

**B.Tech.**  
First Semester Examination  
**Basics of Electronics (ECE-101-F)**

*Note : This question consist of 80 short answer type question and all are compulsory.*

**Q. 1. The electronic components that can process the signal are called :**

- (a) **Passive components** (b) **Active components**  
(c) **None** (d) **All (a) & (b).**

**Ans. (b) Active components.**

**Q. 2. The rating of a resistor is in :**

- (a) **Ohms** (b) **Watts**  
(c) **Ampere** (d) **Both (a) & (b).**

**Ans. (d) Both (a) & (b).**

**Q. 3. The value of resistor having Red-Red-Red-gold color band is :**

- (a)  **$222\Omega \pm 10\%$**  (b)  **$2.2K\Omega \pm 5\%$**   
(c)  **$120\Omega \pm 5\%$**  (d)  **$220\Omega \pm 5\%$ .**

**Ans. (b)  $2.2K\Omega \pm 5\%$ .**

**Q. 4. Transistor is :**

- (a) **Passive component** (b) **Active component**  
(c) **None**

**Ans. (b) Active component.**

**Q. 5. An example of active device is :**

- (a) **An electric bulb** (b) **Transformer**  
(c) **A microphone** (d) **A silicon controlled rectifier (SCR)**

**Ans. (d) A silicon controlled rectifier (SCR).**

**Q. 6. In electronics the IC denotes :**

- (a) **Industrial control** (b) **Integrated circuits**  
(c) **Internal combustion** (d) **Indian calculation.**

**Ans. (b) Integrated circuits.**

**Q. 7. Radar is a device with the help of which we can :**

- (a) **Perform mathematical calculation easily**  
(b) **Listen more melodius music**  
(c) **Detect the presence of air-craft**  
(d) **Care the damage of human body.**

**Ans. (c) Detect the presence of air-craft.**

**Q. 8. Which of the following has a lowest temperature coefficient of resistivity :**

- (a) Copper
- (b) Silver
- (c) Gold
- (d) Aluminium.

**Ans. (c) Gold.**

**Q. 9. In a metal :**

- (a) The electrical conduction is by hole and electrons
- (b) With rise in temperature, the conductivity decreases
- (c) The conduction band is empty.
- (d) There is small energy gap between two bands.

**Ans. (b) With rise in temperature, the conductivity decreases.**

**Q. 10. The forbidden energy gap in semiconductors :**

- (a) Lies just below the valence band
- (b) Is the same as valence band
- (c) Lies just above the conduction band
- (d) Lies between valence and conduction band.

**Ans. (d) Lies between valence and conduction band.**

**Q. 11. The conduction band of a semiconductor may be :**

- (a) Completely filled
- (b) Partially filled
- (c) Empty
- (d) Either (b) or (c).

**Ans. (d) Either (b) or (c).**

**Q. 12. The energy band which possesses the free electrons is called :**

- (a) Valence band
- (b) Conduction band
- (c) Forbidden band
- (d) None of these.

**Ans. (b) Conduction band.**

**Q. 13. Which of the following behaves as an insulator :**

- (a) Diamond
- (b) Germanium
- (c) Silicon
- (d) Silver.

**Ans. (a) Diamond.**

**Q. 14. Silicon semiconductor devices are ..... over germanium devices.**

**Ans. Preferred.**

**Q. 15. The mobility of charge carrier is :**

- (a)  $m^2 / \text{volt} - \text{sec}$
- (b)  $m / \text{volt} - \text{sec}^2$
- (c)  $m^3 / \text{volt} - \text{sec}$
- (d)  $m \text{ volt-sec.}$

**Ans. (a)  $m^2 / \text{volt} - \text{sec}$ .**

**Q. 16. A semiconductor is electrically neutral because it has :**

- (a) No majority carriers
- (b) No minority carriers

- (c) No free carriers
- (d) Equal number of +ve and -ve carriers.

Ans. (d) Equal number of +ve and -ve carriers.

**Q. 17. An intrinsic semiconductor at absolute zero temperature :**

- (a) Has large number of holes
- (b) Has a same number of hole and electron
- (c) Acts as an insulator
- (d) Acts as metallic character

Ans. (c) Acts as an insulator.

**Q. 18. When the temperature of intrinsic semiconductor is increased :**

- (a) Resistance of semiconductor is also increased
- (b) Conductivity is decreased
- (c) Energy of atoms is increased
- (d) Holes are created

Ans. (c) Energy of atoms is increased.

**Q. 19. A donor-type impurity :**

- (a) Is used to obtain a P-type semiconductor
- (b) Is used to obtain a N-type semiconductor
- (c) Must possess three valence electrons
- (d) Cannot be used silicon crystals.

Ans. (b) Is used to obtain a N-type semiconductor.

**Q. 20. If small amount of antimony is added to Ge :**

- (a) The resistance is increased
- (b) Ge will become a P-type semiconductor
- (c) Antimony becomes an acceptor impurity
- (d) There will be no more free electrons than holes in semiconductor.

Ans. (d) There will be no more free electrons than holes in semiconductor.

**Q. 21. In an N-type semiconductor, the concentration of minority depends upon :**

- (a) Doping technique
- (b) Number of donor atoms
- (c) Temperature of material
- (d) Quality of intrinsic material

Ans. (c) Temperature of material.

