NKT/KS/17/5141

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

Note :— (1) All questions are compulsory.

(2) Draw neat diagrams wherever necessary.

1. **EITHER**

(A) Define h-parameters; obtain fundamental equation of a transistor in C.E mode and draw h-parameter equivalent circuit for it. 5

(B) (i) Draw the circuit diagram of a common emitter NPN transistor amplifier and explain its working in brief. 3

(ii) For a transistor the collector current is 10.525 mA, leakage current I_{CBO} is 5 μA when base current is 100 μA. Calculate the value of β. 2

OR

(C) Explain the working of NPN transistor. 2½

(D) Define stability factor. Why does the transistor require special biasing in CE mode ? 2½

(E) Draw the output characteristics of a transistor connected in common base mode and explain the three regions. 2½

(F) A transistor having hie = 800 Ω, hfe = 50, hoe = 80 × 10^{-6} Ω, and hre = 2.5 × 10^{-4} is used as a CE amplifier. If load resistance is 5 kΩ and effective source resistance is 500 Ω; calculate the current gain, input impedance and voltage gain. 2½

2. **EITHER**

(A) What is MOSFET ? State its principle of operation. Explain the construction and working of n-channel depletion MOSFET. 5

(B) (i) Define three parameters of JFET and hence obtain the relocation between them. 3

(ii) When a reverse gate voltage of 15 V is applied to a JFET, the gate current is 10^{-3} μA. Find the resistance between gate and source. 2

OR

(C) Draw the circuit diagram of a common source amplifier using a n-channel JFET. Explain its working. 2½

(D) Explain drain characteristics of a JFET. Define pinch off voltage. 2½

(E) Calculate the transconductance of JFET with change in drain current 0.3×10^{-3} A and change in gate to source voltage 0.3 V, when drain to source voltage is constant. Also find amplification factor if drain resistance is 33.3 kΩ. 2½

(F) Explain the transfer and output charactristics of n-Channel enhancement MOSFET with diagrams. 2½

3. **EITHER**

(A) Show that the energy levels of a vibrating diatomic molecule are equidistant. State the selection rule. 5

(B) (i) Explain various types of molecules based on the principal moments of inertia. 3

(ii) Find the rotational constant of H_2 molecule if H – H bond is 7.4×10^{-12} meter.

Given : $m_H = 1.67 \times 10^{-27}$ kg, $h = 6.626 \times 10^{-34}$ J-s. 2

OR

(C) Mention the three types of quantization of molecular energies. According to it explain in short three types of molecular spectra. 2½

(D) State and explain selection rules for rotation-vibrational spectra of a molecule. Draw the energy level diagram for rotational vibrational spectra and show P, Q & R branches on it. 2½

(E) The spacing between series of lines in the microwave spectrum of $^{\cdot}A\ell H$ is constant at 12.604 cm^{-1}. Reduced mass of $^{\cdot}A\ell H$ molecules is 0.9718 u. Calculate the inter nuclear distance in the molecules.

(h = 6.63×10^{-17} erg-sec

1 u = 1.67×10^{-24} gm). 2½

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

4. **EITHER**

(A) What is ESR spectroscopy ? Explain the principle of electron spin resonance spectroscopy in brief. What are the applications of ESR ? 5

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

(ii) The exciting line in an experimental study of Raman effect is 5460 Å and stokes line is 5520 Å. Find the Raman shift in cm^{-1}. 2

OR

(C) What is Raman effect ? What are the characteristics of Raman lines ? 2½

(D) State and explain Frank-Condon Principle. 2½

(E) An unpaired electron gives ESR resonance at 35 GHz; when the magnetic field is 1.3 T., calculate the electron g-factor.

(μ_B = 9.2732 × 10^{-24} J/T and h = 6.626 × 10^{-34} J-s). 2½

(F) What is nuclear magnetic resonance (NMR) ? State at least four applications of NMR. 2½

5. Attempt any **TEN** questions :—

(i) State any two applications of solar cell.

(ii) Can emitter and collector terminals of BJT transistor be interchanged ? Why ?

(iii) What is emitted by the emitter of a NPN transistor ? Answer this question for PNP transistor also.

(iv) Why depletion MOSFET its called as dual mode MOSFET ?

(v) Why channel is shown by broken line in enhancement MOSFET ?

(vi) Why does the MOSFET have higher input impedance than JFET ?

(vii) Why homonuclear molecules do not show rotational spectra ?

(viii) Spacing between a series of lines in a micro wave spectrum is X. What is the value of rotational constant ?

(ix) State the Born-Oppenheimer approximation.

(x) State any two applications of Raman effect.

(xi) The wavelength of anti-stoke's line in a Raman experiment was found at 5401 Å. Find the corresponding wave number.

(xii) What is the basic difference between Raman scattering and Rayleigh scattering ? 10×1=10