TKN/KS/16/5856

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.

EITHER

1. (A) What is transistor action ? Discuss the input and output characteristics of a transistor in CB mode. 5

(B) (i) Discuss the graphical method of analysis of working of a transistor as an amplifier in CE mode. 3

(ii) A junction transistor is operated in CB mode. If $\alpha = 0.941$.

Calculate β of the transistor. 2

(E) How does quantum theory explain Raman effect ? 2½

(F) The wavelength of an exciting line in an experiment is 4358 Å and the Stoke's line is at 4458 Å. Find the wavelength of antistokes line. 2½

5. Attempt any **TEN** :—

(i) What is a photovoltaic cell ?

(ii) State the majority and minority charge carriers in N-type and p-type semiconductors.

(iii) Explain thermal runaway.

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

(v) Explain why a deplection region in JFET is Wedge shaped.

(vi) Draw the circuit symbols of N-channel and P-channel JFET.

(vii) State any two failures of Born-Oppenheimer approximation.

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

(ii) State the special features of MOSFETs. 2

OR

(C) Draw the circuit diagram to study the characteristics of an N- channel FET and discuss the transfer characteristic curve. 2½

(D) Obtain expressions for the input impedance and output impedance for a common-source JFET amplifier. 2½

(E) A common-source JFET amplifier has a load resistance R_L = 500 kΩ. If ac drain resistance r_d = 100 kΩ and voltage gain is 20, calculate the amplification factor. 2½

(F) Differentiate between JFET and BJT. 2½

EITHER

3. (A) Derive an expression for spacing between energy levels of vibrational spectra. Show that vibrational energy levels are equally spaced. 5

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

(ii) Calculate the frequency of vibration in v = 0 level of CO molecule, if its force constant is 1870 N/m and reduced mass is 11.4×10^{-27} kg. 2

OR

(C) Assuming the expression for rotational energy of a diatomic molecule, show that the energy levels are not equally spaced. 2½

(D) State the selection rule for rotational spectra. Draw and explain the rotational frequency spectrum of a rigid diatomic molecule. 2½

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

(F) The number of lines in a rotational band is given by :

$\bar{\nu}_{r'} = 1000\ (2n - 1)\ cm^{-1}$

$\bar{\nu}_{r''} = -\ 1000\ (2n + 1)\ cm^{-1}$. for

positive and negative values of n. Calculate moment of inertia of the molecule.

Given :

$h = 6.63 \times 10^{-27}$ erg-sec.

$c = 3 \times 10^{10}$ cm/sec. 2½

EITHER

4. (A) What is Raman effect ? Obtain the expression for Raman shift.

State the applications of Raman effect and explain any one in detail. 5

(B) (i) State and explain the Franck—Condon principle. What are its limitations ? 3

(ii) In observing the Raman spectrum, of a sample using 2537 Å as the exciting line, one gets a Stokes line at 2683 Å. Deduce the Raman shift in cm^{-1}. 2

OR

(C) Describe the electronic spectra of diatomic molecules. 2½

(D) Distinguish between NMR and ESR spectroscopy. 2½

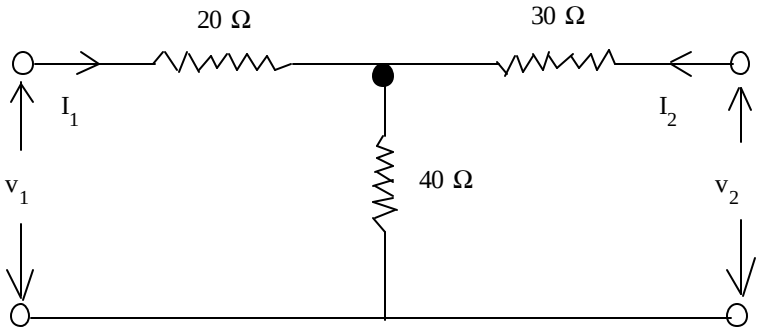
OR

(C) Explain the construction and working of a Solar Cell. 2½

(D) What is load line ? How will you draw a d.c. load line on the output characteristics of a transistor ? 2½

(E) Derive an expression for stability factor in terms of I_{CBO}. 2½

(F) Determine the h-parameters for the following circuit :



2 ½

EITHER

2. (A) What is a MOSFET ? State the principle on which it works. Sketch the structure of a p-channel enhancement MOSFET. Explain its working. 5

(viii) Calculate the frequency of the specctral line if change in energy in vibrational energy level is 0.1 eV.

(ix) Which molecule will exhibit vibration spectra, H_2 or HCl. Why ?

(x) Write the applications of ESR Spectroscopy.

(xi) State the differences between Raman and Fluorescent scattering.

(xii) Define dissociation energy. 1×10