PRACTICE TEST

Semiconductor Basics

1. The outermost orbit of an atom can have a maximum of .... electrons.
(*i*)8 (*ii*)6
(*iii*)4 (*iv*)3

2. When the outermost orbit of an atom has less than 4 electrons, the material is generally a ....
(*i*) non-metal (*ii*) metal
(*iii*) semiconductor (*iv*) none of above

3. The valence electrons have.............
(*i*) very small energy
(*ii*) least energy
(*iii*) maximum energy
(*iv*) none of the above

4. A large number of free electrons exist in ....
(*i*) semiconductors (*ii*) metals
(*iii*) insulators (*iv*) non-metals

5. An ideal voltage source has .... internal resistance.
(*i*) small (*ii*) large
(*iii*) infinite (*iv*) zero

6. An ideal current source has .... internal
resistance.
(*i*) infinite (*ii*) zero
(*iii*) small (*iv*) none of the above

7. Maximum power is transferred if load resistance is equal to .... of the source.
(*i*) half the internal resistance
(*ii*) internal resistance
(*iii*) twice the internal resistance
(*iv*) none of the above

8. Efficiency at maximum power transfer is ....
(*i*) 75% (*ii*) 25%
(*iii*) 90% (*iv*) 50%

9. When the outermost orbit of an atom has exactly 4 valence electrons, the material is generally ....
(*i*) a metal (*ii*) a non-metal
(*iii*) a semiconductor
(*iv*) an insulator

10. Thevenin's theorem replaces a complicated circuit facing a load by an.............
(*i*) ideal voltage source and parallel resistor
(*ii*) ideal current source and parallel resistor
(*iii*) ideal current source and series resistor
(*iv*) ideal voltage source and series resistor

11. The output voltage of an ideal voltage source is ....
(*i*) zero (*ii*) constant
(*iii*) dependent on load resistance
(*iv*) dependent on internal resistance

12. The current output of an ideal current source is ....
(*i*) zero (*ii*) constant
(*iii*) dependent on load resistance
(*iv*) dependent on internal resistance

13. Norton's theorem replaces a complicated circuit facing a load by an ....
(*i*) ideal voltage source and parallel resistor
(*ii*) ideal current source and parallel resistor
(*iii*) ideal voltage source and series resistor
(*iv*) ideal current source and series resistor

14. The practical example of ideal voltage source is ....
(*i*) lead-acid cell (*ii*) dry cell
(*iii*) Daniel cell (*iv*) none of the above

15. The speed of electrons in vacuum is .... than in a conductor.
(*i*) less (*ii*) much more
(*iii*) much less (*iv*) none of the above

16. Maximum power will be transferred from a source of 10 Ω resistance to a load of ....
(*i*)5 Ω (*ii*) 20 Ω
(*iii*) 10 Ω (*iv*) 40 Ω

17. When the outermost orbit of an atom has more than 4 electrons, the material is generally a ....
(*i*)metal (*ii*) non-metal
(*iii*) semiconductor (*iv*) none of the above

18. An ideal source consists of 5 V in series with 10 kΩ resistance. The current magnitude of equivalent current source is ....
(*i*)2 mA (*ii*) 3.5 mA
(*iii*) 0.5 mA (*iv*) none of the above

19. To get Thevenin voltage, you have to ....
(*i*) short the load resistor
(*ii*) open the load resistor
(*iii*) short the voltage source
(*iv*) open the voltage source

20. To get the Norton current, you have to ....
(*i*) short the load resistor
(*ii*) open the load resistor
(*iii*) short the voltage source
(*iv*) open the voltage source

21. The open-circuited voltage at the terminals of load *R* in a network is 30 V. Under the conditions of maximum power transfer, the load voltage will be ....*L*
(*i*) 30 V (*ii*) 10 V
(*iii*)5 V (*iv*) 15 V

22. Under the conditions of maximum power transfer, a voltage source is delivering a power of 30 W to the load. The power produced by the source is ....
(*i*)45 W (*ii*) 60 W
(*iii*)30 W (*iv*) 90 W

23. The maximum power transfer theorem is used in ....
(*i*) electronic circuits
(*ii*) power system
(*iii*) home lighting circuits
(*iv*) none of the above

24. The Norton resistance of a network is 20 Ω and the shorted-load current is 2 A. If the network is loaded by a resistance equal to 20 Ω, the current through the load will be ....
(*i*)2 A (*ii*) 0.5 A
(*iii*)4 A (*iv*)1 A

