

POSTAL Book Package

2023

Electrical Engineering Objective Practice Sets

Power Electronics

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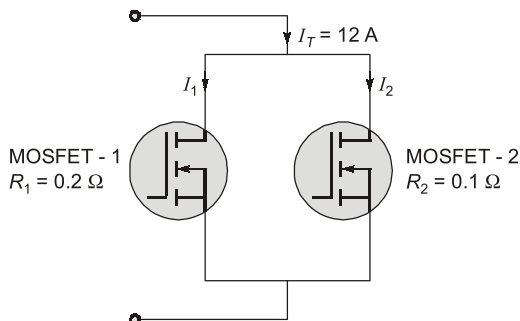
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Power Semiconductor Diode and Transistor

MCQ and NAT Questions

- Q.1** The correct sequence of the among semiconductor devices is (decreasing order) of speed
 (a) Power BJT, Power MOSFET, IGBT, SCR
 (b) IGBT, Power MOSFET, Power BJT, SCR
 (c) SCR, Power BJT, IGBT, MOSFET
 (d) MOSFET, IGBT, Power BJT, SCR
- Q.2** Choose the correct statements among the following according to choice:
 1. Switching losses in BJT is more than MOSFET
 2. Conduction losses in BJT is less than MOSFET
 3. SCRs have lower power losses than MOSFET and IGBT
 (a) 1, 2 and 3 (b) 1 and 2
 (c) 2 and 3 (d) 1 and 3
- Q.3** Turn-on and turn-off times of transistor depend on
 (a) static characteristic
 (b) junction capacitances
 (c) current gain
 (d) none of the above
- Q.4** The power loss in MOSFET-1 and MOSFET-2 for the circuit shown below are respectively

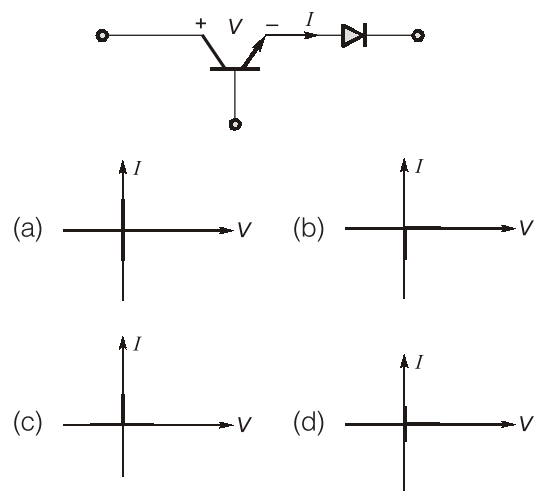


- (a) 6.4 W and 3.2 W (b) 2.8 W and 7.2 W
 (c) 3.2 W and 6.4 W (d) 7.2 W and 2.8 W
- Q.5** A diode and a FET is parallel combination blocks:
 (a) Bidirectional voltage of passes unidirectional current.

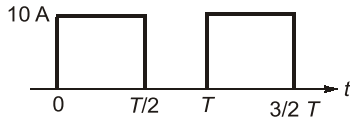
- (b) Bidirectional voltage and passes bidirectional current.
 (c) Unidirectional voltage and passes unidirectional current.
 (d) Unidirectional voltage and passes bidirectional current.

- Q.6** For MOSFET:
 (a) they are easy for parallel connection for higher current.
 (b) leakage current is relatively high.
 (c) have more linear characteristics.
 (d) overload and perk current handling capability are high.
- Q.7** For which transistor the symmetry is obtained as the emitter and collector or source and drain can be interchanged?
 (a) BJT (b) IGBT
 (c) SCR (d) MOSFET

- Q.8** The V-I characteristics for the switch shown is (Devices are ideal)



- Q.9** A MOSFET rated for 20 A, carries a periodic current as shown in the figure. The on-state resistance of the MOSFET is 0.2 ohm. What is the average on-state power loss of device per cycle?



- (a) 20 W (b) 15 W
(c) 10 W (d) 5 W

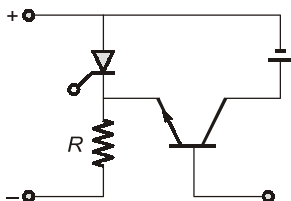
Q.10 For a BJT as a power control switch by biasing it in the cut-off region (off state) or in the saturation region (on state). In the on state, for the BJT (B-Base, E-Emitter, C-Collector)

- (a) Both junctions are reverse biased.
(b) B-E junction reversed and B-C junction forward.
(c) B-E junction forward and B-C junction reversed.
(d) Both the base emitter and base-collector junctions are forward biased.

Q.11 A fast conducting switch is rated for high switching applications. If it is IGBT then consider the following statements:

1. It combines the attributes of MOSFET and BJT.
 2. It has low forward voltage drop.
 3. Its switching speed is very much lower than MOSFET.
 4. It has high input impedance.
- (a) 1, 2, 3 and 4 are correct.
(b) 1, 2, and 4 are correct.
(c) 1, 2, and 3 are correct.
(a) 3 and 4 are correct.

