

Code: AE26
Time: 3 Hours

DECEMBER 2008

Subject: POWER ELECTRONICS
Max. Marks: 100

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or best alternative in the following: (2x10)

- a. 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
- b. For thyristors pulse triggering is preferred to dc triggering because
- (A) Gate dissipation is low
(B) Pulse system is simpler
(C) Triggering signal is required for very short duration
(D) None of these
- c. A single phase half wave controlled rectifier has $400 \sin 314t$ as the input voltage and R as the load. For the firing angle of 60° for the SCR, the average output voltage is:
- (A) $400/\pi$ (B) $300/\pi$
(C) $240/\pi$ (D) $200/\pi$
- d. In a 3-phase controlled bridge rectifier, with an increase of overlap angle, the output dc voltage:
- (A) Decreases (B) Depend upon load inductance
(C) Increases (D) Does not change
- e. The number of SCRs required for 3-phase to 3-phase cycloconverter are
- (A) 06 (B) 18
(C) 36 (D) none of these
- f. Natural commutation method is applied in:
- (A) ac voltage controller (B) Controlled rectifiers
(C) Inverters (D) both (A) and (B)
- g. When an UJT is used for triggering an SCR, the wave shape of the voltage obtained from UJT

circuit is a:

- (A) Sine wave (B) saw-tooth wave
(C) Trapezoidal wave (D) square wave

h. In a chopper fed dc drive, chopping frequency is approximately

- (A) 50 Hz (B) 300 Hz
(C) 1000 Hz (D) 5000 Hz

i. The bridge inverter with single pulse width modulation

- (A) The output frequency is equal to frequency of reference signal
(B) The output frequency is equal to frequency of control signal
(C) Either (A) or (B)
(D) Neither (A) or (B)

j. When chopper feeds an RL load, the load current remains absolutely constant.

- (A) True (B) False

**Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.**

- Q.2** a. Explain the two transistor analogy of a thyristor. Draw its V-I characteristics. (8)
- b. What is PUT? How it is different from other power electronic devices? What is its application? Draw its V-I characteristics. (8)
- Q.3** a. Draw and explain the circuit of a single phase half wave controlled rectifier with resistive load and deduce expression for average load voltage. (8)
- b. A three phase fully controlled bridge converter with 415V supply, 0.04Ω resistance per phase and 0.25Ω reactance per phase is operating in inverting mode at a firing advance angle of 35° . Calculate the mean generator voltage when the current level is at 80A. The thyristor voltage drop is 1.5V. (8)
- Q.4** a. State the principle of chopper operation highlighting the operation of step down and step up chopper. (10)
- b. The on time of the switch of a boost regulator is $50 \mu\text{ sec}$. If the input voltage be 50 V while the required output voltage is 75 V, calculate the switching frequency; switch off time and average current. Assume $L=250 \mu\text{H}$ and $R_L(\text{Load resistance})=2.5 \Omega$. (6)

- Q.5** a. Explain in brief
(i) Load side commutation and
(ii) Line side commutation. Why Line side commutation is sometime preferred over load side commutation? **(8)**
- b. Discuss the working of TRIAC with the help of a transistor analogue. **(8)**
- Q.6** a. Compare the merits and demerits of on-off and phase angle ac voltage controllers. **(10)**
- b. A three phase, three wire full wave phase controller with a star connected resistive load of $R=10\ \Omega$, is fed from the supply voltage of 230V rms. Calculate the rms output phase voltage for $\alpha =60^\circ$. **(6)**
- Q.7** a. What do you understand by control of cycloconverter? Explain. **(8)**
- b. A three phase to single phase blocked group operated cycloconverter constituted by 6-pulse bridge converters is to supply an inductive load. The output frequency is 2 Hz and the inductive load reactance at this frequency is $1.6\ \Omega$. The load circuit resistance is $2\ \Omega$. The cycloconverter is directly supplied from a three phase 440 V rms (line to line), 50 Hz source. The cycloconverter uses cosinusoidal modulating signal and sinusoidal reference voltage. Calculate (i) RMS output voltage if modulation factor is 0.5. Neglect commutation intervals of thyristors and (ii) RMS output current. **(8)**
- Q.8** a. Compare the single pulse width modulation and multiple pulse width modulation methods for control of single phase bridge inverters. Draw diagrams to illustrate your answer. **(8)**
- b. Describe the operation of a three phase bridge inverter for 120° conduction mode. **(8)**
- Q.9** a. Explain the operation of chopper drive for a separately excited dc motor in Regeneration braking mode. **(6)**
- b. Give advantages of microprocessor-controlled drive. **(5)**
- c. Give industrial applications of AC and DC drives. **(5)**