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Roll No. : .....

**328315(28)**

**B. E. (Third Semester) Examination, April-May 2021**

**(Old Scheme)**

**(Et & T Engg. Branch)**

**SOLID STATE DEVICES and COMPONENTS**

***Time Allowed : Three hours***

***Maximum Marks : 80***

***Minimum Pass Marks : 28***

***Note:*** All units are compulsory. Part (a) is compulsory of each unit and solve any two parts from (b), (c) & (d) of each question. Part (a) carries 2 marks and Part (b), (c) & (d) carry 7 marks each. Symbols used have their usual meaning. Assume data wherever necessary.

**Unit-I**

1. (a) Write the Einstein's relationship of mobility and diffusion constant. 2

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(b) For open circuited step graded junction.

prove that :

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$$V_0 = V_T \log \left( \frac{N_{AND}}{n_i^2} \right)$$

(c) Deduce the continuity equation for electrons in a P-type material.

7

(d) Prove that the fermi-level in intrinsic semiconductor lies in the midway in the forbidden band.

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### Unit-II

2. (a) Define the term Polarizability.

2

(b) Show that dielectric loss is directly proportional to the imaginary part of the complex relative dielectric constant.

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(c) Explain Lenz law. Show that the current induced in a loop wire having zero resistance remains constant even when magnetic flux does not change.

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(d) For a dielectric material  $\epsilon_r = 4.95$  and  $n^2 = 2.69$

where  $n$  is the index of refraction. Calculate the ratio between electronic and ionic polarizability of the material.

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### Unit-III

3. (a) Differentiate magnetic material according to presence and alignment of magnetic dipoles.

2

(b) Give the difference between anti-ferromagnetic and ferromagnetic material.

7

(c) For an anti-ferromagnetic material at high temperatures, show that the magnetic susceptibility is given by

$$x = \frac{2C}{T + \theta}$$

where  $C = MB^4 \mu_0 / R$  and  $\theta = \gamma C$ .

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(d) State and prove the Bio-Savart law.

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**Unit-IV**

4. (a) Define super conductivity. 2
- (b) Prove that the heat developed per  $m^3$  per second in a conductor, carrying a current density  $J$ , as a result of an applied field  $E$  is given by  $W = \sigma E^2$ . 7
- (c) Explain the term : 7
- (i) Collision time
  - (ii) Mean free path
- (d) The relaxation time of a conduction electron in copper is  $3.5 \times 10^{-14}$  sec. An electric field of 2.5 V/m is applied along negative X-axis. Calculate the increase in the X-component of velocity between two collisions. What is the average increase in energy of the electron between two collisions? 7

**Unit-V**

5. (a) Define active and passive components. 2

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- (b) Explain the working principle of audio transformer along with low and high frequency equivalent circuit. 7
- (c) Explain the various characteristics of resistors. 7
- (d) Design a straight line wavelength capacitor suitable for typical communication receiver. 7