



**WEST BENGAL STATE UNIVERSITY**

B.Sc. Honours 2nd Semester Examination, 2021

**ELSACOR03T-ELECTRONICS (CC3)**

**SEMICONDUCTOR DEVICES**

Time Allotted: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.  
Candidates should answer in their own words and adhere to the word limit as practicable.  
All symbols are of usual significance.*

**GROUP-A**

**Answer any five questions from the following**

2×5 = 10

1. What is intrinsic semiconductor? Which states get filled in the conduction band when the donor-type impurity is added to a crystal?
2. What is early effect?
3. Show that for a simple cubic lattice  $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$ .
4. Why the contact potential between p-n junction cannot be measured using a voltmeter?
5. What is hall effect? Mention one application of Hall effect.
6. Distinguish BJT and FET.
7. Draw the transfer characteristics of JFET.
8. Why the emitter region of transistor is more heavily doped than the base region?

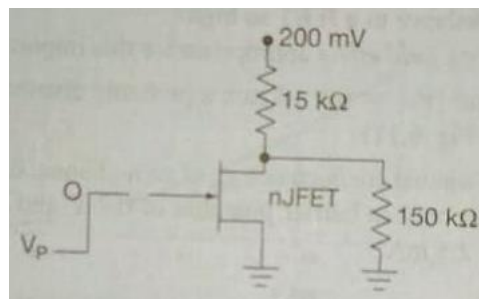
**GROUP-B**

**Answer any six questions from the following**

5×6 = 30

9. Derive hole concentration at normal equilibrium in intrinsic semiconductor. 5
10. Show that when an electron moves through a crystal, the effective mass of the electron can be expressed as  $m = \frac{\hbar^2}{\left(\frac{d^2 E}{dK^2}\right)}$ . (Symbols carrying usual meaning). 5
- 11.(a) Establish Einstein relation at equilibrium from current density equation containing diffusion and drift current. 3

- (b) A sample of Si is doped with  $10^{17}$  phosphorous atoms/cm<sup>3</sup>. What Hall voltage would you expect in a sample 100  $\mu\text{m}$  thick if  $I_x = 1\text{mA}$  and  $B_z = 1\text{kG} = 10^{-5}\text{Wb/cm}^2$ ? 2
12. What is potential barrier? For a p-n junction diode derive an expression for junction capacitance. 1+4
- 13.(a) Among the three configurations CC, CB, CE, which of the configuration has the (i) highest input resistance ( $R_i$ ), (ii) lowest input resistance ( $R_i$ ), (iii) highest output resistance ( $R_o$ ), (iv) lowest output resistance ( $R_o$ ), (v) lowest voltage gain ( $A_v$ ), (vi) lowest current gain ( $A_i$ ). 3
- (b) What is Base width Modulation? 2
- 14.(a) Why transistor is called current controlled device? 2
- (b) Why CC configuration is called a voltage buffer? What is its other name? 2+1
- 15.(a) Sketch the structure of a p-channel enhancement MOSFET. 5
- (b) Draw and explain its transfer characteristics.
- 16.(a) Sketch the ohmic region in drain characteristics of JFET. 2
- (b) Compare p-channel and n-channel JFET. 2
- (c) What are the advantages of FET over BJT? 1
- 17.(a) With respect to BJT what are  $\alpha$  and  $\beta$  parameters represent? 2
- (b) Show that  $\alpha = \frac{\beta}{1 + \beta}$ . 3
18. For the n-channel JFET circuit shown in the figure, determine the value of voltage across the 150 k $\Omega$  resistor when  $V_{GS} = 0\text{ V}$  and when  $V_{GS} = V_P$ . Assume the ON resistance of a JFET is 75  $\Omega$ . 5



**N.B. :** Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.

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