**Q. 22. When a reverse bias is applied to a crystal diode, it :**

- (a) Raises the potential barrier
- (b) Lowers the potential barrier
- (c) Increases the majority-carrier current greatly

(d) None

Ans. (a) Raises the potential barrier.

Q. 23. When a forward bias is applied to crystal diode, it :

(a) Raises the potential barrier

(b) Lower the potential barrier

(c) Reduces the majority-carrier current to zero

(d) None.

Ans. (b) Lower the potential barrier.

Q. 24. Avalanche breakdown in a crystal diode occurs when :

(a) The potential barrier is reduced to zero

(b) Forward current exceeds a certain value

(c) Reverse bias exceeds a certain value

(d) All of these.

Ans. (c) Reverse bias exceeds a certain value.

Q. 25. When a pn junction is forward biased :

(a) Electron in the n-region are injected into the p-region

(b) Holes in the p-region are injected into the n-region

(c) Both (a) & (b)

(d) None.

Ans. (c) Both (a) & (b).

Q. 26. The maximum efficiency of F.W.R. is :

(a) 40.6%

(b) 100%

(c) 81.2%

(d) 85.6%

Ans. (c) 81.2%.

Q. 27. A zener diode has a :

(a) High forward voltage rating

(b) Negative resistances

(c) High amplification

(d) Sharp breakdown voltage at low rating voltage

Ans. (d) Sharp breakdown voltage at low rating voltage.

Q. 28. A zener diode used as :

(a) An amplifier

(b) A voltage regulator

(c) A coupler

(d) A rectifier.

Ans. (b) A voltage regulator.

Q. 29. In an npn transistor with normal bias :

(a) Only holes cross the collector junction

(b) Only majority carriers cross the collector junction

(c) The emitter junction has a high resistance

(d) The emitter junction is forward biased and collector junction is reverse bias.

Ans. (d) The emitter junction is forward biased and collector junction is reverse bias.

Q. 30. The most commonly used transistor circuit arrangement is :

- (a) Common base
- (b) Common emitter
- (c) Common collector
- (d) None of these.

Ans. (b) Common emitter.

Q. 31. The emitter of transistor is doped :

- (a) Heavily
- (b) Lightly
- (c) Moderately
- (d) None.

Ans. (a) Heavily.

Q. 32. The magnitude of current  $I_{CBO}$  :

- (a) Depends largely upon the emitter doping
- (b) Depends largely upon the emitter-base junction base
- (c) Increases with increase in temperature
- (d) Is generally greater in silicon than in germanium transistor.

Ans. (c) Increases with increase in temperature.

Q. 33. The current  $I_{CBO}$  flows in the :

- (a) Emitter and base leads
- (b) Collector and base leads
- (c) Emitter and collector leads
- (d) None of these.

Ans. (b) Collector and base leads.

Q. 34. The silicon transistor used more widely than germanium transistor because :

- (a) They have smaller leakage current
- (b) They have better ability to dissipate heat
- (c) They have smaller depletion layers
- (d) They larger current carrying capacitors.

Ans. (a) They have smaller leakage current.

Q. 35. The CE amplifier circuits are preferred over CB amplifier circuit because they have :

- (a) Lower amplification factor
- (b) Larger amplification factor
- (c) High input resistance & low output resistance
- (d) None.

Ans. (b) Larger amplification factor.

Q. 36. If the power and voltage gain of an amplifier is 25000 and 250 respectively than its current gain will be :

- (a)  $625 \times 10^4$
- (b) 100

(c) 250

(d) None of these.

Ans. (b) 100.

Q. 37. If the current gain and voltage gain of an amplifiers is X & Y respectively, then its power gain will be :

(a) XY

(b) X-Y

(c) X+Y

(c) Y/X

Ans. (a) X.Y.

Q. 38. In a CE transistor amplifier, voltage gain .....  $\times \frac{R_{AC}}{R_{in}}$ .

(a)  $\alpha$

(b)  $\beta + 1$

(c)  $\beta - 1$

(d)  $\beta$ .

Ans. (d)  $\beta$ .

Q. 39. The input signal of an amplifier is given as " $\cos(314t)$ ", the output signal of the gain of 200 will be :

(a)  $200 \cos(314t + 90^\circ)$

(b)  $200 \cos(314t - 90^\circ)$

(c)  $200 \cos(314t + 180^\circ)$

(d)  $100 \cos(314t + 180^\circ)$

Ans. (c)  $200 \cos(314t + 180^\circ)$ .

Q. 40. If a transistor amplifier draw  $20\mu A$ . When the input signal voltage is  $10mV$ , then the input impedance is :

(a)  $200\Omega$

(b)  $2\Omega$

(c)  $5\Omega$

(d)  $500\Omega$ .

Ans. (d)  $500\Omega$ .

Q. 41. If the input signal to a transistor amplifier is  $1mV$  (rms),  $R_{AC} = 2K\Omega$ ,  $R_m = 1K\Omega$  and  $\beta = 50$  then output voltage will be :

(a)  $25mV$

(b)  $50mV$

(c)  $100mV$

(d) None.

Ans. (c)  $100mV$ .