25. The Norton current is sometimes called the..............
(*i*) shorted-load current
(*ii*) open-load current
(*iii*) Thevenin current
(*iv*) Thevenin voltage

PN Junction Diode

1. A semiconductor is formed by........ bonds.
(*i*) covalent (*ii*) electrovalent
(*iii*) co-ordinate (*iv*) none of the above

2. A semiconductor has .... temperature coefficient of resistance.
(*i*) positive (*ii*) zero
(*iii*) negative (*iv*) none of the above

3. The most commonly used semiconductor is........
(*i*) germanium (*ii*) silicon
(*iii*) carbon (*iv*) sulphur

4. A semiconductor has generally........ valence electrons.
(*i*)2 (*ii*)3
(*iii*)6 (*iv*)4

5. The resistivity of pure germanium under standard conditions is about ....
(*i*)$6 * 10^4$ Ω cm (*ii*) 60 Ω cm
(*iii*)$3 * 10^6$ cm (*iv*)$6 * 10^{-4}$ Ω cm

6. The resistivity of pure silicon is about ....
(*i*) 100 Ω cm (*ii*) 6000 Ω cm
(*iii*)$3 * 10^5$ Ω cm (*iv*) $1.6 * 10^{-8}$ Ω cm

7. When a pure semiconductor is heated, its resistance ....
(*i*) goes up (*ii*) goes down
(*iii*) remains the same (*iv*) cannot say

8. The strength of a semiconductor crystal comes from ....
(*i*) forces between nuclei
(*ii*) forces between protons
(*iii*) electron-pair bonds
(*iv*) none of the above

9. When a pentavalent impurity is added to a pure semiconductor, it becomes ....
(*i*) an insulator
(*ii*) an intrinsic semiconductor
(*iii*) *p*-type semiconductor
(*iv*) *n*-type semiconductor

10. Addition of pentavalent impurity to a semi-conductor creates many........
(*i*) free electrons (*ii*) holes
(*iii*) valence electrons
(*iv*) bound electrons

11. A pentavalent impurity has........ valence electrons.
(*i*)3 (*ii*)5
(*iii*)4 (*iv*)6

12. An *n*-type semiconductor is........
(*i*) positively charged
(*ii*) negatively charged
(*iii*) electrically neutral
(*iv*) none of the above

13. A trivalent impurity has........ valence electrons.
(*i*)4 (*ii*)5
(*iii*)6 (*iv*)3

14. Addition of trivalent impurity to a semiconductor creates many ....
(*i*) holes (*ii*) free electrons
(*iii*) valence electrons
(*iv*) bound electrons

15. A hole in a semiconductor is defined as ....
(*i*) a free electron
(*ii*) the incomplete part of an electron pair bond
(*iii*) a free proton
(*iv*) a free neutron

16. The impurity level in an extrinsic semiconductor
is about .... of pure semiconductor.
(*i*) 10 atoms for 10^8 atoms
(*ii*) 1 atom for 10^8 atoms

(*iii*) 1 atom for 10^4 atoms
(*iv*) 1 atom for 100 atoms

17. As the doping to a pure semiconductor increases, the bulk resistance of the semiconductor ....
(*i*) remains the same
(*ii*) increases
(*iii*) decreases
(*iv*) none of the above

18. A hole and electron in close proximity would tend to ....
(*i*) repel each other
(*ii*) attract each other
(*iii*) have no effect on each other
(*iv*) none of the above

19. In a semiconductor, current conduction is due ....
(*i*) only to holes
(*ii*) only to free electrons
(*iii*) to holes and free electrons
(*iv*) none of the above

20. The random motion of holes and free electrons due to thermal agitation is called........
(*i*) diffusion (*ii*) pressure
(*iii*) ionisation (*iv*) none of the above

21. A forward biased *pn* junction has a resistance of the........
(*i*) order of **Ω** (*ii*) order of k **Ω**
(*iii*) order of M **Ω** (*iv*) none of the above

22. The battery connections required to forward bias a *pn* junction are ....
(*i*) +ve terminal to *p* and -ve terminal to *n*
(*ii*) -ve terminal to *p* and +ve terminal to *n*
(*iii*) -ve terminal to *p* and -ve terminal to *n*
(*iv*) none of the above

