

DiplETE – ET (OLD SCHEME)

Code: DE06
Time: 3 Hours

JUNE 2010

Subject: BASIC ELECTRONICS
Max. Marks: 100

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.
- 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. Respective resistance values and wattage ratings of wire wound resistors are _____.
- (A) from 1Ω to $100\text{ k}\Omega$ and 400 W
(B) from 1Ω to 100Ω and 200 W
(C) from 1Ω to $1\text{ k}\Omega$ and 300 W
(D) from 1Ω to $100\text{ k}\Omega$ and 200 W
- b. In a semiconductor, the movement of holes is due to _____.
- (A) movement of electrons in conduction band
(B) movement of holes in conduction band
(C) movement of holes in valence band
(D) movement of electrons in valence band
- c. In a P-N junction, the barrier Potential offers opposition to only _____.
- (A) holes in P-region
(B) free electrons in N-region
(C) majority carriers in both regions
(D) minority carriers in both regions
- d. If the output voltage of a bridge rectifier is 100 V, the Peak Inverse Voltage (PIV) of diode will be _____.
- (A) $\sqrt{2} \times 100\text{ V}$ (B) $\frac{2 \times 100}{\pi}\text{ V}$
(C) $\pi \times 100\text{ V}$ (D) $\frac{\pi}{2} \times 100\text{ V}$
- e. Which of the following diodes show the negative resistance region?
- (A) P-N junction (B) Zener
(C) Tunnel (D) Schottky
- f. In an N-P-N transistor collector current is _____.
- (A) more than emitter current

- (B) less than emitter current, approximately equal to 0.95 time of emitter current
 (C) exactly equal to emitter current
 (D) approximately equal to half of the emitter current
- g. In a JFET, drain current will be maximum when gate-source voltage is _____.
 (A) equal to V_P (B) positive
 (C) negative (D) zero
- h. The triac is equivalent to _____.
 (A) two SCRs connected in Parallel
 (B) two SCRs connected in antiparallel
 (C) one SCR, one diode connected in Parallel
 (D) one diode, one SCR connected in antiparallel
- i. An inverting op-amp has $R_f = 2\text{ M}\Omega$ and $R_1 = 2\text{ k}\Omega$. Its scale factor is _____.
 (A) 1000 (B) -1000
 (C) 10^{-3} (D) -10^{-3}
- j. Ultraviolet radiation is used in IC fabrication process for _____.
 (A) diffusion (B) masking
 (C) isolation (D) metalization

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

- Q.2** a. What is a passive circuit element? Name the most commonly used passive circuit elements. Briefly explain the following:
 (i) Paper capacitors.
 (ii) Mica capacitors. (9)
- b. Differentiate between a current source and a voltage source. Give their graphical representations. Convert 4A source with its parallel resistance of $15\ \Omega$ into its equivalent voltage source. (7)
- Q.3** a. What is a semiconductor? Explain the formation of N-type material from intrinsic semi-conductor by proper impurity doping. (10)
- b. A specimen of germanium at 300°K for which the density of carriers is $2.5 \times 10^{13} / \text{cm}^3$, is doped with impurity atoms such that there is one impurity atom for 10^6 germanium atoms. All the impurity atoms may be assumed ionized. The receptivity of doped material is $0.039\ \Omega - \text{cm}$.
 Carrier mobility for germanium at 300°K is 3,600. For the doped material, find the electron and whole densities. Given that the electron charge (e) is $1.602 \times 10^{-19}\ \text{C}$. (6)
- Q.4** a. Discuss how a depletion layer is formed in a P-N diode and how does it vary with biasing? Draw the V-I characteristics of P-N junction diode. (10)
- b. Determine the current flowing through the Zener diode for the circuit as shown in Fig.1, if $R_L = 5,000\ \Omega$, input

voltage is 50 V, $R_S = 2,000 \Omega$ and output voltage is 30 V. (6)

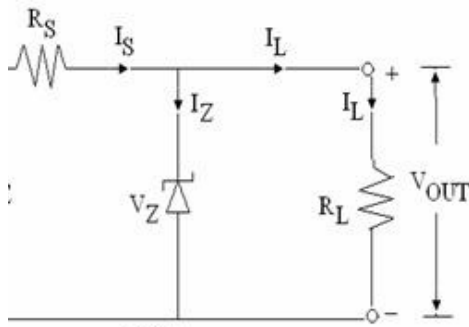


Fig.1

Q.5 a. What is a voltage multiplier? What are its applications? Draw the circuit diagram of half-wave voltage doubler and explain its operation with input and output waveforms. (10)

b. A single-phase Full-Wave Rectifier uses two diodes, has the internal resistance of each being 20Ω . The transformer rms secondary voltage from centre-tap to each end of secondary is 50 V and load resistance is 980Ω . Find

- The mean load Current (I_{dc}).
 - rms load Current (I_{rms}) and
 - Output efficiency (η).
- (6)

Q.6 a. Sketch a family of CB output characteristics for an NPN transistor and indicate the Active, Cut-off, Saturation and Break-down regions. Explain the shapes of the curves qualitatively. (10)

b. The reverse leakage current of the transistor when connected in CB configuration is $0.2 \mu A$ and it is $18 \mu A$ when the same transistor is connected in CE configuration. Assume that the base current, I_B is 30 mA and find

- Collector Current (I_c).
 - Common Base d.c. Current gain (α_{dc}) and
 - Common Emitter d.c. Current gain (β_{dc}) of the transistor.
- (6)

Q.7 a. What is the significant difference between the construction of an Enhancement type MOSFET and a Depletion type MOSFET? Explain the operation of an N-channel Enhancement MOSFET. (10)

b. For an N-channel JFET, if $I_{DSS} = 8.7 \text{ mA}$, $V_P = -3 \text{ V}$, and $V_{GS} = -1 \text{ V}$. Find the values of

- Drain Current (I_D).
 - Transconductance for $V_{GS} = 0$ (g_{m0}) and
 - Transconductance (g_m).
- (6)

Q.8 a. What are the various types of electron emissions? Explain in detail, the photoelectric emission. (6)

b. With neat diagrams, explain the construction, operation and characteristics of SCR. Mention its applications. **(10)**

Q. 9. a. Draw the circuit diagram of differentiator using op-amp and derive an expression for its output voltage. **(6)**

b. Determine the output voltage for the op-amp circuit as shown in Fig.2, if $R_1 = R = 1\text{ k}\Omega$, $R_f = 2\text{ k}\Omega$, $V_a = +5\text{ V}$, $V_b = -3\text{ V}$ and $V_c = +4\text{ V}$ **(4)**

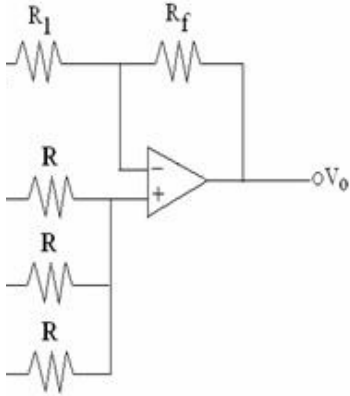


Fig.2

c. Write a short note on IC resistors.

(6)