**Roll No. .....**

| Question Booklet Number |
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**O. M. R. Serial No.**

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# M. Sc. (Electronics) (Fourth Semester)

# EXAMINATION, July, 2022

## (Elective Course)

## POWER ELECTRONICS

| Paper Code | | | | |
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| ELC | 4 | 0 | 4 | (A) |

| Questions Booklet Series |
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| A |

*Time : 1:30 Hours* ] [ *Maximum Marks : 100*

**Instructions to the Examinee :**

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 60 questions. Examinee is required to answer any 50 questions in the OMR Answer-Sheet provided and not in the question booklet. If more than 50 questions are attempted by student, then the first attempted 50 questions will be considered for evaluation. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 60 प्रश्न हैं। परीक्षार्थी को किन्हीं 50 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। यदि छात्र द्वारा 50 से अधिक प्रश्नों को हल किया जाता है तो प्रारम्भिक हल किये हुए 50 उत्तरों को ही मूल्यांकन हेतु सम्मिलित किया जाएगा। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

**(Remaining instructions on the last page)** (शेष निर्देश अन्तिम पृष्ठ पर)

***(Only for Rough Work)***

1. Which of the following devices does not belong to the transistor family ?

   (A) IGBT

   (B) MOSFET

   (C) GTO

   (D) BJT

2. A power transistor is a :

   (A) three layer, three junction device

   (B) three layer, two junction device

   (C) two layer, one junction device

   (D) four layer, three junction device

3. In a power transistor, ..... is the controlled parameter.

   (A) $V_{BE}$

   (B) $V_{CE}$

   (C) $I_B$

   (D) $I_C$

4. A power transistor is a ..... device.

   (A) two terminal, bipolar, voltage controlled

   (B) two terminal, unipolar, current controlled

   (C) three terminal, unipolar, voltage controlled

   (D) three terminal, bipolar, current controlled

5. In a power transistor, the $I_B$ vs $V_{BE}$ curve is :

   (A) a parabolic curve

   (B) an exponentially decaying curve

   (C) resembling the diode curve

   (D) a straight line $Y = I_B$

6. For a power transistor, if the base current $I_B$ is increased keeping $V_{CE}$ constant, then :

   (A) $I_C$ increases

   (B) $I_C$ decreases

   (C) $I_C$ remains constant

   (D) None of the above

7. The forward current gain $\alpha$ is given by :

   (A) $I_C/I_B$

   (B) $I_C/I_E$

   (C) $I_E/I_C$

   (D) $I_E/I_B$

8. In an AC-DC converter, a diode might be used as a :

(A) Voltage source

(B) Phase angle controller

(C) Freewheeling Diode

(D) Filter

9. The value of $\beta$ is given by the expression :

(A) $I_C/I_B$

(B) $I_C/I_E$

(C) $I_E/I_C$

(D) $I_E/I_B$

10. An ideal power diode must have :

(A) low forward current carrying capacity

(B) large reverse breakdown voltage

(C) high ohmic junction resistance

(D) high reverse recovery time

11. Power diode is .....

(A) a three terminal semiconductor device

(B) a two terminal semiconductor device

(C) a four terminal semiconductor device

(D) a three terminal analog device

12. Which of the following is true in case of a power diode with R load ?

(A) I grows almost linearly with V

(B) I decays almost linearly with V

(C) I is independent of V

(D) I initial grows than decays

13. In case of an ideal power diode, the leakage current flows from :

(A) anode to cathode

(B) cathode to anode

(C) in both the directions

(D) leakage current does not flow

14. A power diode with small softness factor (S-factor) has :

(A) small oscillatory over voltages

(B) large oscillatory over voltages

(C) large peak reverse current

(D) small peak reverse current

15. The V-I characteristics of the diode lie in the :

(A) 1st and 2nd quadrant

(B) 1st and 3rd quadrant

(C) 1st and 4th quadrant

(D) Only in the 1st quadrant

16. The power electronics devices have a very high efficiency because :

(A) cooling is very efficient

(B) the devices traverse active region at high speed and stays at the two states, on and off

