Hall Ticket Number:

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VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

B.E. (E.E.E.) III Year I-Semester Supplementary Examinations, May/June-2017

Power Electronics

Time: **3** hours Max. Marks: **70**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks)

1. Draw the $I_C - V_{CE}$ characteristics of IGBT for three values of V_{ge}.
2. Draw the symbol of GTO showing the three terminals (Anode, Cathode and Gate).
3. Give in one or two lines the principle of natural (line) commutation of a single-phase bridge rectifier using SCRs.
4. Propose a circuit to protect SCR against dv/dt and di/dt.
5. In a single-phase bridge rectifier using SCRs, give the two main functions of using a free-wheeling diode at the output DC terminals.
6. In a three-phase bridge converter using SCRs, the output DC voltage is about 173 volts with a firing angle of **30°**. Give the firing angle to obtain the output DC voltage of about 100 volts.
7. What is the difference between Class-A chopper and Class-C chopper?
8. Describe the main purpose of using a cycloconverter (in two or three lines).
9. In a three-phase bridge inverter with 180° conduction mode feeding a resistive load, how many devices conduct simultaneously in one interval?
10. For pulse-width modulation, give the definition of amplitude modulation index.

Part-B (5 × 10 = 50 Marks)

11. a) Giving the principle of operation of SCR, explain its static anode–cathode (I_a versus V_a) characteristics in four quadrants, showing forward-leakage current, forward-blocking region, forward-conduction region, reverse-leakage current, reverse-blocking region and reverse-avalanche region. [5]

    b) Give 5 important points of comparison between Power MOSFETs and IGBTs. [5]

12. a) With the help of a circuit diagram, describe the gate-driver circuit for the MOSFET. [5]

    b) What are the five different possible methods for the turn-on of SCRs. [5]

13. a) For a three-phase fully-controlled bridge rectifier with R – L load, having a large value of L, so that the current in DC link is continuous and nearly constant, explain its operation giving the waveforms of AC supply voltage, output DC voltage, DC link current, and the current in three lines on AC supply side for a firing angle of **30°**. [8]

    b) For a single-phase fully-controlled bridge rectifier having a free-wheeling diode connected at its output DC terminals, calculate the output DC voltage for a single-phase AC supply voltage of 230 volts RMS and a firing angle of **60°**. [2]

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14. a) Giving the basic circuit diagram and the waveforms of gate pulses, inductor current, inductor voltage and capacitor current, explain the operation of buck converter. Derive the expressions for the output voltage, minimum inductor value to keep the converter in continuous mode, ripple factor. [7]

    b) Class-A (Step-down) chopper is operating at a frequency of 1 kHz on a 220V DC supply. If the load voltage is 170 V, calculate the conduction (ON) and blocking (OFF) periods of the chopper. [3]

15. a) Explain the operation of a three-phase bridge inverter with 120° conduction mode giving operation table (showing conducting devices in six intervals in one cycle), and waveforms of six gate signals, phase-to-neutral voltages of three phases & three line voltages over a period of about two cycles (**720°**). [7]

    b) A three-phase bridge inverter is operated in 120° conduction mode with DC link voltage of 200V. Calculate approximate values of the RMS values of the fundamental component of AC line voltage, the RMS value of AC line voltage and the distortion factor. [3]

16. a) Giving the waveforms of anode voltage, anode current & gate current, explain the turn-off mechanism of a GTO. [6]

    b) With the help of circuit diagram and waveforms, describe the R-C trigger circuit for SCR. [4]

17. Write short notes on any ***two*** of the following:

    a) Dual converter with circulating-current mode. [5]

    b) DC-to-DC buck-boost converter. [5]

    c) Sinusoidal pulse-width modulation for inverters. [5]