Bachelor of Science (B.Sc.) Semester—IV (C.B.S.) Examination

PHYSICS (SOLID STATE ELECTRONICS AND MOLECULAR PHYSICS)

Paper—II

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) **ALL** questions are compulsory.

(2) Draw neat and labelled diagrams wherever necessary.

EITHER

1. (A) Define h parameter. Draw h parameter equivalent circuit of transistor in CE mode. Obtain h parameters equation using two port network for CE mode. 5

(B) (i) Explain construction and working of light emitting diode. 3

(ii) An LED is made up of Gallium Arsenide Phosphide for which the band gap energy Eg = 1.6 V at 300 K. Calculate the wavelength of light emitted by it, when it is in forward biased.

(Given h = 6.63×10^{-34} JS, q = 1.6×10^{-19} C, C = 3×10^{8} m/s) 2

OR

(C) Explain working of npn transistor. 2½

(D) Explain construction and working of solar cell. 2½

(E) Draw circuit diagram to study transistor characteristics in CB mode and explain its input, output characteristics. 2½

(F) A transistor is connected in CE mode. The voltage drop across 5 kΩ resistor which is connected in the collector circuit is 5 V. Find the base current. The current gain α of the transistor is 0.998. 2½

EITHER

2. (A) Explain with neat diagram the working of JFET as a common source amplifier. Derive an expression for the input and output impedance and voltage gain of an amplifier. 5

(B) (i) Explain the static drain characteristics and transfer characteristics of enhancement MOSFET. 3

(ii) Calculate the voltage gain of JFET voltage amplifier having transconductance 4000 μmho and the load resistance of 10 kΩ. 2

OR

(C) Define the parameters of JFET and obtain the relation between them. 2½

(D) State the advantages of JFET and MUSFET over Bipolar Junction Transistor (BJT). 2½

(E) Describe construction of N-channel depletion MOSFET. 2½

(F) The following readings were obtained experimentally for a JFET :

V_{as} (voltr)	:	0	0	0.2
V_{DS} (voltr)	:	7	16	16
I_D (mA)	:	10	10.3	9.8

Calculate :

(i) ac drain resistance

(ii) transconductance

(iii) amplification factor. 2½

EITHER

3. (A) Obtain an expression for rotational energy of a diatonic molecule. 5

(B) (i) Draw and explain energy level diagram in vibrational-rotational spectra. 3

(ii) The force constant of the CO band is 187 N/m. Find the frequency of vibration of CO molecule. (Mass of C^{12} atom = 1.99×10^{-26} kg and mass of O^{16} atom = 2.66×10^{-26} kg) 2

OR

(C) With suitable example, give the classification of molecule on the basis of moment of inertia. 2½

(D) What is the difference between zero point energy of a harmonic and anharmonic oscillator ? 2½

(E) Obtain an expression for the moment of inertia of two nuclei about their centre of mass HCl molecule. 2½

(F) The wave number of the lines in a band are given by $\bar{\nu}$ = 1000 (2n – 1) for n positive and by $\bar{\nu}$ = –1000 (2n + 1) for n negative. Calculate the moment of inertia of the emitter molecule of the spectrum. 2½

EITHER

4. (A) What is Raman effect ? Discuss experimental arrangement to study Raman effect and obtain the expression for Raman shift. 5

(B) (i) Discuss the quantum mechanical explanation of Raman effect. 3

(ii) While exciting line 2536 Å a Raman line for a sample is observed at 2612 Å, Calculate the Raman shift in cm^{-1}. 2

OR

(C) Explain with block diagram, the working of NMR spectrometer. 2½

(D) What are the applications of ESR spectroscopy ? 2½

(E) Describe the existence of Stokes and Antistokes lines on the basis of quantum theory. 2½

(F) The small (rotational) Raman displacement for HCl molecule is 41.6 cm^{-1}. Find the internuclear distance between the atoms forming the molecule.

Given :

h = 6.63×10^{-34} Js, C = 3.0×10^{8} m/sec and N_A = 6.023×10^{23} mol^{-1}. 2½

5. Attempt any ***ten*** :

(i) Define stability factor.

(ii) State applications of LED.

(iii) Calculate the current amplification factor in CE mode in ΔI_C = 10 mA and ΔI_B = 0.5 mA.

(iv) Draw symbol of N-channel and P-channel depletion MOSFET.

(v) Explain why a depletion region in JFET is wedge shaped.

(vi) Calculate the resistance between gate and source if reverse gate voltage of 15 V which produce gate current 10^{-3} μA in a given JFET.

(vii) Why homo nuclear molecule do not show rotational spectra ?

(viii) State the Born-Oppenheimer approximation.

(ix) Calculate the spacing between vibrational energy level for frequency of vibration 2.04×10^{13} Hz.

(x) What is meant by heat of dissociation ?

(xi) State Franck-Condon principle.

(xii) Calculate the wave number of Raman line of wavelength 4358 Å. 1×10