Hall Ticket Number:

Code No.: 7121 M

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

M.E. I Year (EEE) I-Semester (Make Up) Examinations, March-2016

(Power Systems & Power Electronics)

Power Semiconductor Devices and Circuits

Time: 3 hours Max. Marks: 70

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

Part-A (10 X 2=20 Marks)

1. Complete the following sentences.
   (a) A power MOSFET is a ..... - polar device.
   (b) A power MOSFET is a ..... - controlled device.
2. Draw the "Safe Operating Areas (SOAs)" of IGBT, both with forward-bias and reverse-bias.
3. Explain in one or two sentences the purpose of using a high value inductor in the step-down IGBT chopper.
4. Complete the sentence. "In a step-down chopper using an IGBT, a diode and an inductor, the main purpose of the diode is ....."
5. Give the two disadvantages of a three-phase square-wave inverter.
6. Give the definition of "modulation index" for the PWM control of inverter.
7. Complete the sentence. "A resonant tank in a resonant converter contains at least two main components, which are ..... and ....."
8. Complete the sentence. "The main function of resonant switch converter is to reduce the switching losses in the IGBTs by ....."
9. Give in one sentence how the DC output voltage can be controlled in the Switched Mode Power Supply (SMPS).
10. Complete the sentence. "The size of the power transformer in a Switched Mode Power Supply is reduced by operating the transformer at high ....."

Part B (5 X 10= 50 Marks)

11 (a) Give a neat sketch showing basic structure of a "Depletion Enhancement" MOSFET, and explain the operation of DE MOSFET in depletion mode only. (5)
(b) Briefly explain the possibility of static latching up of IGBT. (5)

12 (a) A step-down chopper has a resistive load of 15 ohms and input voltage of 200 V. When the chopper remains ON, its voltage-drop is 2.5 V. The chopper frequency is 1000 Hz. For a duty-cycle of 50 %, calculate the average and RMS values of output voltage. (5)
(b) Explain the principle of operation of a DC-to-DC converter circuit, where both step-up and step-down operations can be realized using only one chopper circuit. (5)

13 (a) For a three-phase bridge inverter, explain the operation of the inverter with 180^0 conduction mode with resistive load. (5)
(b) For the inverter operation given in (a) above, draw the voltage waveforms of three phases and line. (5)

Contd ---2--

14 (a) Giving the basic circuit of a parallel-loaded resonant L- C converter, derive the expressions for resonant frequency, quality factor and voltage gain, and draw the plot of frequency response (voltage gain versus frequency ratio for increasing value of quality factor). (5)

(b) Explain the principle of a full-bridge series resonant (load resonant / self-commutating) inverter with bidirectional switches with the help of a circuit diagram and waveforms of current and voltage. (5)

15 (a) Give the basic circuit diagram of a flyback converter operating in a continuous mode. Explain the function of each component in the circuit. (5)

(b) For the flyback converter given in (a) above, give the waveforms of different voltages, currents, etc. Give two advantages and two disadvantages of the continuous mode. (5)

16 (a) Give comparison between Power MOSFET and IGBT in the form of a table. (4)

(b) For a Gate Turn-Off Thyristor (GTO), give the circuit symbol, explain the two-transistor analogy, and discuss the basic structure showing anode-to-N base short-circuiting spots. (6)

17 (a) With the help of associated waveforms (carrier signal. reference signal and generated gate pulses), explain the principle of sinusoidal pulse-width modulation (PWM) using unidirectional triangular carrier wave as applied to voltage control of inverters. (6)

(b) For the resonant-switch (quasi-resonant) converters, give various favourable features and the main drawbacks. (4)

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