(C) the devices never operate in active region

(D) the devices always operate in the active region

17. For a power transistor, if the forward current gain $\alpha = 0.97$, then $\beta$ = ?

(A) 0.03

(B) 2.03

(C) 49.24

(D) 32.33

18. For a power transistor, which of the following relations is true ?

(A) $I_e > I_c > I_b$

(B) $I_b > I_c > I_e$

(C) $I_c > I_e > I_b$

(D) $I_e = I_b$

19. High frequency operation of any device limited by the :

(A) forward voltage rating

(B) switching losses

(C) thermal conductivity

(D) heat sink arrangements

20. The instantaneous power loss during the delay time of a transistor is given by :

(A) $I_c V_{ce}$

(B) $I_b V_{be}$

(C) $I_c V_{be}$

(D) $I_b V_{ce}$

21. Which of the following relations is true for a BJT ?

(A) $I_c \approx I_e$

(B) $I_b \approx I_c$

(C) $I_e \approx I_b$

(D) $I_b \approx l_e \approx I_c$

22. Choose the correct statement :

(A) A transistor will remain on as long the base current is applied

(B) A transistor remains on after a high to low pulse is applied at the base

(C) A transistor will remain on as long the collector current is applied

(D) A transistor remains on after a high two low pulse is applied at the collector

23. The MOSFET combines the areas of ..... and .....

(A) field effect and MOS technology

(B) semiconductor and TTL

(C) mos technology and CMOS technology

(D) None of the mentioned

24. Which of the following terminals does not belong to the MOSFET ?

(A) Drain

(B) Gate

(C) Base

(D) Source

25. Choose the correct statement :

(A) MOSFET is a uncontrolled device

(B) MOSFET is a voltage controlled device

(C) MOSFET is a current controlled device

(D) MOSFET is a temperature controlled device

26. The three terminals of MCT :

(A) Anode, cathode, gate

(B) Collector, emitter, gate

(C) Drain, source, base

(D) Drain, source, gate

27. Choose the correct statement :

(A) MOSFET is a unipolar, voltage controlled, two terminal device

(B) MOSFET is a bipolar, current controlled, three terminal device

(C) MOSFET is a unipolar, voltage controlled, three terminal device

(D) MOSFET is a bipolar, current controlled, two terminal device

28. The arrow on the symbol of MOSFET indicates :

(A) that it is a N-channel MOSFET

(B) the direction of electrons

(C) the direction of conventional current flow

(D) that it is a P-channel MOSFET

29. The controlling parameter in MOSFET is :

(A) $V_{ds}$

(B) $I_g$

(C) $V_{gs}$

(D) $I_s$

30. In the internal structure of a MOSFET, a parasitic BJT exists between the :

(A) source and gate terminals

(B) source and drain terminals

(C) drain and gate terminals

(D) there is no parasitic BJT is MOSFET

31. TRIAC is used in :

(A) chopper

(B) speed control of induction machine

(C) speed control of universal motor

(D) None of the mentioned

32. The output characteristics of a MOSFET is a plot of :

(A) $I_d$ as a function of $V_{gs}$ with $V_{ds}$ as a parameter

(B) $I_d$ as a function of $V_{ds}$ with $V_{gs}$ as a parameter

(C) $I_g$ as a function of $V_{gs}$ with $V_{ds}$ as a parameter

(D) $I_g$ as a function of $V_{ds}$ with $V_{gs}$ as a parameter

33. Which among the following devices is the most suited for high frequency applications ?

(A) BJT

(B) IGBT

(C) MOSFET

(D) SCR

34. Choose the correct statement :

(A) MOSFET has a positive temperature co-efficient

(B) MOSFET has a high gate circuit impedance

(C) MOSFET is a voltage controlled device

(D) All of the mentioned

35. Consider an ideal MOSFET, If $V_{gs}$ = 0 V, then $I_d$ = ?

(A) Zero

(B) Maximum

(C) $I_d$ (on)

