5. a) What do you mean by a solid-state relay?

   b) Explain why a zero-cross detector is required in motor control circuits.

   c) Describe single-phase half-wave converter feeding a separately-excited dc motor.

   d) Describe ignitron contractor, heat control circuit and weld timer electronic control in resistance welding.

OR

Discuss the application of power semiconductor devices to :

i) Induction heating

ii) Dielectric heating.

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*Total No. of Questions :5]* *[Total No. of Printed Pages :4*

Roll No .....

# EI/IC-504

## B.E. V Semester

Examination, December 2016

## Power Electronics

***Time : Three Hours***

***Maximum Marks : 70***

***Note:*** i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each questions are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max.50 words) carry 2 marks, part C (Max.100 words) carry 3 marks, part D (Max.400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

1. a) List the semiconductor devices which can withstand :

   i) Unipolar voltages

   ii) Bipolar voltages

   iii) Unidirectional current capability

   b) Explain the switching performance of power transistor with relevant wave forms. Indicate clearly turn-on and turn-off times and their components.

   c) What is IGBT? Give its basic structural features and working.

   d) Describe various methods of triggering of the thyristor.

OR

Discuss the static and switching characteristics of IGBT and MOSFET.

2. a) Describe the principle of phase control.

   b) A single phase 230V, 1kW heater is connected across 1-phase, 230V, 50Hz supply through an SCR. Calculate the power absorbed in the heater element for firing angle delay of 90°.

   c) A single-phase one pulse SCR controlled converter feeds on RL load with a free-wheeling diode across the load. Discuss how free wheeling diode comes into play when supply voltage is passing through zero and becoming negative.

   d) A single-phase full converter charges a battery which offers a constant value of E. A resistor R is inserted to limit the battery charging current. Derive an expression for the average charging current in terms of $V_m$, E, R etc. On the assumption that each pair of SCRs is fired continuously in each half cycle. Take $V_r$ as the voltage drop in conducting SCRs.

OR

A single phase full converter is supplied from 230V, 50Hz source. The load consists of R = 10Ω and a large inductance so as to render the load current constant. For a firing angle delay of 30°, determine :

i) Average output voltage

ii) Average output current

iii) The power factor.









3. a) What are line commutated inverters? How do they operate?

   b) What is the purpose of connecting diodes in antiparallel with thyristors in inverter circuits?

   c) Describe the principle of dc chopper operation. Derive an expression for its average dc output voltage.

   d) Discuss the principle of working of a three-phase bridge inverter with an appropriate circuit diagram. Draw phase and line voltage wave forms on the assumption that each thyristor conducts of 120° and the resistive load is star connected.

OR

Describe a voltage commutated chopper with relevant current and voltage waveforms as a function of time.

4. a) What is an ac Voltage controller? List some of its industrial applications.

   b) Describe the operating principle of single-phase to single-phase step-up cycloconverter.

   c) Compare the merits of controlling the heater power by a triac using integral cycle control over the phase-angle control.

   d) Draw and explain the working of a single-phase a.c. voltage regulator feeding an inductive load.

OR

Describe the basic principle of working of single-phase to single phase step-down cycloconverter for both continuous and discontinuous conductions for a bridge type cycloconverter.