Q. 42. h-parameters of a transistor are :

(a) Four in number

(b)  $h_{ie}$ ,  $h_{re}$ ,  $h_{fb}$ ,  $h_{oc}$

(c)  $h_{fo}$ ,  $h_{rc}$ ,  $h_{fe}$ ,  $h_{oe}$

(d)  $h_{ie}$ ,  $h_{rb}$ ,  $h_{fc}$ ,  $h_{ob}$

Ans. (a) Four in number.

Q. 43. For CE amplifier circuit :

(a)  $Z_{in} = \frac{h_{re}h_{fe}}{h_{oe} + r_L}$

(c)  $Z_{in} = \frac{-h_{fe}}{\left(h_{oe} + \frac{1}{r_L}\right)}$

(b)  $Z_{in} = \frac{h_{fe}}{1 + h_{oe} + r_L}$

(d)  $Z_{in} = h_{ie} - \frac{h_{re}h_{fe}}{h_{oe} + \frac{1}{r_L}}$

Ans. (d)  $Z_{in} = h_{ie} - \frac{h_{re}h_{fe}}{h_{oe} + \frac{1}{r_L}}$

Q. 44. The base of radix of binary number system is :

(a) 2

(c) 8

(b) 4

(d) 16.

Ans. (a) 2.

Q. 45. How many bits are in one byte :

(a) 2

(c) 8

(b) 4

(d) 10

Ans. (c) 8.

Q. 46. How many bits are there in one nibble :

(a) 2

(c) 8

(b) 4

(d) 10.

Ans. (b) 4.

Q. 47. How many digits are there in octal number system :

(a) 2

(c) 10

(b) 8

(d) 16.

Ans. (b) 8.

Q. 48. What is the number of digits of hexadecimal number system.

(a) 2

(c) 10

(b) 8

(d) 16.

Ans. (d) 16.

Q. 49. What is the equivalent binary number of  $11_{10}$ ?

(a) 1011

(c) 1111

(b) 1010

(d) 1101?

Ans. (a) 1011.

Q. 50. What is decimal equivalent of  $567_8$  is :

(a)  $567_{10}$

(c)  $375_{10}$

(b)  $887_{10}$

(d)  $501_{10}$ .

Ans. (c)  $375_{10}$ .

Q. 51. State which Boolean expression is correct :

- (a)  $A.(A + C) = (\bar{A}.B) + (\bar{A}.C)$
- (b)  $A + B.C = (A + B).(A + C)$
- (c)  $A.(A + B) = B$
- (d)  $(A + B).(\bar{A} + A).(B + C) = (A + B)(A + C)$

Ans. (b)  $A + B.C = (A + B).(A + C)$ .

Q. 52. The unique output of NAND logic gate is a '0'

- (a) When all inputs are '0'
- (b) When all inputs are '9'
- (c) When anyone input is '0'
- (c) When any one input is '1'.

Ans. (b) When all inputs are '9'.

Q. 53. The input impedance of an ideal op-amp is :

- (a) Finite
- (b) Zero
- (c) Infinite
- (d) Unity.

Ans. (c) Infinite.

Q. 54. An op-amp is a device having the following number of input trends :

- (a) One
- (b) Two
- (c) Three
- (d) Four.

Ans. (b) Two.

Q. 55. The gain of an inverting amplifier is given as :

- (a)  $-\frac{R_2}{R_1}$
- (b)  $\frac{R_1}{R_2}$
- (c)  $-\frac{R_1}{R_2}$
- (d)  $\frac{R_1}{R_1 + R_2}$

Ans. (a)  $-\frac{R_2}{R_1}$ .

Q. 56. The gain of op-amp voltage follow :

- (a) Zero
- (b) Unity
- (c) Infinite
- (d) Very high.

Ans. (b) Unity.

Q. 57. The signal generator are used for :

- (a) Representing sine wave graphically
- (b) Troubleshooting in electronic equipment

- (c) Generating square wave only
- (d) All of these.

Ans. (b) Troubleshooting in electronic equipment.

Q. 58. A multimeter is basically :

- (a) A moving coil instrument
- (b) An induction type instrument
- (c) A PMMC instrument
- (d) None.

Ans. (c) A PMMC instrument.

Q. 59. The full scale deflection of ohm scale in a multimode reacts :

- (a) Infinity resistance
- (b) Zero resistance
- (c)  $100\Omega$  resistance
- (d) None.

Ans. (b) Zero resistance.

Q. 60. A VTVM is never used to measure :

- (a) Voltage
- (b) Resistance
- (c) Current
- (d) None.

Ans. (c) Current.

Q. 61. The difference of  $FAB32C_{16}$  and  $AB2C3_{16}$  is

- (a)  $3BD4A3_{16}$
- (b)  $3DD4A3_{16}$
- (c)  $3DD4A4_{16}$
- (d)  $3DC4B4_{16}$

Ans. (b)  $3DD4A3_{16}$ .

Q. 62. The decimal number system has radix of :

- (a) 10
- (b) 2
- (c) 8
- (d) 16.

Ans. (a) 10.

Q. 63. The number of input variables which a NOT gate can have is :

- (a) One
- (b) Two
- (c) Three
- (d) Any number.

Ans. (a) One.

Q. 64. A transistor is said to be in a quiescent state when :

- (a) It is unbiased
- (b) No current flow through it
- (c) No signal is applied to input
- (d) Emitter junction just biased equal to collector junction.

Ans. (c) No signal is applied to input.

