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 = 6.63×10^{-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 μA. 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

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} kgm^2. 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 $= 1.99 \times 10^{-26}$ kg and mass of O^{16} atom $= 2.66 \times 10^{-26}$ 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 5520 Å. Find the wavelength of the anti-stokes' line.   2½

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

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. $1 \times 10 = 10$