23. The barrier voltage at a *pn* junction for germanium is about ....
(*i*) 3.5 V (*ii*)3V
(*iii*) zero (*iv*) 0.3 V

24. In the depletion region of a *pn* junction, there is a shortage of ....
(*i*) acceptor ions (*ii*) holes and electrons
(*iii*) donor ions (*iv*) none of the above

25. A reverse biased *pn* junction has ....
(*i*) very narrow depletion layer
(*ii*) almost no current
(*iii*) very low resistance
(*iv*) large current flow

26. A *pn* junction acts as a ....
(*i*) controlled switch
(*ii*) bidirectional switch
(*iii*) unidirectional switch
(*iv*) none of the above

27. A reverse biased *pn* junction has resistance of the........
(*i*) order of **Ω** (*ii*) order of k **Ω**
(*iii*) order of M **Ω** (*iv*) none of the above

28. The leakage current across a *pn* junction is due to ....
(*i*) minority carriers
(*ii*) majority carriers
(*iii*) junction capacitance
(*iv*) none of the above

29. When the temperature of an extrinsic semiconductor is increased, the pronounced Effect is on ....
(*i*) junction capacitance
(*ii*) minority carriers
(*iii*) majority carriers
(*iv*) none of the above

30. With forward bias to a *pn* junction, the width of depletion layer........
(*i*) decreases (*ii*) increases
(*iii*) remains the same
(*iv*) none of the above

31. The leakage current in a *pn* junction is of the order of ....
(*i*)A (*ii*)mA
(*iii*)kA (*iv*) µA

32. In an intrinsic semiconductor, the number of free electrons ....
(*i*) equals the number of holes
(*ii*) is greater than the number of holes
(*iii*) is less than the number of holes
(*iv*) none of the above

(*iii*) many free electrons
(*iv*) no holes or free electrons

35. At room temperature, an intrinsic silicon crystal acts approximately as ....
(*i*) a battery
(*ii*) a conductor
(*iii*) an insulator
(*iv*) a piece of copper wire

33. At room temperature, an intrinsic semiconductor has ....
(*i*) many holes only
(*ii*) a few free electrons and holes
(*iii*) many free electrons only
(*iv*) no holes or free electrons

34. At absolute temperature, an intrinsic semiconductor has ....
(*i*) a few free electrons
(*ii*) many holes

PN Junction Diode Application

1. A crystal diode has........
(*i*) one *pn* junction
(*ii*) two *pn* junctions
(*iii*) three *pn* junctions
(*iv*) none of the above

2. A crystal diode has forward resistance of the order of ....
(*i*)kΩ (*ii*) Ω
(*iii*)M Ω (*iv*) none of the above

3. If the arrow of crystal diode symbol is positive w.r.t. bar, then diode is........ biased.
(*i*) forward
(*ii*) reverse
(*iii*) either forward or reverse
(*iv*) none of the above

4. The reverse current in a diode is of the order of ....
(*i*)kA (*ii*)mA
(*iii*) μA (*iv*)A

5. The forward voltage drop across a silicon diode is about ....
(*i*) 2.5 V (*ii*)3 V
(*iii*) 10 V (*iv*) 0.7 V

6. A crystal diode is used as ....
(*i*) an amplifier (*ii*) a rectifier
(*iii*) an oscillator (*iv*) a voltage regulator

7. The d.c. resistance of a crystal diode is ....its a.c. resistance.
(*i*) the same as (*ii*) more than
(*iii*) less than (*iv*) none of the above

8. An ideal crystal diode is one which behaves as a perfect .... when forward biased.
(*i*) conductor
(*ii*) insulator
(*iii*) resistance material
(*iv*) none of the above

9. The ratio of reverse resistance and forward resistance of a germanium crystal diode is about ....
(*i*)1 : 1 (*ii*) 100 : 1
(*iii*) 1000 : 1 (*iv*) 40000 : 1

10. The leakage current in a crystal diode is due to ....
(*i*) minority carriers
(*ii*) majority carriers
(*iii*) junction capacitance
(*iv*) none of the above

11. If the temperature of a crystal diode increases, then leakage current ....
(*i*) remains the same
(*ii*) decreases
(*iii*) increases
(*iv*) becomes zero

12. The PIV rating of a crystal diode is .... that of equivalent vacuum diode.
(*i*) the same as (*ii*) lower than
(*iii*) more than (*iv*) none of the above