Q. 65. In the initial stage of a transistor amplifier, the zero signal collector current  $I_c$  is generally :

- (a) 0.5 mA
- (b) 1.0 mA
- (c) 1.5 mA
- (d) 2.0 mA.

Ans. (b) 1.0mA.

Q. 66. The Ideal value of stability factor is?

- (a) 1
- (b) 5
- (c) 10
- (d) 100.

Ans. (a) 1.

Q. 67. A zener diode is used as :

- (a) An amplifier
- (b) A voltage regulator
- (c) A coupler
- (d) A rectifier.

Ans. (b) A voltage regulator.

Q. 68. The maximum efficiency of F.W.R.

- (a) 40.6%
- (b) 100%
- (c) 81.2%
- (d) 85.6%.

Ans. (c) 81.2%.

Q. 69. In FWR input frequency 50Hz then output frequency is :

- (a) 50 Hz
- (b) 75 Hz
- (c) 100 Hz
- (d) 200 Hz

Ans. (c) 100Hz.

Q. 70. Under normal operating, the reverse current of silicon diode is ;

- (a) 10 mA
- (b) 1 $\mu$ A
- (c) 1000  $\mu$ A
- (d) None.

Ans. (b) 1  $\mu$ A.

Q. 71. T flip-flop is used as :

- (a) Transfer data circuit
- (b) Toggle switch
- (c) Time delay switch
- (d) None of these.

Ans. (b) Toggle switch.

Q. 72. Following flip-flop is used to eliminate race around problem.

- (a) R-S flip-flop
- (b) Master slave J-K flip-flop
- (c) J-K flip flop
- (d) None of above.

Ans. (b) Master slave J-K flip-flop.

Q. 73. Race condition Occurs in :

- (a) Synchronous circuit
- (b) Asynchronous circuit
- (c) Combinational circuit
- (d) All the digital circuit.

Ans. (b) Asynchronous circuit.

Q. 74. The basic sequential logic building block in which the output follows the data input as long as the ENABLE input is active is :

- (a) J-K flip flop
- (b) D-Type flip-flop
- (c) T-flip-flop
- (d) D-Type latch.

Ans. (d) D-Type latch.

Q. 75. The characteristic equation of an R-S flip-flop is given by :-

(a)  $Q_{n+1} = S + RQ_n$

(b)  $Q_{n+1} = \bar{S} + RQ_n$

(c)  $Q_{n+1} = S + \bar{R}Q_n$

(d)  $Q_{n+1} = R\bar{Q}_n + \bar{S}Q_n$

Ans. (c)  $Q_{n+1} = S + \bar{R}Q_n$ .

Q. 76. In any asynchronous counter :

(a) All flip-flops change state at the same time.

(b) Only D-type flip-flops are used.

(c) The counter responds to negative going clock edges.

(d) Each flip-flop output serves as clock input to the next flip-flop.

Ans. (d) Each flip-flop output serves as clock input to the next flip-flop.

Q. 77. A 5-bit counter :

(a) Has a modulus of 5

(b) Has a modulus of  $2^5$

(c) Cannot have modulus that is greater than  $2^5$

(d) Has a modulus that is less than  $2^5$ .

(e) Both (c) and (d) are true.

Ans. (e) Both (c) and (d) are true.

Q. 78. All BCD counters :

(a) Are decade counters because all decade counters are BCD counters :

(b) Are not decade counters

(c) Have modulus of 10

(d) Are constructed with only presentable D-type flop-flips

(e) Both (c) and (d) are correct.

Ans. (c) Have modulus of 10.

Q. 79. The minimum numbers of flip-flops required to construct a MOD-10 Johnson counter and MOD-5 Ring Counter respectively are :

(a) 10, 5

(b) 5, 10

(c) 5, 5

(d) 10, 10.

Ans. (c) 5, 5.

Q. 80. If a counter is connected using six flip-flop, then the maximum number of states that the counter can count are :

(a) 6

(b) 8

(c) 256

(d) 64.

Ans. (d) 64.

## Section-A

Note : All questions carries 5 marks.

20

**Q. 1. Write the expression for difference potential of a diode and explain.**

Ans. Its can be proved that the contact potential is given by

$$V_j = V_T \log_e \left[ \frac{N_A \cdot N_D}{n_i^2} \right] \text{ volts.} \quad \dots(1)$$

Where,

$$V_T = \text{Voltage equivalent of temperature} = \frac{T}{11600}$$

and  $n_i$  = intrinsic concentration

$N_A$  = concentration of acceptor impurities

$N_D$  = concentration of donor impurities

Hence contact potential depends upon the following parameters :

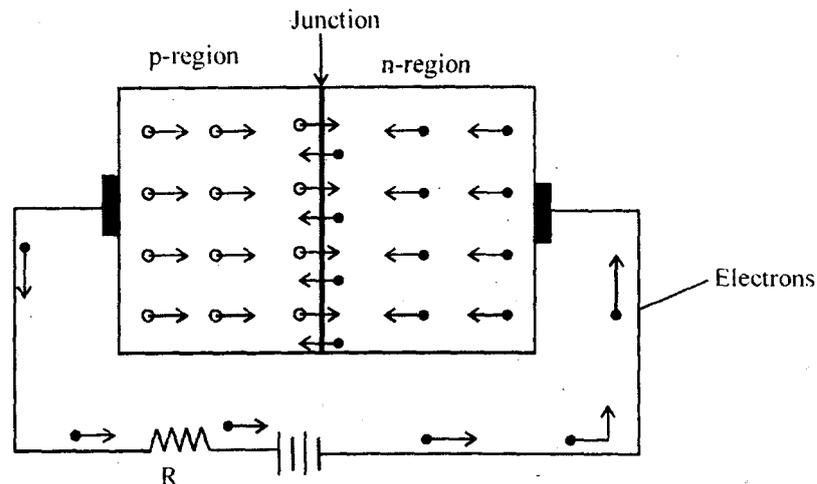
- (i) Concentration of donour impurities  $N_D$ .
- (ii) Concentration of intrinsic impurities  $N_A$ .
- (iii) Intrinsic concentration  $n_i$  and
- (iv)  $V_T$ .

