

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018**

**Course Code: EE305**

**Course Name: POWER ELECTRONICS (EE)**

*(Graph sheets to be permitted)*

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 5 marks*

Marks

- |   |   |     |
|---|---|-----|
| 1 | “A thyristor can be triggered by an external gate pulse”- Justify using two transistor analogy of thyristor.  | (5) |
| 2 | Explain how the firing angle of an SCR can be varied by using a UJT relaxation oscillator.  | (5) |
| 3 | What is the role of freewheeling diode in a 3 phase semi-converter?   | (5) |
| 4 | Compare voltage source and current source inverters.  | (5) |
| 5 | What is sequence control in single phase ac voltage controllers? What are the advantages of employing it?   | (5) |
| 6 | Explain sine PWM technique, with relevant waveforms. Define modulation index and mention its significance.  | (5) |
| 7 | A type A chopper has input voltage of 200 V. The current through a load of $R=10\Omega$ in series with $L=80$ mH, varies between 12 A and 16 A. Find the form factor of the output voltage waveform.                                      | (5) |
| 8 | Design a dc-dc converter with 12 V input and 200 V output at up to 50W. The ripple in the output voltage and input current should not exceed $\pm 5\%$ and $\pm 20\%$ respectively. Choose an appropriate switching device and frequency. | (5) |

**PART B**

*Answer any two full questions, each carries 10 marks*

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|----|--|-----|
| 9  | a) With neat sketches, explain the static V-I characteristics of an SCR. Define latching and holding current.  | (6) |
|    | b) Two thyristors having a difference of 4 mA in latching current are connected in series. The voltage across the devices are 500 V and 480 V. Calculate the derating factor and the static equalizing resistance value for maximum string efficiency. | (4) |
| 10 | a) Compare Thyristor, Power MOSFET and IGBT on the basis of following parameters:<br>i) Switching frequency            ii) Voltage and current ratings<br>iii) Applications (at least two)   | (5) |
|    | b) Compare the maximum power that can be handled by fully controlled rectifier in mid-point and bridge configuration if the firing angle is $30^\circ$ and the reverse voltage rating (peak) of the thyristors is 200V.                                | (5) |
| 11 | a) Explain a half-wave controlled rectifier feeding RL load, with waveforms of output voltage and output current. Derive the expression for average output voltage.  | (6) |

- b) A single phase semi-converter fed from 120 V, 50 Hz supply is connected to a load resistance of  $10 \Omega$ . If the average output voltage is 25% of its maximum possible average output voltage, find the circuit turn off time. (4)

### PART C

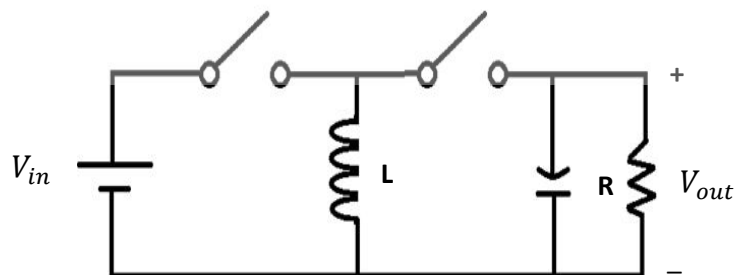
*Answer any two full questions, each carries 10 marks*

- 12 a) Draw the circuit for three phase full converter feeding RLE load. Sketch the output voltage waveform for a firing angle of  $60^\circ$ . (6)
- b) A three-phase half-wave controlled converter is connected to 380 V (line) supply. If the load current is constant at 32 A independent of the firing angle and on state forward drop of SCRs is 1.2 V, Find: (4)
- Peak reverse voltage rating of SCRs
  - Average power dissipation in each SCR
- 13 a) Explain the basic working of an ideal Dual converter and its four-quadrant operation. (6)
- b) A single-phase half bridge inverter has a resistive load of  $10 \Omega$ , and a center-tap dc input voltage of 96 V. Obtain the Fourier series representation of the output voltage waveform and hence find the value of distortion factor. (4)
- 14 Explain the  $120^\circ$  conduction mode of a three-phase bridge inverter with output voltage waveforms, indicating the devices conducting in each state. (10)

### PART D

*Answer any two full questions, each carries 10 marks*

- 15 a) Explain the operation of single phase voltage controller with RL load with output voltage and current waveforms. (6)
- b) For a single-phase voltage controller, develop a relationship between conduction angle and firing angle. Under what condition conduction angle equals  $\pi$ ? (4)
- 16 a) Design a simple light dimmer circuit using TRIAC including the trigger circuit. (4)
- b) Explain the working of Two quadrant (Class C) chopper, with relevant waveforms. (6)
- 17 a) Derive the expression for output voltage of a Buck-Boost regulator, showing relevant waveforms. (6)
- b) The switches in the figure are operated alternatively, each switch being on for half of each cycle. Determine the relationship between  $V_{in}$  and  $V_{out}$ . (4)



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