Q.12 For the shown circuit the objective function of BJT is



- (a) to give control signal to trigger SCR
(b) to make SCR on
(c) to make SCR off
(d) to amplify anode current

Q.13 Which one of the following does **not** exhibit negative resistance characteristic is

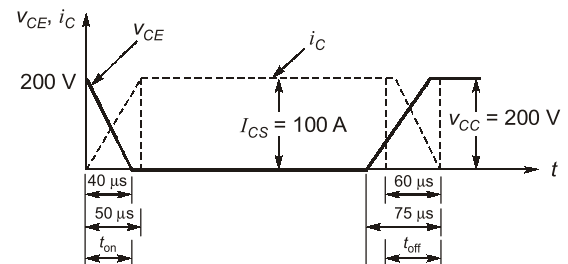
- (d) FET (b) UJT
(c) Tunnel diode (d) SCR

Q.14 Assertion (A): MOSFETs have larger power handling capability in linear applications.

Reason (R): This can be attributed to their excellent thermal stability due to their positive temperature co-efficient.

- (a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not a correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Q.15 A power transistor has its switching waveforms as shown in figure. If the average power loss in the transistor is limited to 300 W, the switching frequency at which the transistor can be operated is approximately equal to



- (a) 0.98 kHz (b) 1.25 kHz
(c) 1.12 kHz (d) 1.65 kHz

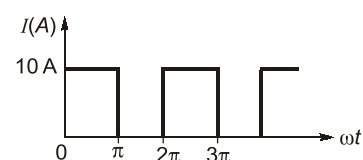
Q.16 The reduction in the on-state voltage drop in IGBT is due to

- (a) added Si layer in the IGBT structure
(b) conductivity modulation
(c) the *n*-drift layer
(d) all of the above

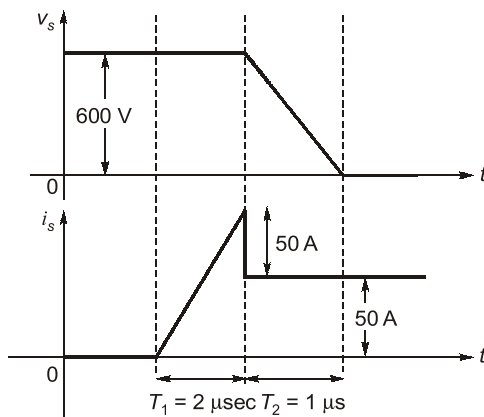
Q.17 Which device is used for current protection?

- (a) the fuse (b) R-C network
(c) snubber network (d) none of these

Q.18 A MOSFET rated for 15 A, carries a periodic current as shown in the below figure. The ON state resistance of the MOSFET is 0.15 ohm. What is the average ON state loss in the MOSFET?



- (a) 3.75 W (b) 7.5 W
(c) 15.0 W (d) 30.0 W

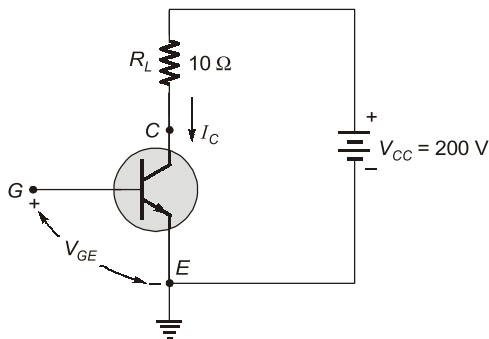


Q.37 The value of the on state resistance for low value of V_{ds} according to output characteristics of power MOSFET will be

- (a) $\frac{V_{ds}}{I_g}$ (b) $\frac{V_{ds}}{I_d}$
(c) 0 (d) ∞

Q.38 The IGBT used in the circuit of given figure has the following data:

$t_{ON} = 3 \mu s$, $t_{off} = 1.2 \mu s$, D (duty cycle) = 0.7,
 $V_{CE(sat)} = 2 V$ and $f_s = 1 kHz$.



The switching power loss during turn-on is around

- (a) 2 W (b) 1.5 W
(c) 1 W (d) 3.5 W

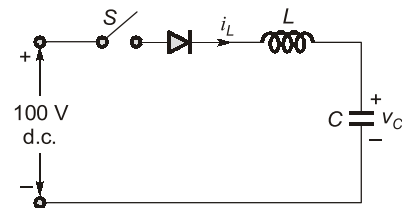
Q.39 Consider the following statements regarding IGBT:

1. Injection layer in IGBT injects holes into n layer.
2. The voltage blocking capability of the IGBT is determined by the injection layer.
3. A latched up IGBT can be turned off by forced commutation of current only.

Which of the above mentioned statements is/are correct?