**Conclusion :**

- (i) The junction potentials depends on the voltage equivalent of temperature  $V_T$ .
- (ii) The junction potential is decided by doping level.
- (iii) The junction potential for silicon diodes is 0.6 to 0.7 while for germanium diode it is 0.2 to 0.3V.

**Q. 2. Explain how to current flow in diodes forward bias condition?**

Ans.



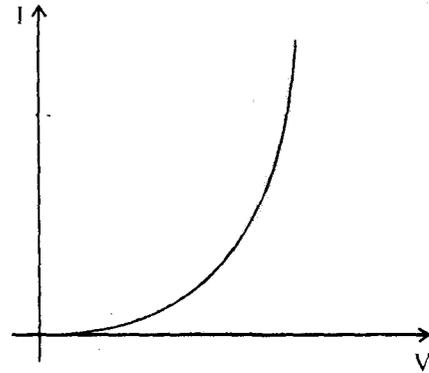
As soon as the free electrons enter into the p-region from the n-side, they become valence electron, so these electrons will jump from one atom to the other to fill up the holes present there. Thus, the movement of electron on p-side will be due to movement of holes.

These electrons move towards the positive end of the source and the holes will move towards the junction.

Thus, current through the p-region flows due to the movement of majority carrier.

Similarly the current on the n-side is due to the movement of free electrons which are the majority carriers. Hence, we conclude :

"The forward current through a p-n junction diode flows due to the majority carriers and its direction of flow is always from anode to cathode."

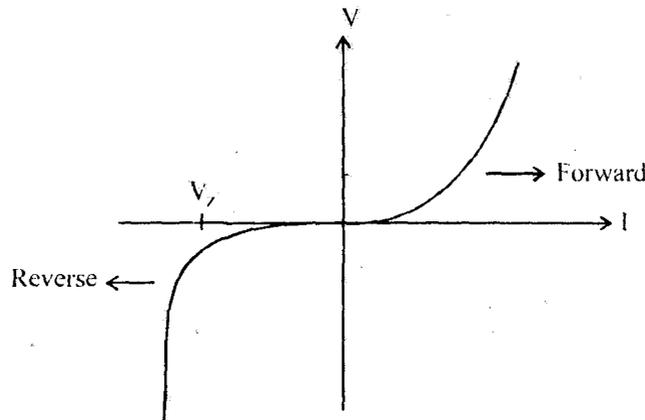


**Q. 3. Explain the breakdown due to Zener effect.**

**Ans.** The reverse breakdown can take place due to another effect called Zener effect. The event takes place in the following sequence in the process of breakdown due to Zener effect due to the heavy doping of p and n-sides of the diode, the depletion region is narrow in the reverse bias condition, all the reverse voltage 'V' appears across the depletion region.

Therefore the electric field is very intense across the depletion region. This intense electric field can pull some of valence electrons by breaking the covalent bonds these electrons then become free electrons.

A large number of such electrons can constitute a large reverse current through the diode. This is called breakdown due to Zener effect.



**Q. 4. Discuss the effect of temperature on V-I characteristics of diode.**

**Ans.** The expression for diode current is :

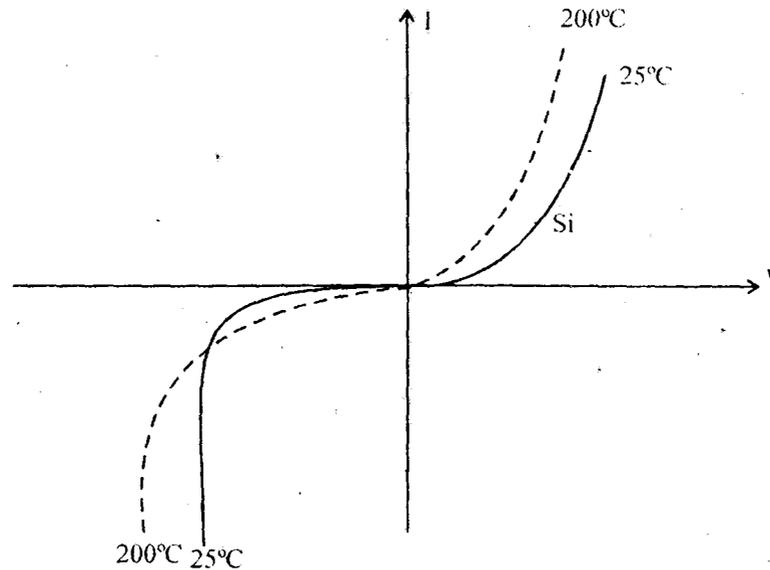
$$I_D = I_0 \left[ e^{V/\eta V_T} - 1 \right]$$

