KNT/KW/16/5141

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 diagrams wherever necessary.

(3) Symbols have their usual meaning unless otherwise stated.

EITHER

1. (A) With a neat diagram, describe construction and working of an N-P-N bipolar transistor. 5

(B) (i) Explain the construction of a light emitting diode and state its uses. 3

(ii) An LED made of Ga As P has a band gap of 1.9 ev at room temperature. Calculate the wavelength of light emitted by it when it is forward biased.

(Given : $h = 6.63 \times 10^{-34}$ JS). 2

OR

(C) Explain Thermal runway and how can it be avoided ? 2½

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

(E) Draw the circuit diagram of an emitter bias circuit and explain its working. 2½

(F) In a NPN transistor the common base current gain is 0.98. The reverse saturation current $I_{CBO} = 12.5\ \mu A$. Determine the base and collector current for an emitter current $I_E = 2$ mA. 2½

EITHER

2. (A) Give the construction and working of an n-channel depletion MOSFET. 5

(B) (i) State the special features of MOSFET. 3

(ii) When the V_{GS} of a JFET changes from –3.1 V to –3.0 V, the drain current changes from 1 mA to 1.3 mA. Calculate the value of transconductance. 2

(Contd

OR

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

(D) State the advantages of JFET over BJT. 2½

(E) Calculate the voltage gain of JFET voltage amplifier having transconductance 4000 μmho and the load resistance 10 kΩ. 2½

(F) Draw the output characteristic curves of a JFET and explain the various regions. 2½

EITHER

3. (A) Derive an expression for rotational energy of a diatomic molecules. 5

(B) (i) On the basis of moment of inertia differentiate between symmetric top and spherical top molecules. Also give one example of each type. 3

(ii) The moment of inertia of CO molecule is 1.46×10^{-46} kgm². Calculate the energy in eV and angular velocity in the lowest energy level. 2

OR

(C) Draw energy level diagram showing P and R branches for a diatomic vibrating rotator. 2½

(D) Derive the expression for frequency of a vibrating molecule. 2½

(E) The force constant for the CO-bond is 187 N/m, find the frequency of vibration of CO-molecule.

(Give mass of C^{12} atom = 1.99×10^{-26} kg and mass of O^{16} atom = 2.66×10^{-26} kg). 2½

(F) Write in brief about intensities of rotational lines. 2½

EITHER

4. (A) What is Raman effect ? Describe the experimental arrangement to study Raman effect. 5

(B) (i) How does the Quantum theory explain Raman effect ? 3

(ii) With an 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) What is nuclear magnetic resonance ? Draw the block diagram of an NMR spectrometer. 2½

(D) State and explain the Frank-Condon principle. 2½

(E) In an experiment in the study of Raman effect, with exciting line of 5460 Å, a sample gives stokes' line at 6520 Å. Find the wavelength of the anti-stokes' line. 2½

(F) Differentiate between Raman scattering and Fluorescent scattering. 2½

(Contd.)

5. Attempt any **ten questions :**

(i) *Draw the symbol for a P-N-P transistor.*

(ii) Define Heat Sink.

(iii) For a CE transistor $\alpha = 0.95$ calculate the value of β.

(iv) Draw the symbol for a P-channel JFET.

(v) A JFET has the following parameters, $I_{DSS} = 32$ mA, $V_{GS(off)} = -8V$, $V_{GS} = -4.5$ V. Find value of drain current.

(vi) Draw the circuit symbols of p-channel enhancement MOSFET.

(vii) What is the selection rule for rotational transitions ?

(viii) What do you mean by asymmetric top molecule ?

(ix) What is an anharmonic oscillator ?

(x) What is ESR spectroscopy ?

(xi) Write the selection rule for vibrational rotational Raman spectra.

(xii) State the applications of Raman spectroscopy. $1 \times 10 = 10$