ROLL NO. _____

Code: AE123 **Subject: POWER ELECTRONICS**

AMIETE – ET (New Scheme)

Time: 3 Hours **December 2016** **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. Which of the following is a two terminal three layer device?
(A) BJT **(B)** Power diode
(C) MOSFET **(D)** None of these

b. SCR is _____ Device.
(A) Semi-controlled **(B)** Fully-controlled
(C) Uncontrolled **(D)** None of these

c. ON state voltage drop across SCR lie between the range.
(A) 0 – 0.5 V **(B)** 0.5 – 1 V
(C) 1 – 1.5 V **(D)** 1.5 – 2 V

d. What is the average output voltage expression of a boost converter?
(A) Vout=DVin **(B)** Vout= Vin/D
(C) Vout=DVin/(1-D) **(D)** Vout=Vin/(1-D)

e. AC to DC circulating current dual converters are operated with the following relationship between their triggering angles (α1 and α2).
(A) α1+ α2 = 180° **(B)** α1 – α2 = 90°
(C) α1+ α2 = 90° **(D)** α1 + α2 = 360°

f. Thyristor circuits that directly convert polyphase AC voltage from one frequency to another frequency are called.
(A) SCR **(B)** cycloconverter
(C) Inverter **(D)** converter

g. When the firing angle of α of a single phase fully controlled rectifier feeding constant dc current to a load is 30°, the displacement power factor of rectifier is
(A) 1 **(B)** 0.5
(C) $1/\sqrt{3}$ **(D)** $\sqrt{3}/2$

h. Solid-state relays are used for switching of _____.
(A) AC only **(B)** DC only
(C) Both AC and DC **(D)** none of these

i. An inverter is a _____.
(A) AC to AC converter **(B)** AC to DC converter
(C) DC to DC converter **(D)** DC to AC converter

j. In a CSI, if frequency of output voltage is f Hz, then the frequency of voltage input to CSI is _____ Hz.
(A) f **(B)** 2f
(C) f/2 **(D)** 3f

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

Q.2 a. Draw the basic structure of IGBT and explain its **(2+2+2+2)**
(i) principle of operation
(ii) forward characteristics and
(iii) transfer characteristics.

b. What is a Power MOSFET? Explain and draw its switching characteristics. **(4+4)**

Q.3 a. Draw the two-transistor behavioural model of a thyristor & derive the expression for anode current in terms of current gain of transistors. **(8)**

b. Draw the static characteristics of a thyristor and show the forward blocking mode, reverse blocking mode & forward conducting mode. Also explain the latching and holding currents. **(4+4)**

Q.4 a. Draw the circuit diagram of a full-wave controlled bridge rectifier. For an R-L load, draw the output voltage and output current waveforms. In case, the load happens to be a highly inductive load, what will be the average and rms output voltage? **(8)**

b. A single phase fully controlled bridge rectifier having supply voltage of 230 V at 50 Hz delivers power to a resistive load R=10 Ω. Determine the rms and average output voltage for the firing angle of 30° and 60°. Also draw the waveform. **(8)**

Q.5 a. Draw the circuit diagram of a three phase half- controlled rectifier with resistive load and explain its working with the help of output current and output voltage waveforms. Also derive expression of the average output voltage. **(5+5)**

b. What is a freewheeling diode? Explain its role in a converter circuit & its advantage. **(3+3)**

Q.6 a. Define a chopper. Draw the circuit diagram of a buck (step down) chopper and draw its output voltage and inductor current waveform. Derive the expression for output voltage. **(2+4+4)**

b. Calculate the output average voltage of buck-boost chopper for input voltage of 200V, switching frequency of 500Hz, having switch ON time of 1ms. What will be the effect on output voltage if switching frequency is changed to 200Hz? **(6)**

Q.7 a. What do you mean by PWM (pulse width modulation)? Discuss the variation in the output voltage of an inverter by PWM technique. **(8)**

b. Write the difference between unipolar and bipolar pulse width modulation technique. Draw output voltage waveforms for both techniques. **(8)**

Q.8 a. Define AC voltage controller. Draw the circuit diagram and output voltage waveform for a single phase full-wave AC voltage controller with resistive load. **(8)**

b. State working principle of static VAR controller. **(8)**

Q.9 a. What are the advantages and disadvantages of HVDC transmission? Justify use of HVDC for long distance transmission. **(8)**

b. Write short notes on **ANY TW**O of the followings: **(4+4)**
(i) SMPS
(ii) UPS
(iii) static circuit breaker