ROLL NO. _____

Code: AE26 **Subject: POWER ELECTRONICS**

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **JUNE 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **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 the best alternative in the following: **(2×10)**

a. An IGBT has three terminals called

(A) Collector, emitter and gate
(B) Collector, emitter and base
(C) Drain, source and gate
(D) Drain, source and base.

b. When a thyristor gets turned on, the gate drive

(A) Should not be removed as it will turn-off the SCR
(B) May or may not be removed
(C) Should be removed
(D) Should be removed in order to avoid increased losses and higher junction Temperature

c. The effect of source inductance on the performance of single-phase and three-phase full converters is to

(A) Reduce the ripples in the load current.
(B) Make discontinuous current as continuous
(C) Reduce the output voltage
(D) Increase the load voltage

d. In dc choppers, if T is the chopping period, then output voltage can be controlled by PWM by varying

(A) T keeping T_{on} constant **(B)** T_{on} keeping T constant
(C) T_{off} keeping T constant **(D)** Both **(B)** and **(C)**

e. A single-phase CSI has capacitor C as the load. For a constant source current, the voltage across the capacitor is

(A) Square wave **(B)** Triangular wave
(C) Step function **(D)** Pulsed wave

f. A load resistance of 10Ω is fed through a 1 -phase voltage controller from a voltage source of 200 sin314t. For a firing angle delay of 90°, the power to load delivered in kW is

(A) 0.5 **(B)** 0.75
(C) 1.0 **(D)** 2.0

g. A cycloconverter is a

(A) Frequency changer (f_c) from higher to lower frequency with one state conversion
(B) f_c from higher to lower frequency with two state conversion
(C) f_c from lower to higher frequency with one state conversion
(D) Either **(A)** or **(C)**

h. A four quadrant operation requires

(A) Two full converters in series
(B) Two full converters connected back to back
(C) Two full converters connected in parallel
(D) Two semi-converters connected back to back

i. In a 3-phase semi-converter ,the three SCRs are triggered at an interval of

(A) 60° **(B)** 90°
(C) 120° **(D)** 180°

j. In dc choppers, the waveforms for input and output voltages are respectively

(A) Discontinuous, continuous **(B)** Both continuous.
(C) Both discontinuous **(D)** Continuous, discontinuous

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

Q.2 a. Snubber circuit for an SCR should primarily consist of capacitor only. But, in actual practice, a resistor is used in series with the capacitor. Discuss. **(8)**

b. Explain resistance and resistance-capacitance firing circuits. How is it different from UJT firing circuit? **(8)**

Q.3 a. Explain dual converter both in circulating and non circulating modes with circuit diagram and waveforms **(8)**

b. A single phase voltage controller feeds power to a resistive load of 3 Ω from 230 V, 50 Hz source. Calculate:

(i) The maximum values of average and rms thyristor currents for any firing angle α,
(ii) The minimum circuit turnoff time for any firing angle α. **(8)**

Q.4 a. Discuss the principle of step down chopper. Explain its working with RL load. **(8)**

b. Explain the working of impulse commutated chopper with appropriate circuit diagram and waveforms. **(8)**

Q.5 a. Distinguish clearly between voltage commutation and current commutation in thyristor circuits. Also discuss how the voltage across the commutating capacitor is reversed in a commutating circuit. **(8)**

b. What are the advantages of voltage source inverter fed drives? **(8)**

Q.6 a. Draw the waveforms of source voltage, gating signals, output voltage, source and output currents and voltage across one SCR for a single phase voltage controller feeding a resistive load. Explain the working with the help of these waveforms. **(8)**

b. Draw and explain the three phases half wave converter (3-pulse) circuit with input and output voltage waveforms for firing angle 30 degree and R,L load. Also derive output voltage expression. **(8)**

Q.7 a. A 3-phase VSI feeds three-phase star connected resistive load. Obtain the output phase and line voltage if three SCRs conduct at a time. (180 degree mode) **(8)**

b. What is pulse width modulation in concern with inverter? List the various PWM techniques. How do these differ from each other? **(8)**

Q.8 a. What is the principle of operation of cycloconverters? Explain the effect of load inductance on the performance of cycloconverters. **(8)**

b. A 3-phase to single-phase cycloconverter employs 3-pulse positive and negative group converters. Each converter is supplied from delta/star transformer with per phase turns ratio of 2:1. The supply voltage is 400 V, 50 Hz. The RL load has R=2Ω and at low output frequency, ωL = 1.5 Ω. In order to account for commutation overlap and thyristor turn-off time, the firing angle in the inversion mode should not exceed 160°. Compute
(i) The value of the fundamental rms output voltage,
(ii) Rms output current and
(iii) Output power. **(8)**

Q.9 Write short note on: (any **TWO**)
(i) Chopper Circuit design.
(ii) Voltage control of three-phase Inverter
(iii) Industrial applications of DC and AC Drive. **(8×2)**