Name : ............................................................

Roll No. : ............................................................

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

## CS/B.Tech(EIE)/SEM-7/EI-703/2009-10
## 2009
## 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 :

$$10 \times 1 = 10$$

i) In heat of combustion method, $H_2$ is supplied at pressure of about

a) $1.5 - 2$ kg/cm$^2$       b) $3 - 3.5$ kg/cm$^2$

c) $4 - 6$ kg/mc$^2$        d) above 10 kg/cm$^2$ .

ii) 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.

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iii)   Ilkovic equation appears in the electrochemical analysis method of

a)   amperometric titration

b)   voltammetry

c)   coulometry

d)   electrogravimetry.

iv)   Which viscometer is used for both of Newtonian and Non-Newtonian fluid ?

a)   Saybolt's viscometer

b)   Ostwald viscometer

c)   Cone and plate viscometer

d)   None of these.

v)   Dew point is expressed as

a)   % ( percentage )          b)   °C

c)   $V_{ppm}$                        d)   none of these.

vi)   In Flame ionization detecter, the magnitude of current is proportional to

a)   Proton number

b)   Neutron number

c)   Effective carbon number

d)   Mass number.

vii)   Aerosol is formed by

a)   Bolometer          b)   Scintillation Counter

c)   Nebulizer          d)   Nephelometer.

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viii) In Nernst equation of Zirconia $O_2$ analyzer, value of $n$ is taken as

a) 0

b) 1

c) 3

d) 4.

ix) Pyroelectric detector is formed temperature sensitive

a) Resister

b) Inductor

c) Capacitor

d) Diode.

x) 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) $t_M - t_R$.

where $t_R$ is retention time and $t_M$ is dead time.

xi) The constant polarizing voltage applied in polarographic cell is

a) 0·5 V

b) 0·8 V

c) 1·5 V

d) 2·0 V.

xii) The temperature range of inductively coupled plasma is

a) 4000 – 5000 K

b) 6000 – 7000 K

c) 7000 – 8000 K

d) 13000 – 14000 K.

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## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following.    $3 \times 5 = 15$

2. Why is IR spectoscopy called vibrational spectroscopy ? Show that molecular electronic excitation, vibrational excitation & rotational excitation take place in UV — Visible, NIR, FIR regions of electromagnetic wave spectrum respectively.    2 + 3

3. From two component chromatogram, determine the expressions of capacity factor, selective factor & resolugion.

    5

4. Describe continuous and stepwise elusion process of solvent programming in HPLC.    5

5. What are the advantages and disadvantages of Quinhydrone electrode ? Write down the *emf* equation of this electrode.

    3 + 2

6. What is polarization ? How can it be minimized or eliminated ?    2 + 3

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## GROUP – C
### ( Long Answer Type Questions )
Answer any *three* of the following.　　3 × 15 = 45

7. a) Describe the moisture measurement technique with necessary diagram.

   b) How may thermal conductivity gas analyzer be used to measure the concentration of the component gas of a binary gas mixture ?

   c) Define density of the fluid. Describe with neat diagram the techniques for measuremtnt of density of a process fluid for controlling the quality.　　5 + 4 + ( 1 + 5 ) = 15

8. a) Explain with the help of a functional diagram, how can be oxygen concentration in sample gas determined by differential pressure type paramagnetic analyzer. Why does the instrument incorporate an electromagnet with changing flux intensity ?　　5 + 1

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

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c) Write some applications of hot wire TCD analyzer. 2

d) Define kinematic viscosity & dew point. 2

9. a) Draw the schematic of the Ion Selective FET ( *ISFET* ) electrode and describe the working of the same. How can selectivity and reliability be improved of the ISFET ?

b) What do you mean by concentration polarization ? Describe the linear-scan polarography process with necessary circuit diagram. Also explain the nature of the polarograph found. ( 5 + 2 ) + ( 2 + 4 + 2 ) = 15

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 & 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 & atomic emission spectroscopy ?

2 + 1 + 1

11. Write short notes on any *three* of the following :     $3 \times 5 = 15$

    a)     Hydrometer

    b)     IR Sources

    c)     X-ray Spectroscopy

    d)     Katharometer.

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