography? (5)
b) Describe types of Capillary column in Gas chromatography. (5)
Q.4: a) Describe applications of TGA curves. (5)
b) Describe different problems while using HPLC. (5)