

B.E/B.TECH Degree Examination, December 2020

Fifth Semester

**EE16503 – POWER ELECTRONICS**

(Regulation 2016)

Time: Three hours

Maximum : 80 Marks

Answer **ALL** questions**PART A - (8 X 2 = 16 marks)**

1. Assertion: SCR should be protected against high rate of rise of anode current.  
Reason: SCR gets damaged as localized hot spots are produced due to high current density.
  - a) Assertion is true, but Reason is false.
  - b) Assertion is false, but Reason is true.
  - c) Both Assertion and Reason are true.
  - d) Both Assertion and Reason are false.
2. Which of the following statements are correct for an ac-dc full-converter feeding a dc motor?
  - a) Two quadrant converter
  - b) Allows power flow from motor to ac source
  - c) Uses 2 thyristors and 2 diodes
  - d) It is line commutated.
3. A buck dc-dc converter has the following parameters:  $V_{in} = 50\text{ V}$ ;  $D = 0.4$ ;  $L = 400\ \mu\text{H}$ ;  $C = 100\ \mu\text{F}$ ;  $f = 10\ \text{kHz}$ ;  $R = 10\ \Omega$ . Assuming ideal components and continuous inductor current, the output voltage  $V_o$  is
  - a) 20 V    b) 83.33 V    c) 33.33 V    d) 5 V
4. A single-phase half wave ac voltage controller (one SCR and one diode in anti-parallel) has a resistive load of  $R = 10\ \Omega$  and the input voltage is 230V, 50Hz. The delay angle of thyristor is  $= 45^\circ$ . The RMS output voltage is \_\_\_\_\_.
  - a) 203.19 V    b) 230.00 V    c) 220 V    d) 224.71 V
5. Justify why thyristors are force commutated in circuits with DC input source.
6. Differentiate constant frequency and variable frequency control strategies of DC-DC converter.
7. Identify a DC-AC power electronic circuit that maintains stiff dc voltage at input side. List out its applications.
8. Deduce the control range of firing angle in 1 phase AC voltage controller with RL load.

**PART B - (4 X16 = 64 marks)**

9. (a) Identify the unidirectional device with controlled turn on and uncontrolled turn off **(16)** feature. Explain its construction, working in various operating mode and static characteristics.

**(OR)**

- (b) An IGBT is preferred as a power switch over power MOSFET and power transistor. (16)  
Justify the statement. Also, explain in detail its static and dynamic characteristics.
10. (a) A single phase full bridge converter feeding RL load is utilized to produce DC output voltage. The input voltage is 230V and the load current is 8A for a firing angle of  $120^\circ$ . i.) Calculate the dc output voltage. ii.) Calculate the dc output voltage and current if a freewheeling diode is used at the output for the same firing angle as in (i). Draw the necessary relevant waveforms. (16)
- (OR)**
- (b) Explain the operation of three phase dual converter in circulating current mode with complete circuit diagram and waveforms. Derive the expression for the circulating current. Enumerate its advantages compared with non-circulating current mode. (16)
11. (a) Analyse the working principle of DC-DC inverting regulator with necessary circuit and waveforms. Derive the design equations of critical inductance and capacitance. (16)
- (OR)**
- (b) Design the filter components for a DC - DC converter which has an input voltage of 12V and output voltage of 5V. The peak to peak output ripple voltage is 20mV and peak to peak ripple current of inductor is limited to 0.9A. The switching frequency is 20kHz. Also, derive the necessary equations. (16)
12. (a) Explain the operation of transistorised three phase DC-AC power converter in  $120^\circ$  mode of conduction for a star connected resistive load. Derive the rms voltage expression. (16)
- (OR)**
- (b) A single phase voltage controller has input voltage of 230V, 50Hz and a load of  $R \Omega$ . For  $x$  cycles ON and  $y$  cycles OFF, derive the expression for rms output voltage. Explain its working in detail. (16)  
Also, determine the rms output voltage and current for  $x = 6$  and  $y = 4$ .