(D) $I_{dd}$

36. IGBT possesses :

(A) low input impedance

(B) high input impedance

(C) high on-state resistance

(D) second breakdown problems

37. IGBT and BJT both possess .....

(A) low on-state power losses

(B) high on-state power losses

(C) low switching losses

(D) high input impedance

38. The three terminals of the IGBT are :

(A) base, emitter and collector

(B) gate, source and drain

(C) gate, emitter and collector

(D) base, source and drain

39. In IGBT, the $p^+$ layer connected to the collector terminal is called as the :

(A) drift layer

(B) injection layer

(C) body layer

(D) collector layer

40. The controlling parameter in IGBT is the :

(A) $I_G$

(B) $V_{GE}$

(C) $I_C$

(D) $V_{CE}$

41. In IGBT, the $n^-$ layer above the $p^+$ layer is called as the :

(A) drift layer

(B) injection layer

(C) body layer

(D) collector layer

42. The static V-I curve of an IGBT is plotted with :

(A) $V_{ce}$ as the parameter

(B) $I_c$ as the parameter

(C) $V_{ge}$ as the parameter

(D) $I_g$ as the parameter

43. A thyristor (SCR) is a :

(A) P-N-P device

(B) N-P-N device

(C) P-N-P-N device

(D) P-N device

44. Which terminal does not belong to the SCR ?

(A) Anode

(B) Gate

(C) Base

(D) Cathode

45. An SCR is a :

(A) four layer, four junction device

(B) four layer, three junction device

(C) four layer, two junction device

(D) three layer, single junction device

46. Choose the false statement :

(A) SCR is a bidirectional device

(B) SCR is a controlled device

(C) In SCR the gate is the controlling terminal

(D) SCR are used for high-power applications

47. In the SCR structure the gate terminal is located :

(A) near the anode terminal

(B) near the cathode terminal

(C) in between the anode and cathode terminal

(D) None of the mentioned

48. For an SCR in the reverse blocking mode, (practically) :

(A) leakage current does not flow

(B) leakage current flows from anode to cathode

(C) leakage current flows from cathode to anode

(D) leakage current flows from gate to anode

49. For an SCR in the forward blocking mode (practically) :

(A) leakage current does not flow

(B) leakage current flows from anode to cathode

(C) leakage current flows from cathode to anode

(D) leakage current flows from gate to anode

50. Find the output voltage for a step-up chopper when it is operated at a duty cycle of 50% and $V_s$ = 240 V.

(A) 240 V

(B) 480 V

(C) 560 V

(D) 120 V

51. What is the duty cycle of a chopper ?

(A) $T_{on}/T_{off}$

(B) $T_{on}/T$

(C) $T/T_{on}$

(D) $T_{off} \times T_{on}$

52. Which device can be used in a chopper circuit ?

(A) BJT

(B) MOSFET

(C) GTO

(D) All of the above

53. Choppers convert :

(A) AC to DC

(B) DC to AC

(C) DC to DC

(D) AC to AC

54. To avoid commutation failure :

(A) circuit turn-off time must be greater than the thyristor turn-off time

(B) circuit turn-off time must be lesser than the thyristor turn-off time

(C) circuit turn-off time must be equal to the thyristor turn-off time

(D) None of the above

55. The two transistor model of the SCR can obtained by :

(A) bisecting the SCR vertically

(B) bisecting the SCR horizontally

(C) bisecting the SCRs top two and bottom two layers

(D) bisecting the SCRs middle two layers

56. Latching current for an SCR is 100 mA, DC source of 200 V is also connected from the SCR to the L load. Compute the minimum width of the gate pulse required to turn on the device. Take L = 0.2 H.

(A) 50 μsec

(B) 100 μsec

(C) 150 μsec

(D) 200 μsec

57. di/dt protection is provided to the thryistor by :

(A) connecting an inductor in parallel across the load

(B) connecting an inductor in series with the load

(C) connecting an indutor in parallel across the gate terminal

(D) connecting an inductor in series with the gate

58. SCRs are connected in parallel to fulfil the ..... demand.

(A) high voltage

(B) high current

(C) size

(D) efficiency

59. The GTO can be turned off :

(A) by a positive gate pulse

(B) by a negative gate pulse

(C) by a negative anode-cathode voltage

(D) by removing the gate pulse

60. The GTO (gate turn-off thyristor) is a :

(A) p-n-p-n device

(B) p-n-p device

(C) p-metal-n device

(D) p-n single junction device

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the most correct/appropriate answer and mark the same in the OMR Answer-Sheet as per the direction :

**Example :**

**Question :**

Q. 1 (A) ● (C) (D)
Q. 2 (A) (B) ● (D)
Q. 3 (A) ● (C) (D)

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.

6. All answers are to be given on OMR Answer sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.

7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.

8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.

9. There will be no negative marking.

10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.

11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.

12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

**Impt. :** On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is ny discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर— A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से एक सबसे सही अथवा सबसे उपयुक्त उत्तर छाँटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

उदाहरण :

प्रश्न :

प्रश्न 1 (A) ● (C) (D)
प्रश्न 2 (A) (B) ● (D)
प्रश्न 3 (A) ● (C) (D)

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।

6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।

7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।

8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।

9. निगेटिव मार्किंग नहीं है।

10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।

11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।

12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

महत्वपूर्ण : प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।