- (a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Q.40 In the circuit of figure the switch 'S' is closed at $t = 0$ with $i_L(0) = 0$ and $v_C(0) = 0$. In the steady state v_C is equals ____ V.



Multiple Select Questions (MSQ)

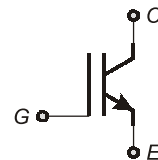
Q.41 Which of these following devices possess bidirectional current capacity?

- (a) Triac (b) GTO
(c) RCT (d) IGBT

Q.42 Which of the following is/are advantage of power MOSFET?

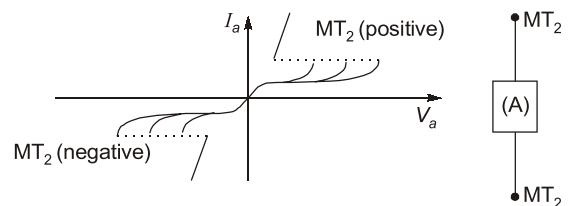
- (a) Lower switching losses
(b) Lower conduction losses
(c) Easy parallel operation
(d) Occurrence of secondary breakdown

Q.43 Which of the following option(s) is/are correct regarding the device whose symbol is shown below:



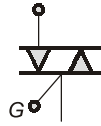
- (a) The device is power MOSFET.
(b) The device is known as metal oxide insulated gate transistor.
(c) It has high input impedance.
(d) It has low on state power loss.

Q.44 The static VI characteristics of a device is shown. The correct option(s) regarding the device can be



- (a) The device is UJT
(b) The device is bidirectional in nature.

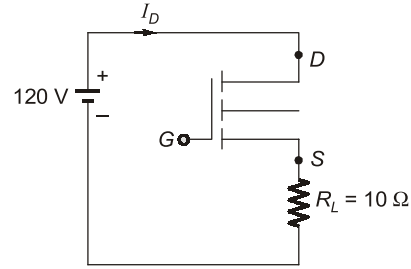
- (c) The block A can be



- (d) The device is extensively used for heat control, speed control of single phase induction motors.

Q.45 For the circuit shown, MOSFET parameters are

$$t_r = 2.5 \mu\text{sec}; R_{DS(ON)} = 0.25 \Omega; \text{duty cycle} = 0.6; f = 25 \text{ kHz}$$



Correct options is/are:

- (a) drain current = 12 A
(b) on time period = 24 μsec
(c) Energy loss during ON time = 822.74 μJ
(d) Power loss during ON time = 21 μW

■■■■

Answers Power Semiconductor Diode and Transistor

- | | | | | | | | | |
|-----------|---------|-------------|--------------|-----------|-----------|-------------|-------------|-----------|
| 1. (d) | 2. (b) | 3. (b) | 4. (c) | 5. (d) | 6. (b) | 7. (d) | 8. (c) | 9. (c) |
| 10. (d) | 11. (a) | 12. (c) | 13. (a) | 14. (a) | 15. (c) | 16. (b) | 17. (a) | 18. (b) |
| 19. (a) | 20. (d) | 21. (c) | 22. (213.33) | 23. (b) | 24. (a) | 25. (d) | 26. (0.027) | 27. (c) |
| 28. (960) | 29. (d) | 30. (1.265) | 31. (b) | 32. (a) | 33. (b) | 34. (0) | 35. (c) | 36. (75) |
| 37. (b) | 38. (a) | 39. (c) | 40. (280) | 41. (a,c) | 42. (a,c) | 43. (b,c,d) | 44. (b,c,d) | 45. (b,c) |

Explanations Power Semiconductor Diode and Transistor

1. (d)

MOSFET has the highest operating speed (frequency).

2. (b)

- (i) BJT has the better conduction hence less conduction losses. MOSFET has lower switching loss and high conduction losses.
(ii) IGBT: lower switching losses than BJT.

3. (b)

Turn-on and turn-off times of transistor depend on junction capacitance.
Because of charging and discharging of junction capacitance a transistor does not turn-on and turn off instantly.

4. (c)

During on state, MOSFET can be replaced resistors.
 \therefore Using current divider rule,

$$I_1 = \left(\frac{R_2}{R_1 + R_2} \right) I_T$$

or

$$I_1 = \left(\frac{0.1}{0.3} \right) \times 12 = 4 \text{ A}$$

and

$$I_2 = I_T - I_1 = 12 - 4 = 8 \text{ A}$$

\therefore

$$P_1 = I_1^2 \cdot R_1 = 4^2 \times 0.2 = 3.2 \text{ W}$$

and

$$P_2 = I_2^2 \cdot R_2 = 8^2 \times 0.1 = 6.4 \text{ W}$$

5. (d)

If device has one antiparallel diode, entire circuit allows the bidirectional current and at the same time it blocks the unidirectional voltage.

6. (b)

Leakage current is relatively high.

7. (d)

MOSFET has this symmetry.

8. (c)

Because of diode current can never be negative.