Bachelor of Science (B.Sc.) Sem-IV Examination

PHYSICS

Paper–II

(Solid State Electronics & Molecular Physics)

Time—Three Hours] [Maximum Marks—50

Note :– (i) All questions are compulsory.

(ii) Draw well labelled diagram wherever necessary.

EITHER

1. (A) What is transistor ? Explain the input and output characteristics of NPN transistor in CE mode with neat circuit diagram. 5

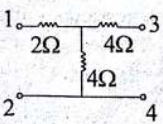
(B) (i) Explain the construction and working of a light emitting diode. 3

(ii) Calculate the wavelength in A° of a light emitted by LED if the band gap is 3eV.
Given $h = 6.626 \times 10^{-34}$ J-S,
$c = 3 \times 10^{8}$ m/s and $1eV = 1.6 \times 10^{-19}$ J. 2

OR

(C) Explain the factors that affect the operating point of a transistor. 2½

(D) Find the h-parameters of the circuit shown in figure.



2½

(E) Give the construction and working of photovoltaic cell. 2½

(F) Draw the equivalent circuit of transistor at low frequency in CE mode and explain in brief. 2½

EITHER

2. (A) Draw the circuit diagram of JFET as an amplifier with input and output waveforms. Derive an expression for the input and output impedance and voltage ga of an amplifier.

(B) (i) Explain the drain characteristics of n-channel depletion MOSFET when (i) V_{GS} is negative and (ii) V_{GS} is positive. 3

(ii) In the drain characteristics of MOSFET, $\Delta I_D = 2$ mA when $\Delta V_{DS} = 10$ volts at constant $V_{GS} = 3$V. Calculate the output impedance. 2

OR

(C) Draw the output characteristics of JFET and explain different regions in it. 2½

(D) Calculate the transconductance of JFET with change in drain current 4mA and change in gate to source voltage 0.4 V when drain to source voltage is constant. Hence find the amplification factor if drain resistanc is 47 kΩ. 2½

(E) Explain JFET as an amplifier with neat diagram. 2½

(F) State the difference between BJT and JFETS. 2½

EITHER

3. (A) Derive an expression for rotational energy of diatomic molecule and explain why diatomic molecule in ground state can not rotate. 5

(B) (i) Obtain an expression for frequency of pure vibrational spectra of a molecule. 3

(ii) Calculate the wave number of the spectral line if change in energy in vibrational energy level is 0.1 eV. 2

OR

(C) The OH radical has moment of inertia 1.48×10^{-47} kg m^2, calculate its inter nuclear distance (Given $m_H = 1.67 \times 10^{-27}$ kg, $m_o = 26.72 \times 10^{-27}$ kg. 2½

(D) Discuss in short failure of Born-Oppenheimer approximation. 2½

(E) Assuming the equation of energy of unharmonic vibration of a molecule, derive the expression for wave number of unharmonic vibrator in V^{th} eigen state. 2½

(F) Discuss vibration-rotation spectra of diatomic molecule with energy level diagram in brief. 2½

EITHER

4. (A) What is Raman Effect ? Give the experimental set up with diagram to obtain Raman Spectrum of a given sample. 5

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

(ii) The wavelength of an exciting line in a Raman experiment is 5460 A^o and Stokes line is at 5520 A^o. Find Raman shift ($c = 3 \times 10^8$ m/s). 2

OR

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

(D) State and explain Franck-Condon principle for the intensity distribution. 2½

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

(F) The vibrational spectrum of O_2 molecules has a continuum limit of 56875 cm^{-1}. The upper electronic state dissociates into one ground state atom and one excited atom whose energy from atomic spectrum is 15875 cm^{-1}. Estimate the dissociation.
Given : $h = 6.63 \times 10^{-34}$ J.S, $c = 3 \times 10^{10}$ cm/s
Avag. Number = 6.03×10^{23} joule/mole. 2½

5. Solve any **TEN** (1 mark each) :
   (i) Why is base thin and lightly doped in transistor ?
   (ii) In CB mode, the transistor has an $\alpha = 0.9$, determine collector current Ic if emitter current IE = 1 mA.
   (iii) What is heat sink ? State its necessity.
   (iv) The MOSFET is also called IGFET, why ?
   (v) What are FET's parameter ?
   (vi) State the advantages of FETS over BJTS.
   (vii) Draw the energy diagram of rotational spectra of diatomic molecule.
   (viii) Calculate the spacing between vibrational energy level for frequency of vibration 2.04×10^{13} Hz.
   (ix) State the selection rules for vibrational spectra.
   (x) What is meant by heat of dissociation ?
   (xi) Why LASER source is most suitable to study Raman effect ?
   (xii) Calculate the wave number of. Raman line of wavelength 4358 A°. 1×10