

AMIETE – ET (OLD SCHEME)

Time: 3 Hours

JUNE 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. What occurs when a conduction-band electron loses energy and falls back into a hole in the valence band?
- (A) Doping (B) Recombination
(C) Generation (D) None of the above
- b. Total emitter current is
- (A) $I_E - I_C$ (B) $I_C + I_E$
(C) $I_B + I_C$ (D) $I_B - I_C$
- c. Hall Effect can be used
- (A) to find the type of semiconductor
(B) to find carrier concentration
(C) to measure conductivity
(D) all of the above
- d. Transistor is a
- (A) Current controlled current device
(B) Current controlled voltage device
(C) Voltage controlled current device
(D) Voltage controlled voltage device
- e. What is the current gain for a common-base configuration where $I_E = 4.2$ mA and $I_C = 4.0$ mA?
- (A) 16.80 (B) 1.05
(C) 0.2 (D) 0.95

- f. The normal operating region for a zener diode is the
- (A) Forward-Bias region (B) Reverse-Bias region
(C) Zero-Crossing region (D) Reverse-Breakdown region
- g. Which diode operates only with majority carriers?
- (A) Laser (B) Tunnel
(C) Schottky (D) Step Recovery
- h. Midpoint bias for a D-MOSFET is $I_D = \underline{\hspace{2cm}}$, obtained by setting $V_{GS} = 0$.
- (A) $I_{DSS} / 2$ (B) $I_{DSS} / 3.4$
(C) I_{DSS} (D) None of the above
- i. LED is forward-biased. The diode should be on, but no light is showing. A possible trouble might be
- (A) the diode is open
(B) the series resistor is too small.
(C) none, the diode should be off if forward-biased.
(D) the power supply voltage is too high.
- j. The process of emitting photons from a semiconductive material is called
- (A) photoluminescence (B) electroluminescence
(C) Radiation (D) Simulation

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

- Q.2** a. Draw and explain the energy band diagrams of a direct band gap and indirect band gap semiconductors. Mention the suitable applications of both. (8)
- b. Explain the significance of Hall Effect in determining the mobility of charge carriers in extrinsic semiconductors. The resistivity of a bar is 230,000 Ω -cm when a magnetic flux of 0.1 Wb/m² is applied to the bar. For semiconductor bar $d=w=3$ mm. Current measured is 10 μ A and Hall Voltage is 50 mV. Determine the mobility of holes. (8)
- Q.3** a. Explain the different capacitive effects existing in p-n junction diodes. (8)
- b. A conducting line on IC chip is 2.5 mm long and has a cross sectional area of 5×10^{-12} m². A current of 2 mA produces a voltage drop of 40 mV across the line. If mobility of electrons is 500 cm²/V-s, find the electron concentration. (8)
- Q.4** a. Describe "Punch Through" and "Early Effect" in practical BJT devices. (8)

- b. Explain the following terms in context with BJT
(i) Collector Efficiency
(ii) Base Transport Factor (8)
- Q.5** a. Discuss the various short channel effects present in small geometry MOS devices. (8)
- b. Distinguish between depletion mode and enhancement mode MOSFETs. Explain the mechanism that leads to channel pinch off at higher drain source voltage drop. (8)
- Q.6** a. What is a varactor diode? How does it realize a voltage variable capacitance? Explain its working principle. (8)
- b. Explain the suitability of solar cells as a global energy source. Discuss the V-I characteristics of an illuminated solar cell. (8)
- Q.7** a. Differentiate between SSI, MSI, LSI, VLSI. Why do MOS ICs find wide applications in LSI and VLSI chips? (8)
- b. Discuss briefly various types of Packaging for ICs. (8)
- Q.8** a. Discuss the formation and drift of a space charge domain in a Gunn diode. (8)
- b. A bar of intrinsic Si measures 10 mm × 10 mm in cross-section. If a potential of 12 V is applied across the ends of bar, calculate the following:
(i) Electron and hole drift velocities.
(ii) Current in bar if its length is 1 cm
(Given data $\mu_p=500 \text{ cm}^2/\text{V-s}$, $\mu_n=1300 \text{ cm}^2/\text{V-s}$, $n_i=1.5 \times 10^{10} / \text{cm}^3$) (8)
- Q.9** Write short notes on the following:
- (i) Photodetectors
(ii) Breakdown mechanisms in p-n junction diodes
(iii) Frequency limitations of transistors
(iv) Substrate Bias effects in MOSFET (4×4)