

**AMIETE – ET (OLD SCHEME)**

Time: 3 Hours

**OCTOBER 2012**

Max. Marks: 100

*PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.*

**NOTE: There are 9 Questions in all.**

- Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.
- The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

**Q.1 Choose the correct or the best alternative in the following: (2×10)**

- a. MOSFET can be used as a
- (A) current controlled capacitor      (B) voltage controlled capacitor  
(C) current controlled inductor      (D) voltage controlled inductors
- b. The early effect in a bipolar junction transistor is caused by
- (A) fast turn-on      (B) fast turn-off  
(C) large collector-base reverse bias      (D) large emitter-base forward bias
- c. Which of the following is not associated with a p-n junction?
- (A) channel length modulation      (B) charge storage capacitance  
(C) depletion capacitance      (D) junction capacitance
- d. The MOSFET switch in its on-state may be considered equivalent to
- (A) resistor      (B) inductor  
(C) capacitor      (D) battery
- e. Fermi level for extrinsic semiconductor depends on
- (A) Donor element      (B) Impurity concentration  
(C) Temperature      (D) All
- f. Which of the following materials is not a semiconductor?
- (A) Silicone.      (B) Germanium.  
(C) Gallium arsenide.      (D) Gallium nitride.
- g. Energy band gap size for Si semiconductors is in the range \_\_\_\_\_ eV.
- (A) 1-2      (B) 2-3  
(C) 3-4      (D) > 4

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Subject: PHYSICAL ELECTRONICS AND SOLID STATE DEVICES

- h. Which type of special-purpose diode has the characteristics of a voltage controlled capacitor?
- (A) varactor diode. (B) tunnel diode.  
(C) zener diode. (D) Schottky diode.
- i. Flow of electrons is affected by the following
- (A) Thermal vibrations (B) Impurity atoms  
(C) Crystal defects (D) all
- j. A Zener diode is based on the principle of:
- (A) Thermionic emission  
(B) Tunneling of charge carriers across the junction  
(C) Diffusion of charge carriers across the junction  
(D) None of the above

**Answer any FIVE Questions out of EIGHT Questions.  
Each question carries 16 marks.**

- Q.2** a. Describe the impact ionization process where a high energy conduction-band electron scatters from a valence-band electron, producing two conduction-band electrons and a hole. (8)
- b. A sample of Si is doped with  $10^{17}$  phosphorus atoms/cm<sup>3</sup>. What would you expect to measure for its resistivity? What Hall voltage would you expect in a sample 100μm thick if  $I_x = 1\text{mA}$  and  $B_z = 1\text{KG} = 10^{-5} \text{wb/cm}^2$  (8)
- Q.3** a. When a heavily doped junction is reverse biased, the energy bands become crossed at relatively low voltages, explain it by characteristics curves. (8)
- b. Describe and design an ohmic contact for n-type GaAs using InAs, with an intervening graded InGaAs region. (8)
- Q.4** a. Explain briefly the switching operation of a transistor. (8)
- b. List and explain BJT static performance parameters. (8)
- Q.5** a. Discuss the output characteristics of the MOS field effect transistor. (8)
- b. Consider an aluminium-SiO<sub>2</sub>-Si MOS device. The work function of Al is 4.1eV, the electron affinity for SiO<sub>2</sub> is 0.9eV, and that of Si is 4.15 eV. Calculate the potential  $V_{fb}$  if the Si doping is  $N_a = 10^{14} \text{cm}^{-3}$ . (8)
- Q.6** a. Briefly explain the principle and applications of semiconductor lasers. (8)
- b. Write a brief about the characteristics of microwave transistor. (8)

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- Q.7** Write a brief note on the evolution of IC technology and the role of testing, bonding and packaging into IC fabrication. (16)
- Q.8** a. The production of a voltage difference across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current. Derive the effect with diagram. (8)
- b. State and derive Einstein's relation in the carrier dynamics of semi conductors. (8)
- Q.9** Write short notes on any **TWO**:
- (i) Schottky barriers
  - (ii) Kirk effect
  - (iii) Charge transfer device
  - (iv) Solar cells
- (2×8)