Where,  $I_0$  = Reverse saturation current

$$\begin{cases} V_T = T / 11600 \\ \eta = 1(\text{Ge}) \& 2(\text{Si}) \\ V = \text{Diode voltage} \end{cases}$$

- (i) The diode characteristics is mathematically expressed by the equation  $I_D$ .
- (ii) The two parameters  $I_0$  and  $V_T$  are the temperature dependent hence characteristic dependent on temperature.
- (iii) The effect on characteristic due to change in temperature is shown in diagram.
- (iv) We can express the dependency of  $I_0$  on temperature by expression given below :

$$I_0 = K T^m e^{-V_{G0}/\eta V_T}$$



**Q. 5. The forward current through a silicon diode is 10mA at room temperature (27°C). The corresponding forward voltage is 0.75 volts. Calculate reverse saturation current  $I_0$ .**

Ans.

$$I_F = 10\text{mA}, V_F = 0.75\text{ volts}$$

$$T = 27^\circ\text{C} = 300^\circ\text{K}; \eta = 2 \text{ for silicon diode}$$

$$V_T = \frac{T}{11600} = \frac{300}{11600}$$

$$V_T = 26\text{mV}$$

The forward current through diode is given by

$$I_F = I_0 \left( e^{V_F/\eta V_T} - 1 \right) \quad \dots(1)$$

Substituting the Value :

$$10 \times 10^{-3} = I_0 \left[ e^{-0.75/2 \times 26 \times 10^{-3}} - 1 \right]$$

$$I_0 = \frac{10 \times 10^{-3}}{\left[ e^{-0.75/2 \times 26 \times 10^{-3}} - 1 \right]}$$

$$I = 5.446 \text{ mA}$$

**Q. 6. Find out expression for the dynamic resistance of a diode.**

**Ans.** The dynamic resistance is defined as :

$$r_d = \frac{I}{\text{Slope of } V + I \text{ characteristic}} = \frac{I}{[dI/dV]} \quad \dots(i)$$

But  $I = I_0 \left[ e^{V_F/\eta V_T} - 1 \right]$  ... (ii)

$$\Rightarrow \frac{dI}{dV} = I_0 \left[ \frac{1}{\eta V_T} e^{V_F/\eta V_T} \right]$$

$$\Rightarrow \frac{dI}{dV} = \frac{I_0 e^{V_F/\eta V_T}}{\eta V_T} \quad \dots(iii)$$

Hence,  $r_d = \frac{I}{dI/dV}$

$$\Rightarrow r_d = \frac{\eta V_T}{I_0 e^{V_F/\eta V_T}} \quad \dots(iv)$$

And from equation (ii), we get

$$I + I_0 = I_0 e^{V_F/\eta V_T}$$

Substitute in equation (iv)

$$\Rightarrow r_d = \frac{\eta V_T}{I + I_0}$$

**Q. 7. Find the static and the dynamic resistance of a p-n junction germanium diode if the temperature is 27°C and  $I_0 = 1\mu\text{A}$  for an applied forward bias of 0.2 volts.**

**Ans.** As the diode equation for Ge diode is,

$$\begin{aligned} I &= I_0 \left[ \exp\left(\frac{eV}{K_T}\right) - 1 \right] \\ &= 10^{-6} \left[ \exp\left(\frac{1.6 \times 10^{-19} \times 0.2}{1.38 \times 10^{-23} \times 300}\right) - 1 \right] \\ &= 10^{-6} \left[ \exp\left(\frac{0.2eV}{0.025eV}\right) - 1 \right] = 10^{-6} [\exp(8) - 1] \end{aligned}$$

$$I = 2.27 \text{ mA}$$

**Static Resistance :**

$$r_{dc} = \frac{V}{I} = \frac{0.2}{2.27 \times 10^{-3}} = 88 \Omega$$

**Now for Dynamic Resistance :**

$$\frac{dI}{dV} = I_0 \times 38.6 \exp(38.6)V = 38.6I$$

$$\Rightarrow \frac{dI}{dV} = \frac{I}{38.6I}$$

$$r_{dc} = \frac{1}{38.6 \times 2.27 \times 10^{-3}} \\ = 11.4 \Omega.$$

**Q. 8. Write short note on diffusion capacitance  $C_D$  of diode.**

**Ans.** When a p-n junction diode is forward bias, offers a capacitance caused by the injected charge stored near the junction just outside the transition region. This capacitance is called as diffusion capacitance  $C_D$ .

This is also termed as storage capacitance.

$C_D$  may also be defined as the rate of change of injected charge with voltage,

$$C_D = \frac{dQ}{dV} = \tau \frac{dI}{dV} = \tau g = \frac{\tau}{r}$$

Where  $g$  is the diode internal conductance and equals to  $\frac{dI}{dV}$ .  $r$  is diode dynamic resistance  $= \frac{\eta V_T}{I}$ .

$$\Rightarrow \boxed{C_D = \frac{\tau I}{\eta V_T}}$$

Thus, the diffusion capacitance is proportional to the current  $I$ .

(i) For forward bias  $C_D$  is usually much greater than  $C_T$ .

