



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 :

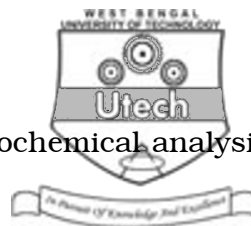
$$10 \times 1 = 10$$

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

- a) $1.5 - 2 \text{ kg/cm}^2$ b) $3 - 3.5 \text{ kg/cm}^2$
c) $4 - 6 \text{ kg/mc}^2$ 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.



- 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 detector, 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.



GROUP – B

(Short Answer Type Questions)

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

2. Why is IR spectroscopy 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 & resolution. 5
4. Describe continuous and stepwise elution 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



GROUP – C

(Long Answer Type Questions)

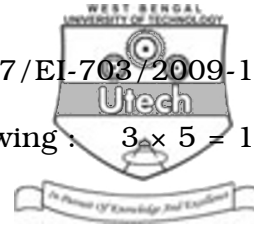
Answer any *three* of the following. $3 \times 15 = 45$

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 measurement 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



- 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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