NRT/KS/19/2108

Bachelor of Science (B.Sc.) Semester—IV Examination

PHYSICS

(Solid State Electronics and Molecular Physics)

Optional Paper—II

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) All questions are compulsory.

(2) Draw neat and labelled diagrams wherever necessary.

EITHER

1. (A) Considering transistor as two port device, write h-parameter equations for transistor in common emitter mode. Define h-parameters of a transistor in CE mode. Why these parameters are called hybrid parameter ? 5

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

(ii) Calculate the energy band gap of Ga As P semiconducting material of LED with output light having wavelength 6715 Å.

(Given : $q = 1.6 \times 10^{-19}$ C, $C = 3 \times 10^{8}$ m/s, $h = 6.626 \times 10^{-34}$ J-s) 2

OR

(C) Draw the circuit diagram of common emitter transistor amplifier and explain its working. 2½

(D) A germanium transistor has a collector cut-off current I_{CBO} = 14 µA at room temperature and $\beta = 50$. It is used in common emitter amplifier.

(i) Calculate the collector current when base current I_B = 0.2 µA.

(ii) Assuming β does not change with temperature, find the new collector current, if the temperature of the transistor rises through 50°C. 2½

(E) Explain construction and working of solar cell. 2½

(F) What is stabilization ? Explain the necessity of bias stabilization of transistor amplifier circuit. 2½

EITHER

2. (A) What is MOSFET ? What are different types of MOSFETs ? Discuss the drain and transfer characteristics of n-channel depletion MOSFETs. 5

(B) (i) Draw the circuit diagram of JFET as an amplifier. Explain its working. 3

(ii) Calculate the voltage gain of JFET voltage amplifier having transconductance 4000 µmho and the load resistance 10 kΩ. 2

OR

(C) What is JFET ? Explain the output characteristics of a JFET. 2½

(D) Define transconductance, drain resistance and amplification factor in JFET. State the relation between them. 2½

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(E) From the following given data :

V_{GS} (volts)	:	0	0	0.2
V_{DS} (volts)	:	7	16	16
I_D (mA)	:	10	10.3	9.8

Calculate a.c. drain resistance and amplification factor. 2½

(F) Draw the well labelled diagram showing the construction of p-channel enhancement MOSFET. State special features of MOSFETs. 2½

EITHER

3. (A) Give the theory of origin of pure rotational spectra for a di atomic molecule. Write the selection rules for it. 5

(B) (i) Discuss the different type of rigid molecules on the basis of their moment of inertia. 3

(ii) The spacing of a series of line in the microwave spectrum of AIH is constant at 12.604 cm^{-1}. Calculate the moment of inertia of AIH molecule about its axis of rotation. ($h = 6.602 \times 10^{-27}$ erg-s). 2

OR

(C) Discuss in brief Born-Oppenheimer approximation. 2½

(D) Draw the energy level diagram for the allowed transitions in rotation-vibration emission spectra when the vibrational transition takes place between V = 1 to V = 0. 2½

(E) Explain the intensity distribution of rotational spectral lines. 2½

(F) Moment of inertia of carbon monooxide molecule is 1.46×10^{-46} kg-m^2. Calculate the energy of this molecule in lowest rotational energy level in eV. 2½

EITHER

4. (A) What is Raman effect ? Explain Raman effect using quantum theory. 5

(B) (i) Describe the experimental arrangement to study the Raman effect. 3

(ii) For the exciting line of 4358 Å spectrum of benzene shows Raman lines for $\Delta\bar{\nu}$ = 608, 846, 995 and 1178 cm^{-1}. If Benzene is irradiated by monochromatic light of wavelength 5461Å, what will be the wavelength of Raman lines for benzene. 2

OR

(C) State Frank-Condon principle. Explain morse curve. 2½

(D) Explain Electron Spin Resonance (ESR). 2½

(E) A substance shows a Raman line at 4567 Å when exciting line 4358 Å is used. Deduce the position of stokes' and anti-stokes' lines for the same substance when the exciting line 4047 Å is used. 2½

(F) Draw main components of Nuclear Magnetic Resonance Spectrometer. State any four applications of NMR. 2½

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5. Attempt any **TEN** questions :—

(i) State necessity of heat sink in transistor.

(ii) Draw the transfer characteristics of transistor in common emitter mode.

(iii) The current gain for a transistor is $\beta = 350$. Calculate the current gain α.

(iv) Why MOSFETs have higher input resistance than JFET ?

(v) Define pinch off voltage in a JFET.

(vi) In a FET, transconductance is 6 mA/V, when reverse gate to source voltage changes by 0.2 V. Find corresponding change in drain current.

(vii) Why homonuclear molecule H_2 and N_2 donot show rotational spectra ?

(viii) The force constant for HCl molecule is 468.2 N/m and reduced mass of HCl molecule is 1.556×10^{-27} kg. What is the natural frequency of vibration of HCl molecule ?

(ix) State two application of vibrational spectroscopy.

(x) Define dissociation energy of a molecule.

(xi) Why a monochromatic source is necessary to study Raman effect ?

(xii) With the exciting line 4358 Å a sample gives stokes' line at 4458 Å. Express this stokes' line in wave number. 1×10=10