(ii) For reverse bias,  $g$  is very small, so that  $C_D$  is negligibly small in comparison with  $C_T$ .

$$\Rightarrow C_D = \frac{\tau}{r}$$

$$\Rightarrow \boxed{C_{dr} = \tau}$$

Hence, diode time constant  $\tau = C_{dr}$ .

**Q. 9. A half-wave rectifier is used to supply 12V dc to a resistive load of 500Ω. If the crystal diode had a forward resistance of 25Ω determine the value of a.c. voltage supplied to the circuit.**

**Ans.** Given that,

$$V_{dc} = 12 \text{ V}, R_L = 500 \Omega \text{ and } r_f = 25 \Omega$$

$$I_{dc} = \frac{V_{dc}}{R_L}$$

$$= \frac{12}{500} = 0.024 \text{ A}$$

Now,  $I_m = I_{dc} \times \pi$

&  $\frac{V_m}{(r_f + R_L)} = I_{dc} \times \pi$

$\Rightarrow V_m = I_{dc} \pi (r_f + R_L)$

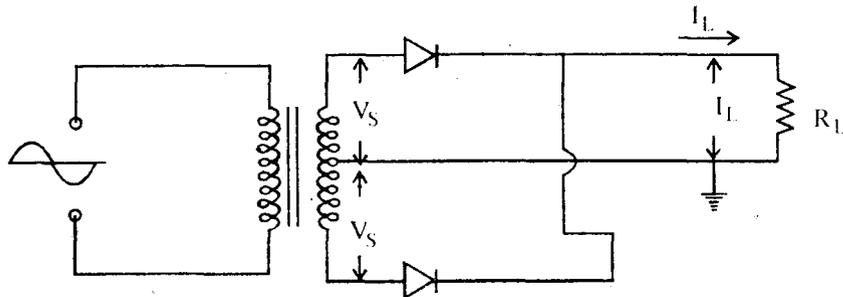
$\Rightarrow V_m = 39.584 \text{ V}$

As a.c. voltage is always represented as r.m.s. value

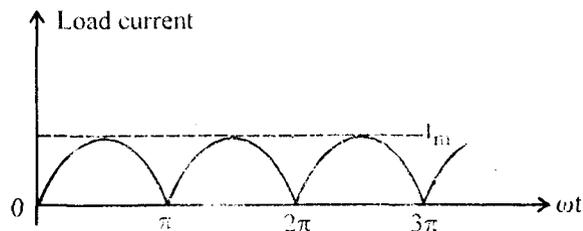
$$V = V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$\frac{39.584}{\sqrt{2}} = 27.99 = 28 \Omega$$

**Q. 10. Find the average value of load current for given circuit.**



**Ans. Load Current Waveform :**



Here, we going to consider the load current waveform extending form 0 to  $\pi$ .

$$\text{Average value} = \frac{\text{Area under the curve}}{\text{Time duration}}$$

$$= \frac{1}{\pi} \int_0^{\pi} I_m \sin \omega t \, d\omega t$$

$$= -\frac{I_m}{\pi} [\cos \omega t]_0^{\pi}$$

$$= -\frac{I_m}{\pi} [\cos \pi - \cos 0]$$

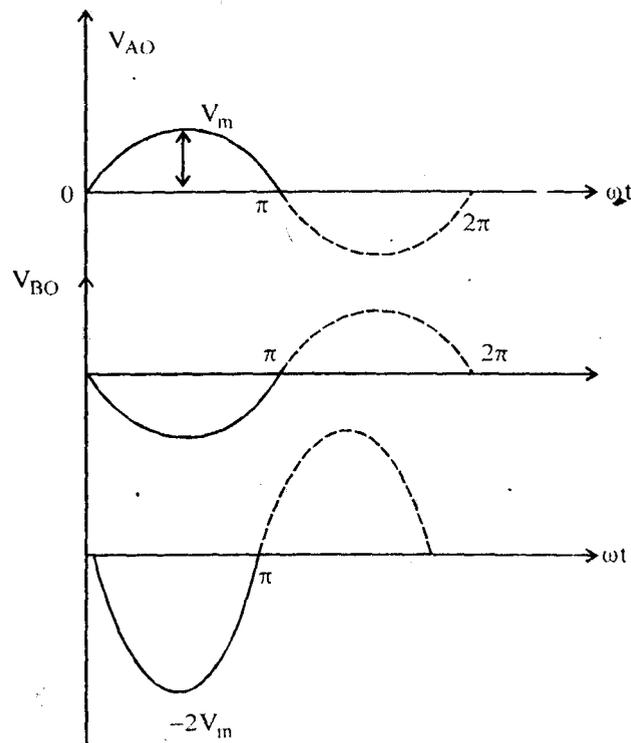
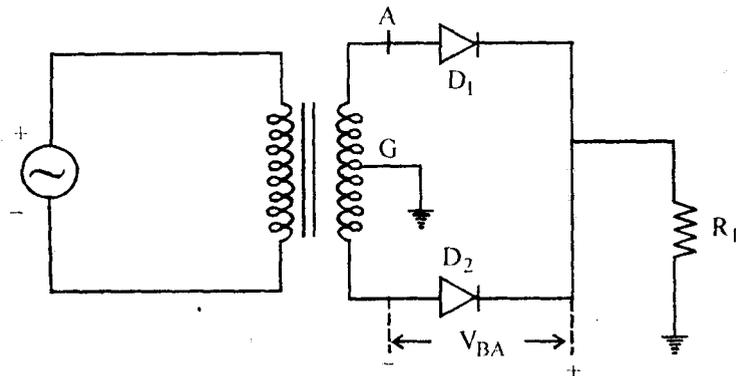
$$I_{dc} = -\frac{2I_m}{\pi}$$

Where

$$I_m = \frac{V_m}{R_S + R_F + R_L}$$

**Q. 11. Define peak inverse voltage for diode.**

**Ans.**



(i) To obtain the value of PIV, refer fig. which is equivalent circuit of FWR in the positive half cycle.

