

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 depletion 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 $R_L = 500 \text{ k}\Omega$. If ac drain resistance $r_d = 100 \text{ k}\Omega$ 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. $2\frac{1}{2}$
- (D) State the selection rule for rotational spectra. Draw and explain the rotational frequency spectrum of a rigid diatomic molecule. $2\frac{1}{2}$
- (E) Obtain an expression for the moment of inertia of two nuclei about their centre of mass of HCl molecule. $2\frac{1}{2}$
- (F) The number of lines in a rotational band is given by :
- $$\nu_{r'} = 1000 (2n - 1) \text{ cm}^{-1}$$
- $$\nu_{r''} = - 1000 (2n + 1) \text{ cm}^{-1} \text{ for}$$

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

Given :

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

$$c = 3 \times 10^{10} \text{ cm/sec.} \quad 2\frac{1}{2}$$

EITHER

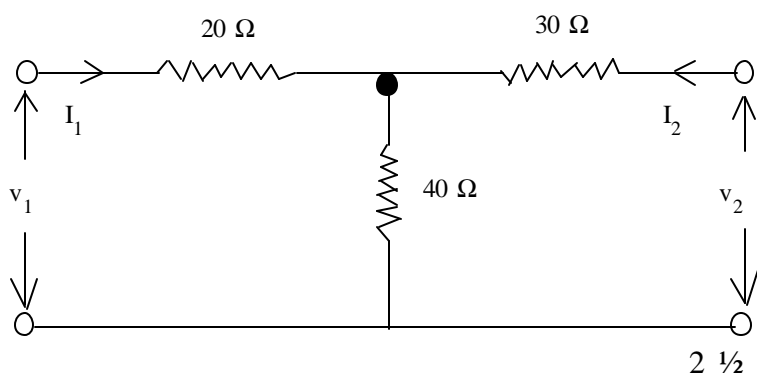
4. (A) What is Raman effect ? Obtain the expression for Raman shift.
- State the applications of Raman effect and explain any one in detail. 5
- (B) (i) State and explain the Franck—Condon principle. What are its limitations ? 3
- (ii) In observing the Raman spectrum, of a sample using 2537 \AA as the exciting line, one gets a Stokes line at 2683 \AA . Deduce the Raman shift in cm^{-1} . 2

OR

- (C) Describe the electronic spectra of diatomic molecules. $2\frac{1}{2}$
- (D) Distinguish between NMR and ESR spectroscopy. $2\frac{1}{2}$

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 :



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 spectral 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