ROLL NO. _____

Code: DE71 **Subject: POWER ELECTRONICS**

DipIETE – ET

Time: 3 Hours **DECEMBER 2014** **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 devices has metal-silicon junction?

(A) schottky diode **(B)** general purpose power diode
(C) SCR **(D)** MOSFET

b. In a power diode, the reverse recovery time is the time from the instant the forward current is zero to the instant when reverse recovery current has decayed to _____

(A) 25 % of peak reverse current **(B)** 10 % of peak reverse current
(C) 50 % of peak reverse current **(D)** zero

c. As compared to power BJT, a power MOSFET has _____

(A) lower switching losses and higher conduction losses
(B) higher switching losses and lower conduction losses
(C) lower switching losses and lower conduction losses
(D) higher switching losses and higher conduction losses

d. The total number of leads in SCR, DIAC and TRIAC respectively are _____

(A) 2,3 and 3 **(B)** 3,2 and 3
(C) 3,3 and 2 **(D)** 3,2 and 4

e. A thyristor needs protection against _____

(A) high $\frac{dv}{dt}$ **(B)** high $\frac{di}{dt}$
(C) both high $\frac{dv}{dt}$ and high $\frac{di}{dt}$ **(D)** either high $\frac{dv}{dt}$ or high $\frac{di}{dt}$

f. A single phase semiconverter is feeding highly inductive load and has freewheeling diode across the load. The waveshapes of output voltage and output current _____

(A) are similar
(B) are similar only if firing angle is zero
(C) may be similar or dissimilar
(D) are not similar

g. In a 3 phase full converter feeding a highly inductive load, the average load current is 150 A. The peak current through thyristor is _____

(A) 150 A
(B) 25 A
(C) 75 A
(D) 50 A

h. A Step-Up Chopper can give an output voltage _____

(A) higher than input voltage
(B) lower than input voltage
(C) both higher and lower input voltage
(D) none of these

i. In a half bridge inverter, the freewheeling diodes are needed _____

(A) even when load is resistive
(B) only when load is inductive
(C) only when load is inductive or capacitive
(D) for all types of loads

j. In a cycloconverter, it is possible to vary _____

(A) only output frequeny
(B) only output voltage
(C) both output voltage and frequency but not simultaneously
(D) both output voltage and output frequency simultaneously

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

Q.2 a. What is power electronics? Why is it needed? List out the applications of power electronics. **(8)**

b. What is the basic difference between a PN junction power diode and an ordinary PN junction diode? Discuss various principal ratings for power diodes. **(8)**

Q.3 a. Explain the operating principle of N-channel IGBT with a neat diagram. Draw the ideal IGBT V-I Characteristics. **(8)**

b. Draw and explain the V-I characteristics of a Power BJT. **(8)**

Q.4 a. What is Silicon Controlled Switch? Draw and explain its structure, symbol and equivalent Circuit. **(6)**

b. Explain two-transistor model of SCR with a neat circuit diagram. **(6)**

c. A gate-triggering circuit for an SCR provides a train of pulses with a frequency of 100 Hz and a pulse width of 2 ms. If the pulse has a peak power of 2 W. Find the average power dissipated by the gate. **(4)**

Q.5 a. With neat diagram, explain the working of Single Phase Full Wave Semi-Controlled Bridge Rectifier with an inductive load. Draw its various waveforms. **(8)**

b. A Single Phase Full-wave controlled rectifier with an inductive load is connected to a 120 V source. The resistive portion of the load is equal to 10 Ω. If the delay angle (α) is 30°. Find

(i) average load voltage (ii) average load current
(iii) form factor (iv) rectifier efficiency **(8)**

Q.6 a. Draw the circuit of Three Phase Full Wave Half-Controlled Bridge Rectifier with freewheeling diode (FWD). Explain its working with the help of voltage & current waveforms, when delay angle is less than 60°. **(8)**

b. A three-phase half-wave controlled rectifier connected to a three-phase, 280 V, 60 Hz AC source supplies power to a 10 Ω resistive load. If the delay angle is 20°. Find

(i) maximum output current
(ii) average output voltage
(iii) average output current
(iv) SCR average current **(8)**

Q.7 a. What is Buck-Boost DC Chopper? Draw its circuit diagram and explain its operation for the ON state and OFF state. **(9)**

b. What is DC chopper? Explain its principle of operation with circuit diagram and various waveforms. **(7)**

Q.8 a. Draw the circuit of basic or Half-Bridge Inverter. Explain its working. List out the industrial applications of inverters. **(8)**

b. What is the necessity of pulse width modulated inverter? Draw the circuit diagram of single phase full-wave pulse-width modulated bridge inverter. Explain its working with output waveforms. **(8)**

Q.9 a. Discuss the principle of the integral cycle control method. Give its applications. **(8)**

b. What is meant by static switch? Compare the advantages and disadvantages of semiconductor switches over mechanical switches. **(8)**