**COURSE: BBS01T1002 SEMICONDUCTOR PHYSICS**

**Syllabus**

**CAT-2 (****Winter-2021-22)**

**Unit- 2 Semiconductor****:**

Direct-indirect band gap semiconductors, Conductivity and mobility, recombination process, Hall Effect and applications.

**Unit -3 Applications of Diodes:**

Concept in optical transitions in bulk semiconductors- absorption process, recombination process, explanation for spontaneous emission-stimulated emission-transition rate, theory of p-n junction, p-n junction diode and its I-V characteristics,

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| S.No. | Questions [Unit- 2 Semiconductor] | Max Marks |
| 1 | An electric field of 200 volt/m is applied to a sample of n type semiconductor whose Hall coefficient is -0.0145 m2/coulomb. Calculate the current density in the sample assuming mobility of electron equals to 0.36 V-1 S-1. | 2 |
| 2 | What is the wavelength corresponding to the bandgap of GaAs (1.42eV) approximately? | 2 |
| 3 | Calculate energy band gap of semiconducting material if it emits light of wavelength 414 nm. | 2 |
| 4 | The carrier concentration in n-type semiconductor is 1019/m3. Determine the value of Hall coefficient. | 2 |
| 5 | Hall coefficient of a semiconductor is 3.22x10-4 m3/C. Its resistivity is 9x10-3ohm-meter. Calculate the mobility in the semiconductor. | 2 |
| 6 | The Hall coefficient (RH) of a semiconductor is 3.22× 10-4 m3/C.  Calculate the carrier concentration of the carriers. (Given that e =1.6× 10-19 C). | 2 |
| 7 | In a p-n junction diode, explain a). Minority charge carrier b). Majority charge carrier | 2 |
| 8 | Derive the expression of current density and Mobility of charge carriers for semiconductor | 5 |
| 9 | Distinguish between the direct and indirect band gap semiconductors using band diagram with one-one example. | 5 |
| 10 | Define current density and mobility of charge carriers for a semiconductor. Hall coefficient of a semiconductor is 3.22x10-4 m3/C. Its resistivity is 9x10-3ohm-meter. Calculate the mobility in the semiconductor. | 5 |
| 11 | Explain the Hall effect and derive the expression for Hall coefficient. | 5 |
| 12 | Define the drift velocity and mobility of an electron and find the expression of mobility in an intrinsic semiconductor. | 8 |
| 13 | Discuss the Hall effect phenomenon in a semiconductor with the suitable diagram | 8 |
| 14 | Explain the Hall effect and derive the expression for Hall coefficient. The carrier concentration in n-type semiconductor is 1019/m3. Determine the value of Hall coefficient. Given [e=1.6x10-19 C ] | 8 |
| 15 | Show that in an intrinsic semiconductor the conductivity of the material is given by the expression; σ= e n (µe +µp), where [ σ =conductivity, n carrier density µe = mobility of electron and µp= mobility of hole and e= electronic charge]. The intrinsic carrier density of Ge at 27oC is 2.4 x 10 17 m-3. Calculate its resistivity, if the electron and hole mobility are 0.35 m2 V-1 s-1 and 0.18 m2 V-1 s-1 respectively. | 8 |

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| S.No. | Questions [Unit -3 Applications of Diodes] | Max Marks |
| 1 | Write down the diode equation. How this equation is modified during forward bias? | 2 |
| 2 | Classify the optical transitions in bulk semiconductors | 2 |
| 3 | Explain avalanche breakdown and Zener breakdown in a p-n junction. | 2 |
| 4 | Explain threshold voltage/ knee voltage and breakdown voltage in a p-n junction diode | 2 |
| 5 | Define built-in-potential (potential barrier). What will be direction of internal electric field developed due to potential barrier in a zero biased p-n junction diode? | 2 |
| 6 | Describe the Forward and reverse biased p-n Junction along with proper circuit diagram. | 5 |
| 7 | In a PN junction diode, explain: a). Minority charge carrier b). Majority charge carrier c). Break down voltage. | 5 |
| 8 | Draw the I-V characteristics of a PN Junction diode and explain the knee voltage. | 5 |
| 9 | Describe the formation of depletion layer in p-n junction diode. Draw and explain the V-I characteristics of a p-n Junction diode. | 5 |
| 10 | Interpret the recombination and generation of electron-hole pairs in a semiconductor. Find the wavelength corresponding to the band gap of GaAs (1.42eV) approximately? | 5 |
| 11 | Discuss in detail that an ideal p-n junction diode act as short circuit in forward biased mode and open circuit in a reverse biased mode. | 8 |
| 12 | Describe the formation of depletion layer in p-n junction diode. Draw and explain the V-I characteristics of a p-n Junction diode. Is current flowing through the p-n junction diode due to majority charge carries? Justify your answer. | 8 |
| 13 | Discuss the different types of biasing of p-n junction diode and its applications | 8 |
| 14 | Differentiate between spontaneous and stimulated emission. Which one emits coherent waves? Also write two -two properties of Coherent and incoherent waves. | 8 |
| 15 | Interpret the recombination and generation of electron hole pairs in a semiconductor. | 8 |