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RF-3907

M. Sc. - I Examination

April / May – 2010

Instrumentation : Paper-IV

(Optical, Analytical, Biomedical, Environmental Instrumentation)

Time : **3** Hours] [Total Marks : **70**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **M. Sc. 1**

Name of the Subject :

☛ **Instrumentation : Paper-4**

☛ Subject Code No. : **3 9 0 7** ☛ Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) **All** questions are **compulsory**.

(3) Figures to the **right** indicate **full** marks.

(4) Assume data if required.

1 (a) Explain the following terms : **6**

(i) Resonance cavity

(ii) Population inversion

(iii) Numerical aperture and acceptance angle of fiber.

(b) Discuss various materials used for the production of optical fibers. What are the factors to be considered for the selection of the said materials. **2**

(c) A point source of light is 12 cm below the surface of a large body of water (n=1.33). What is the radius of the largest circle on water surface through which the light can emerge? **5**

2 (a) Distinguish between stimulated and spontaneous emission. Obtain the condition under which stimulated emission is observed. Discuss the mechanisms for operation of Nd : YAG and Nd : Glass lasers. **6**

(b) Draw the schematic diagram of a pin photodiode and explain its working. Derive the expressions of photocurrent and quantum efficiency. **6**

OR

2 (a) Describe in detail the vapour phase axial deposition technique used for the production of optical fibers. What are its advantages? **6**

(b) Show that the threshold pump energy of Ruby loser is about 54 J/cm^3. **4**

The no. of atoms per unit volume N=1.6×10^{19}cm^{-3} and average pump frequency v_p =6.25×10^{14}Hz.

3 (a) What is EEG? How many types of electrodes are used in EEG. Discuss EEG amplitude and frequency bands. **6**

(b) What is sphygmomanometry?How is it used to measure blood pressure. **4**

OR

3 (a) Using schematic diagram, explain how the heart-lung machine maintains blood circulation and oxygnates the blood during heart surgery. **6**

(b) (i) Calculate the energy stored in a 16μF capacitor that is charged to a potential of 5000 V dc. **2**

(ii) Find the relative index of refraction at interface between two mediums if sound travels at 1500m/s in one and 970 m/sec in the other. **2**

4 (a) Draw a typical scheme of a NMR spectrometer with sweeping magnetic field. Explain the operation of it. **6**

(b) Discuss the application of x-ray fluorescence to the identification of chemical elements. Make a diagram of a typical set up and describe the limitations of the method when fluorescing radiation of energy 27 KeV is used. 4

OR

4 (a) What is the disadvantage of single beam spectro photometer. How it can be overcome by double beam spectrophotometer. Draw the optical arrangement of it and explain briefly. 5

(b) Describe briefly a camera for obtaining x-ray powder photographs for the analysis of crystal structure. Explain why some reflections are missing from certain types of crystal structure. 4

5 (a) Explain different particulate sampling techniques used in air-pollution applications. 6

(b) A sample is collected at a rate of 0.05 ft^3/S for a period of 45 min through a filter area having a diameter of 1.0 in. As a result of the sample collection, the light transmission of the filter paper is reduced from 80 to 55 per cent. Calculate the Coh/1000 ft. 4

OR

5 (a) Explain various techniques used for analysis of SO_2. 6

(b) An operator reports the following raw volume measurements on an orsat device in measuring the combustion products for methane fuel (CH_4). Based on these data, calculate the air fuel ratio and percent excess air for the combustion process. 4

	Volume (cm^3)
Initial Sample	95
After CO_2 absorption	83
After O_2 absorption	79
After CO absorption	78

Physical constants

Charge of an electron $e=1.602\times10^{-19}C$

Boltzmann's constant $K_B=1.38\times10^{-23}J/^oK$

Plank's constant $h=6.626\times10^{-34}J.sec$

Electron rest mass $m_e=9.109\times10^{-31}Kg$

Electron volt $ev=1.602\times10^{-19}J$

Velocity of light $C=3–10^8m/sec.$
