*Name* : .....

*Roll No.* : .....

*Invigilator's Signature* : .....

**CS/B.TECH(ICE)/SEM-8/EI-801C/2012**

**2012**

# 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) A buffer solution is a solution that
   a) retains its pH for a long time
   b) cannot retain its pH for long
   c) has no electrolytic property
   d) acts as an intermediate solution between two solutions of different pH.

iv) Dew point is expressed as
   a) % ( percentage ) b) °C
   c) $V_{ppm}$ d) none of these.

v) Aerosol is formed by
   a) Bolometer b) Scintillation counter
   c) Nebulizer d) Nephelometer.

vi) Pyroelectric detector is formed by temperature sensitive
   a) resistor b) inductor
   c) capacitor d) diode.

vii) NMR stands for
   a) Nuclear Magnetic Resonance
   b) Neural Membrane Response
   c) Nuclear Magnetic Response
   d) none of these.

viii) In gas chromatography, capacity factor $K_c$ can be represented as
   a) $( t_M - t_R ) / t_R$ b) $t_R / t_M$
   c) $( t_R - t_M ) / t_M$ d) $t_M / t_R$ .

ix) The mass spectrometer which uses Mattauch-Herzog geometry is
   a) Quadrupole b) ESR
   c) Double focusing d) Time of flight.

x) In gas chromatography, stationary phase may be
   a) plasma b) liquid
   c) gas d) solid or liquid.

xi) 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 princple of electrolytic hygrometer with the help of schematic diagram. What is the main source of error in such hygrometer ? 4 + 1

4. a) Define viscosity.

   b) Explain an efflux method of viscosity measurement with a diagram. 1 + 4

5. How do you estimate the percentage of oxygen present in sample gas by heat of reaction method ? Explain. 5

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) Draw a diagram of the gas chromatography setup and explain the function of the components. 3 + 4

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

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

8. a) Write down a comparison between thermomagnetic and zirconia oxygen analyzer methods. 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

9. Why is analytical instrumentation system necessary in industrial process ? What do you mean by online instruments ? Describe with neat diagram, the working of thermal conductivity type gas analyzer. 4 + 3 + 8

10. a) What is meant by atomization ? Briefly discuss flame atomizer in context of atomic spectroscopy ? 1 + 5

    b) What is 'Plasma' ? Draw the schematic diagram of ICP source and briefly discuss it. 5

    c) Draw a typical scheme of atomic absorption spectroscopy. Give an example of commonly used source in atomic absorption spectroscopy. What is the basic difference between atomic absorption spectroscopy and atomic emission spectroscopy ? 2 + 1 + 1

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

    a) Vibrating *u* tube densitometer

    b) Oxidation Reduction Potential ( ORP )

    c) *X*-ray Spectrometry

    d) pH measurement

    e) Time of flight type mass spectrometer

    f) Capillary viscometer.