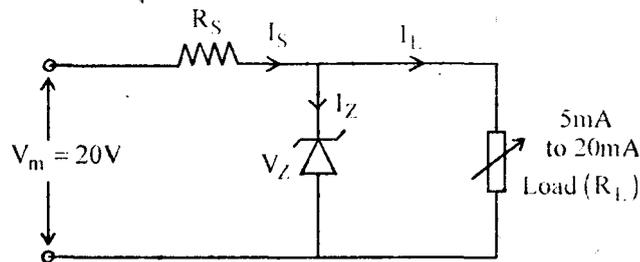
(ii) Diode  $D_1$  is conducting and it is assumed to be equivalent to a closed switch. Let us obtain the PIV  $D_2$  which is now off.

(iii) Figure shows that in the positive half cycle ( $0 - \pi$ ) the instantaneous voltage across  $D_2$  is  $V_{BA}$ . As is shown in the waveform the maximum negative value of  $V_{BA}$  is  $-2V_m$ .

$$\therefore \text{PIV} = 2V_m \text{ volts}$$

**Q. 12. Design a regulating circuit to achieve a constant voltage of 10V ( $\pm 0.7V$ ) across a load in which current varies from 5 to 20 mA the source which supplies power to circuit is of 20V. dc.**

Ans.



To regulate voltage 10V we must select a Zener with

$$V_Z = 10V$$

To meet with the load current, let the current supplied by the source be,

$$I_S = 30 \text{ mA}$$

Value of series resistor.

$$\begin{aligned} R_S &= \frac{V_m - V_Z}{I_S} \\ &= \frac{20 - 10}{30 \times 10^{-3}} = 333 \Omega \end{aligned}$$

$$\text{Wattage of series resistor} = I_S^2 R_S = (30 \times 10^{-3})^2 \times 333 = 0.3W$$

Hence, a resistor of  $\frac{1}{2}W$ ,  $330\Omega \pm 5\%$  tolerance would be applied.

To determine Wattage of Zener diode,

$$I_Z = I_S - I_L = 30 - 5 = 25 \text{ mA}$$

$$\begin{aligned} \text{Wattage of Zener} &= W_Z = V_Z \times I_Z = 10 \times 25 \times 10^{-3} \\ &= 250 \text{ mW} \end{aligned}$$

Q. 13. A CE amplifier has the following h-parameters,

$$h_{ie} = 1100 \text{ ohm} ; h_{re} = 2.5 \times 10^{-4}$$

$$h_{fe} = 50 , h_{oe} = 25 \text{ micro mho .}$$

If the load source resistance both are 1 kilo-ohm. Find current and voltage gain.

Ans. Here  $R_S = 1\text{k}\Omega , r_L = 1\text{k}\Omega = 1 \times 10^3 \Omega$

Current gain :

$$A_I = \frac{h_{fe}}{1 + h_{oe} \times R_L}$$

$$= \frac{50}{1 \times 25 \times 10^{-6} \times 1 \times 10^3}$$

$$= \frac{50}{1 + 0.025} = 48.78$$

Voltage Gain :

$$A_V = \frac{-h_{fe}}{\left( h_{oe} + \frac{1}{r_L} \right) Z_{in}}$$

Where :

$$Z_{in} = h_{ie} - \frac{h_{re} h_{fe}}{h_{oe} + \frac{1}{r_L}} = 1100 - \frac{2.5 \times 10^{-4} \times 50}{25 \times 10^{-6} + 1 \times 10^{-3}}$$

$$Z_{in} = 1100 - 12.5 = 1087.5 \Omega$$

$$\Rightarrow A_V = \frac{-50}{\left( 25 \times 10^{-6} + 1 \times 10^{-3} \right) \times 1087.5} = -45.977$$

The negative sign shows that the output voltage is  $180^\circ$  of phase with input voltage.

Q. 14. A transistor biased by potential divider and emitter resistance biasing has its zero signal operating point fixed at 2mA, 6V, if  $V_{CC} = 15\text{V}$ ,  $R_E = 1\text{k}\Omega$ ,  $R_2 = 10\text{k}\Omega$  and  $V_{BE} = 0.3\text{V}$  find the value of  $R_C$  and  $R_1$ .

Ans.  $I_C = 2\text{mA}$

$$V_{CE} = 6\text{V}$$

Writing the loop equation,

$$V_{CC} = I_C R_C + V_{CE} + I_E R_E$$

$$V_{CC} = I_C R_C + V_{CE} + I_C R_E$$

$$\Rightarrow 15 = 2 \times 10^{-3} R_C + 6 + 2 \times 10^{-3} \times 1 \times 10^3$$

$$R_C = 3.5\text{k}\Omega ,$$

