

**B. MECHANICAL (EVENING) 2<sup>ND</sup> YEAR 1<sup>ST</sup> SEM. SUPPLE EXAMINATION, 2017****MATERIAL SC. AND ENGG.****Time: Three hours****Full Marks: 100****Answer any FIVE questions**

1a) "Graphite is soft and conductor while diamond is hard and insulator although both graphite and diamond are made up of same carbon atoms," ----- Explain. (8)

b) Calculate the density and ionic packing factor of MgO from the following data: (12)

Radius of Magnesium ion = 0.078 nm,      Radius of Oxygen ion = 0.132 nm

Atomic weight of Magnesium = 24.3,      Atomic weight of Oxygen = 16

2a) Explain any two types of diffusion mechanisms. (8)

b) At 900 °C, what is the time required to carburize a steel with initial composition of 0.2% carbon to 1% carbon at a depth of 0.2 mm? Assume a constant surface concentration of 1.4% carbon due to carburising atmosphere.

Given:  $D_0 = 0.7 \times 10^{-4} \frac{m^2}{s}$ ;  $Q = 157 \frac{kJ}{mol}$ ;  $R = 8.314 \frac{J}{mol K}$

Z	0.25	0.30	0.35	0.40
erf(Z)	0.2763	0.3268	0.3794	0.4284

(12)

3a) Derive the expression for composite elastic modulus under iso-stress condition. Also mention the assumption made to derive the expression. (8+4)

b) For a fibre reinforced composite material, the fibre takes 95% of the applied longitudinal force. The cross sectional area of the fibre is 30%. Calculate the modulus ratio of the composite. (8)

4a) What do you mean by 'Intrinsic' and 'Extrinsic' semiconductors? (8)

b) For intrinsic semiconductors, prove that  $\frac{n}{N} = e^{-\frac{E_g}{2kT}}$ . The notations bear usual meanings.

What is n-type semiconductors? (8+4)

5a) Explain the Fermi-Dirac electron energy distribution function with the meanings of different notations used in the equation. (10)

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- b) Calculate the band gap ( $E_g$ ) for a semiconductor from the following data : (10)

Boltzman constant =  $86.2 \times 10^{-6} \text{ eV/K}$ .

Temperature ( $^{\circ}\text{C}$ )	Conductivity ( $\Omega^{-1}\text{m}^{-1}$ )
30	370
120	1250

- 6a) What are Miller Indices ? Explain the steps to determine the Miller Indices. (4+7)

- b) Draw the following crystallographic planes: (9)

i)  $(1\bar{1}2)$       ii)  $(212)$       iii)  $(012)$

- 7a) Draw the different types of phase diagrams ? (12)

- b) What do you mean by 'eutectic point' and 'eutectoid point' with reference to iron-carbon (Fe-C) equilibrium phase diagram. (8)

8. Write short notes on the followings (any four): (4×5)

- |                        |                          |
|------------------------|--------------------------|
| a) Composite materials | b) Ionic bond            |
| c) Energy band gap     | d) Diffusion flux        |
| e) Bond length         | f) p-type semi-conductor |
| g) Activation energy   |                          |