13. If the doping level of a crystal diode is increased, the breakdown voltage ....
(*i*) remains the same
(*ii*) is increased
(*iii*) is decreased
(*iv*) none of the above

14. The knee voltage of a crystal diode is approximately equal to ....
(*i*) applied voltage
(*ii*) breakdown voltage
(*iii*) forward voltage
(*iv*) barrier potential

15. When the graph between current through and voltage across a device is a straight line, the device is referred to as ....
(*i*) linear (*ii*) active
(*iii*) nonlinear (*iv*) passive

16. When the crystal diode current is large, the bias is ....
(*i*) forward (*ii*) inverse
(*iii*) poor (*iv*) reverse

17. A crystal diode is a .... device.
(*i*) non-linear (*ii*) bilateral
(*iii*) linear (*iv*) none of the above

18. A crystal diode utilises .... characteristic for rectification.
(*i*) reverse (*ii*) forward
(*iii*) forward or reverse
(*iv*) none of the above

19. When a crystal diode is used as a rectifier, the most important consideration is ....
(*i*) forward characteristic
(*ii*) doping level
(*iii*) reverse characteristic
(*iv*) PIV rating

20. If the doping level in a crystal diode is increased, the width of depletion layer ....
(*i*) remains the same
(*ii*) is decreased
(*iii*) is increased
(*iv*) none of the above

21. A zener diode has ....
(*i*) one *pn* junction
(*ii*) two *pn* junctions
(*iii*) three *pn* junctions
(*iv*) none of the above

22. A zener diode is used as ....
(*i*) an amplifier (*ii*) a voltage regulator
(*iii*) a rectifier (*iv*) a multivibrator

23. The doping level in a zener diode is .... that of a crystal diode.
(*i*) the same as (*ii*) less than
(*iii*) more than (*iv*) none of the above

24. A zener diode is always .... connected.
(*i*) reverse
(*ii*) forward
(*iii*) either reverse or forward
(*iv*) none of the above

25. A zener diode utilises .... characteristic for its operation.
(*i*) forward
(*ii*) reverse
(*iii*) both forward and reverse
(*iv*) none of the above

26. In the breakdown region, a zener diode behaves like a .... source.
(*i*) constant voltage
(*ii*) constant current
(*iii*) constant resistance
(*iv*) none of the above

27. A zener diode is destroyed if it ....
(*i*) is forward biased
(*ii*) is reverse biased
(*iii*) carries more than rated current
(*iv*) none of the above

28. A series resistance is connected in the Zener circuit to ....
(*i*) properly reverse bias the zener
(*ii*) protect the zener
(*iii*) properly forward bias the zener
(*iv*) none of the above

29. A zener diode is .... device.
(*i*) a non-linear (*ii*) a linear
(*iii*) an amplifying (*iv*) none of the above

30. A zener diode has .... breakdown voltage.
(*i*) undefined (*ii*) sharp
(*iii*) zero (*iv*) none of the above

31. .... rectifier has the lowest forward resistance.
(*i*) solid state (*ii*) vacuum tube

(*iii*) gas tube (*iv*) none of the above

32. Mains a.c. power is converted into d.c. power for ....
(*i*) lighting purposes
(*ii*) heaters
(*iii*) using in electronic equipment
(*iv*) none of the above

33. The disadvantage of a half-wave rectifier is that the ....
(*i*) components are expensive
(*ii*) diodes must have a higher power rating
(*iii*) output is difficult to filter
(*iv*) none of the above

34. If the a.c. input to a half-wave rectifier has an r.m.s. value of $400/\sqrt{2}$ volts, then diode PIV rating is ....
(*i*) $400/\sqrt{2}$ V (*ii*) 400 V
(*iii*) 400 $*/\sqrt{2}$ V (*i v*) none of the above

35. The ripple factor of a half-wave rectifier is........
(*i*)2 (*ii*) 1.21
(*iii*) 2.5 (*iv*) 0.48

36. There is a need of transformer for ....
(*i*) half-wave rectifier
(*ii*) centre-tap full-wave rectifier
(*iii*) bridge full-wave rectifier
(*iv*) none of the above

37. The *PIV* rating of each diode in a bridge rectifier is .... that of the equivalent centretap rectifier.
(*i*) one-half (*ii*) the same as
(*iii*) twice (*iv*) four times

