Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (ICE/EIE(O))/SEM-8/EI-801C/2010

2010
ANALYTICAL INSTRUMENTATION

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

   i) Katharometer cell is used to measure the

      a) pH of the liquid

      b) conductivity of the liquid

      c) thermal conductivity of gas

      d) potential difference.

   ii) Non-dispersive type instrument uses

      a) wide frequency band

      b) no restriction on frequency

      c) narrow frequency band

      d) single frequency.

iii) Dropping mercury electrode is used in

a) Polarography

b) conductivity test

c) pH measurement

d) dissolve oxygen analysis.

iv) Gow-Mac densitometer is used to measure the density of

a) solid b) liquid

c) gas d) none of these.

v) Magneto dynamic type oxygen analyzer dumbel is filled up with

a) oxygen

b) nitrogen

c) hydrogen

d) water vapour.

vi) Viscosity of non-Newtonian fluid is measured by

a) Saybold viscometer

b) Redwood viscometer

c) Cone and plate type viscometer

d) Englar viscometer.

vii) In gas chromatography, the ratio of partition coefficients of two components is called

a) capacity factor b) resolution

c) elution time d) selectivity factor.

viii) The analyzer cell where a third electrode may be added to increase life of the cell is

a) Zirconia fuel cell

b) Polarographic cell

c) Hot wire TCD analyzer

d) Hersh cell.

ix) The mass spectrometer which uses Mattauch-Herzog geometry is

a) Quadrupole b) ESR

c) Double focusing d) Time of flight.

x) Pyroelectric detector is formed as temperature sensitive

a) resistor b) inductor

c) capacitor d) diode.

xi) Force acting on electron charge e, mass m moving with a velocity v in a direction parallel to uniform magnetic field H is

a) 0 b) Hev/r^2

c) mv^2/r d) mv/r.

xii) Which of the following microwave bands is suitable for moisture measurement ?

a) *S* band

b) *X* band

c) both *S* band & *X* band

d) *K* band.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. What is meant by polarization of solution in context of conductivity measurement ? How can it be minimized ? 2 + 3

3. Briefly discuss the working principle of electrolytic hygrometer with the help of schematic diagram. What is the main source of error in such hygrometer ? 4 + 1

4. What are the detectors used for UV absorption spectrometry ?

5. How can microwave be used for moisture measurement ? Explain with neat sketch.

6. What is the function of coalescer ? Draw and discuss the scheme of a steam-injected suction system. 1 + 4

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Why is IR spectroscopy called vibrational spectroscopy ? Prove that molecular electronic excitation, vibrational excitation, rotational excitation take place in UV-visible, NIR, FIR regions of electromagnetic wave spectrum respectively. 2 + 4

b) Write some examples of application field where pH measurement as well as control are necessary. What is buffer solution ? 2 + 1

c) Draw & discuss different procedures of feeding the sample gas to the hot wire cell in case of hot wire TCD analyzer. 5

d) Give an example of source commonly used in atomic absorption spectroscopy. 1

8. a) Draw a diagram of the gas chromatography set-up and explain the function of the components. 3 + 4

b) Explain, with a diagram, the principle of operation of the Electron capture detector. 5

c) Define retain factor. Derive the expression of capacity factor. 1 + 2

9. a) How do you estimate the percentage in sample gas by heat of reaction method ? 4

b) What is cell constant of conductivity cell ? Why is it different in different cells ? 2 + 3

c) What do you mean by pH of solution ? 3

d) What is the requirement of reference cell in pH measurement ? 3

10. a) Write down a comparison between thermomagnetic and zirconia oxygen analyzer method. 4

b) Discuss the difference between the dispersive and non-dispersive IR spectrometer. 4

c) Explain the working principle of the FT IR spectrometer based on Michelson interferometer principle. 7

11. Write short notes on any *three* of the following : 3 × 5

a) Flame ionization detector

b) Golay detector

c) Vibrating U tube densitometer

d) Time of flight type mass spectrometer

e) Working principle of dropping mercury electrode.