

CS/B.Tech/ECE/Odd/Sem-7th/EC-705D/2015-16



**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY,  
WEST BENGAL**

**EC-705D**

**POWER ELECTRONICS**

Time Allotted: 3 Hours

Full Marks: 70

*The questions are of equal value.  
The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**GROUP A  
(Multiple Choice Type Questions)**

1. Answer any *ten* questions. 10 × 1 = 10
- (i) A power MOSFET has three terminals called  
 (A) collector, emitter and base (B) drain, source and base  
 (C) drain, source and gate (D) collector, emitter and gate
- (ii) The average current rating of a semiconductor diode will be maximum for  
 (A) full wave rectified ac (B) half wave rectified ac  
 (C) pure ac (D) pure dc
- (iii) In a thyristor, anode current is made up of  
 (A) electrons only (B) electrons or holes  
 (C) electrons and holes (D) holes only
- (iv) A series circuit consists of  $R=2.4\Omega$ ,  $L=25\mu H$ ,  $C$  and a thyristor. For obtaining self-commutation in the circuit, the value of  $C$  should be equal to  
 (A)  $50\mu F$  (B)  $30\mu F$  (C)  $20\mu F$  (D)  $10\mu F$

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Turn Over

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- (v) A freewheeling diode across inductive load will provide  
 (A) quick turn-on (B) slow turn-off  
 (C) reduced utilization factor (D) improved power factor
- (vi) A chopper can be used on  
 (A) PWM only (B) Frequency modulation only  
 (C) Amplitude modulation only (D) Both PWM and FM
- (vii) In CSI if frequency of output voltage is  $f$  Hz, then frequency of voltage input to CSI is  
 (A)  $f$  (B)  $2f$  (C)  $f/2$  (D)  $3f$
- (viii) The cycloconverters require natural or forced commutation as under:  
 (A) natural commutation in both step up and step-down cycloconverters  
 (B) forced commutation in both step up and step-down cycloconverters  
 (C) forced commutation in step up cycloconverters  
 (D) forced commutation in step-down cycloconverters
- (ix) SMPSs are superior to linear power supplies in respect of  
 (A) size and efficiency (B) efficiency and regulation  
 (C) regulation and noise (D) noise and cost
- (x) A separately-excited dc motor is required to be controlled from a 3 phase source for operation in the first quadrant only. The most preferred converter would be  
 (A) full controlled converter  
 (B) fully controlled converter with freewheeling diode  
 (C) half-controlled converter  
 (D) sequential control of two series connected fully controlled converters
- (xi) A step-down chopper is operated in the continuous conduction mode in steady state with a constant duty ratio  $D$ . If  $V_o$  is the magnitude of the dc output voltage and if  $V_s$  is the magnitude of the dc input voltage, the ratio  $V_o/V_s$  is given by  
 (A)  $D$  (B)  $(1-D)$  (C)  $1/(1-D)$  (D)  $D/(1-D)$
- (xii) In a 3phase full converter the output voltage pulsates at a frequency=  
 (A) supply frequency,  $f$  (B)  $2f$   
 (C)  $3f$  (D)  $6f$

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**GROUP B**  
(Short Answer Type Questions)

Answer any *three* questions.

3×5 = 15

2. Describe the static characteristics of an SCR with help of relevant waveforms.
3. What is commutation? Explain the Load commutation process of thyristor with circuit diagram.
4. Describe the two-mode operation of single phase full controlled converter.
5. Explain with necessary waveform, the principle of operation of Buck-converter.
6. With neat circuit diagram, explain the operation of VSI.

**GROUP C**  
(Long Answer Type Questions)

Answer any *three* questions.

3×15 = 45

7. a) Explain briefly with circuit diagram and waveforms the operation of 3-phase six pulse converter. 9+6
- (b) A three phase six pulse converter is operated from a 3-phase star connected 400V, 50Hz supply and with R load ( $R=10\ \Omega$ )  
It is required to obtain an average output voltage equal to 50% of the maximum possible output voltage of the rectifier.  
Find out at this condition  
(i) the firing angle  
(ii) the average output voltage  
(iii) the average current of each thyristor.

8. (a) Explain the four quadrant operation of dc-dc converter. 7+5+3  
(b) A step up chopper supplies power to a load having 1.5 ohms resistance and 0.8mH inductance. The source voltage is 50V DC and the load voltage 75 V. If the on-time is 1.5ms, find  
(i) the chopper frequency  
(ii) the average value of the source current  
(iii)  $I_{max}$   
(iv)  $I_{min}$   
(c) Write a short note on GTO.
9. (a) Explain the operation of pulse-width modulator. 7+5+3  
(b) A single phase half-wave inverter feeds a resistive load  $R_L=10\ \Omega$ . Source voltage is 240 V DC. Determine the r.m.s. voltage, output power and r.m.s. value of current.  
(c) What is zero voltage switching?
10. (a) Describe the two transistor model of thyristor. 7+5+3  
(b) A thyristor is used to feed a load resistance 8 ohms from a 230 V single phase supply. The ratings of thyristor are:  
Repetitive peak current = 300 A ( $di/dt$ ) max = 40A/ $\mu$  sec and ( $dv/dt$ ) max = 150 V/ $\mu$  sec. Design a snubber circuit for protection of thyristor.  
(c) Explain how the thyristor will remain on even if gate current is removed once the thyristor is triggered from its two transistor model.
11. (a) Describe the construction of IGBT. 2+4+5+4  
(b) Explain the operation with the help of an equivalent circuit. State the advantages of IGBT.  
(c) How  $di/dt$  and  $dv/dt$  protections are achieved in SCR?  
(d) Draw and explain dynamic switching characteristics of power BJT.
12. Write short notes on any three of the following? 3×5  
(a) Switch Mode Power Supplies  
(b) Cycloconverter  
(c) Uninterruptible power supplies  
(d) PWM VSI drives for induction motor  
(e) Need for Power Electronics Converter.