38. For the same secondary voltage, the output voltage from a centre-tap rectifier is ....than that of bridge rectifier.
(*i*) twice (*ii*) thrice
(*iii*) four times (*iv*) one-half

39. If the PIV rating of a diode is exceeded,........
(*i*) the diode conducts poorly
(*ii*) the diode is destroyed
(*iii*) the diode behaves as zener diode
(*iv*) none of the above

40. A 10 V power supply would use .... as filter capacitor.
(*i*) paper capacitor (*ii*) mica capacitor
(*iii*) electrolytic capacitor
(*iv*) air capacitor

41. A 1000 V power supply would use .... as a filter capacitor.
(*i*) paper capacitor
(*ii*) air capacitor
(*iii*) mica capacitor
(*iv*) electrolytic capacitor

42. The ...... filter circuit results in the best voltage regulation.
(*i*) choke input
(*ii*) capacitor input
(*iii*) resistance input
(*iv*) none of the above

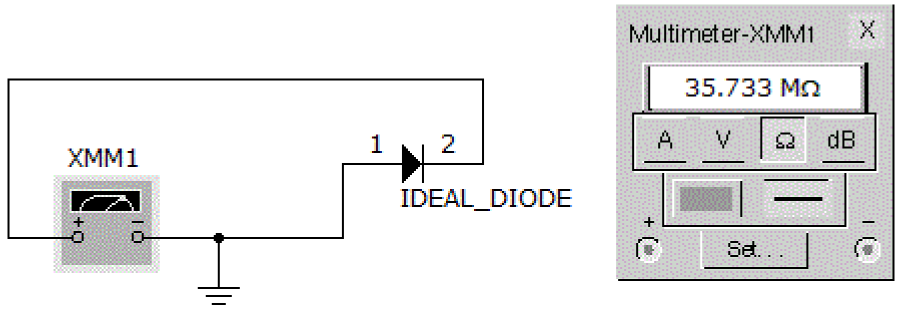
43. A half-wave rectifier has an input voltage of 240 V r.m.s. If the step-down transformer has a turns ratio of 8 : 1, what is the peak load voltage ? Ignore diode drop.
(*i*) 27.5 V (*ii*) 86.5 V
(*iii*) 30 V (*iv*) 42.5 V

44. The maximum efficiency of a half-wave rectifier is ....
(*i*) 40.6% (*ii*) 81.2%
(*iii*) 50% (*iv*) 25%

45. The most widely used rectifier is ....
(*i*) half-wave rectifier
(*ii*) centre-tap full-wave rectifier
(iii) bridge full-wave rectifier
(*iv*) none of the above

THEORY

1. What is wrong the diode?



a. Open
b. Short
c. Nothing
d. Not enough data

2. If a 169.7 V half-wave peak has an average voltage of 54 V, what is the average of two full-wave peaks?

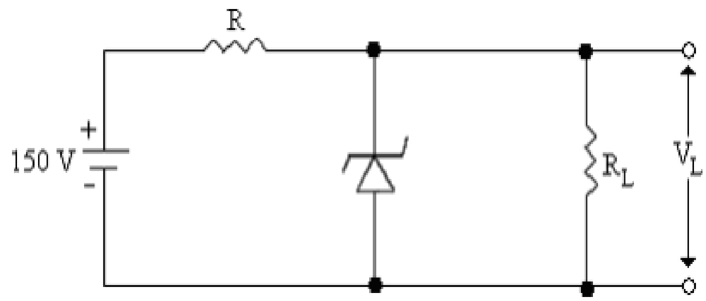
3. A half-wave rectifier has a load resistance of 3.5 KΩ. If the diode and secondary of the transformer have a total resistance of 800KΩ and the ac input voltage has 240 V (peak value), determine:

(i) Peak, rms and average values of current through load
(ii) DC power output
(iii) AC power input
(iv) Rectification efficiency

4. A full wave bridge rectifier is fed with a voltage, 50 sin 100 πt. Its load resistance is 400Ω. The diodes used in the rectifier have an average forward resistance of 30Ω. Compute the

(i) Average and rms values of load current,
(ii) Ripple factor
(iii) Efficiency of rectification.

5. The zener diode in the circuit shown below regulates at 50V, over a range of diode currents from 5mA to 40mA. The supply voltage V = 150V. Compute the value of R to allow voltage regulation from a zero load current to a maximum load current I_{Lmax}. What is I_{Lmax}?



R
+
150 V
-
R L
V L