#### B.TECH/EE/6<sup>TH</sup> SEM/ELEC 3202(BACKLOG)/2021

## POWER ELECTRONICS (ELEC 3202)

**Time Allotted : 3 hrs** 

Full Marks: 70

Figures out of the right margin indicate full marks.

### Candidates are required to answer Group A and <u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

## Group – A (Multiple Choice Type Questions)

1. Choose the correct alternative for the foll	owing:
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 $10 \times 1 = 10$ 

- (i) di/dt protection of SCR is achieved by connecting
  - (a) Inductor in series with SCR
  - (b) Capacitor in series with SCR
  - (c) Resistor and capacitor (RC) across SCR
  - (d) Resistor and capacitor (RC) in series with SCR.
- (ii) In R-triggering circuit of SCR, the maximum firing angle can be
  (a) 90°
  (b) 45°
  (c) 135°
  (d) 180°
- (iii) Power electronics device with poor turn off gain is
  (a) GTO
  (b) SCR
  (c) Power MOSFET
  (d) Power BJT
- (iv) For a 3φ half bridge converter is connected to a 50Hz grid the fundamental ripple frequency of output voltage will be
   (a) 50Hz
   (b) 100Hz
   (c) 150Hz
   (c) 300Hz
- (v) For a buck-boost converter switching frequency is 50kHz, input voltage 12V, and output voltage 24V load current of 1A. Calculate the average input current?
   (a) 2A
   (b) 3A
   (c) 4A
   (d) 2.5A

# (vi) What is the value of duty cycle for per unit ripple current to be maximum? (a) 0.3 (b) 0.75

- (c) 0.6 (d) 0.5
- (vii) The input output voltage relationship for a boost chopper is (a) Vo=Vs (b) Vo= $\alpha$ Vs (c) Vo=Vs/(1- $\alpha$ ) (d) Vo= $\alpha$ Vs/(1- $\alpha$ )

## B.TECH/EE/6<sup>TH</sup> SEM/ELEC 3202(BACKLOG)/2021

- (viii) A voltage source inverter is normally employed when
  - (a) source inductance is large and load inductance is small
  - (b) source inductance is small and load inductance is large
  - (c) both source and load inductances are small
  - (d) both source and load inductances are large

When the conduction angle for a single pulse width modulation scheme is 120° (ix) then the rms fundamental component of output voltage is (a) 0.78V

(c) 0.90V

(b) 1.10V (d) 1.27V

- The use of high-speed circuit breakers (x)
  - (a) reduces the short circuit current
- (b) improves system stability
- (c) decreases system stability
- (d) increases the short circuit current.

# Group – B

- 2. Explain the switching characteristics of thyristor with necessary waveforms. (a)
  - (b) Draw and explain V-I characteristics of TRIAC.
  - (c) Draw and explain gate triggering circuit of SCR using UJT.

5 + 4 + 3 = 12

- 3. (a) Explain resonant pulse commutation of SCR with necessary waveforms.
  - Explain reverse recovery characteristics of power diode. (b)
  - (c) Compare power MOSFET, BJT and IGBT.
  - (d) What is string efficiency?

6 + 2 + 3 + 1 = 12

# Group - C

- Explain the operation of half wave controlled rectifier with R-L load with 4. (a) necessary waveforms.
  - Derive the equation of output RMS voltage for the above mentioned case. (b)
  - (c) Consider a boost converter with input voltage 5V. The average output voltage is 20V and the average load current is 0.5A. The switching frequency is 25 kHz with  $L=250\mu$ H and  $C=420\mu$ F. Determine:
    - (i) Duty cycle.
    - (ii) The ripple current of inductor.
    - (iii) The peak inductor current.
    - (iv) The ripple voltage of capacitor.

5 + 3 + 4 = 12

Explain the operation of a buck chopper with necessary equations. Also draw 5. (a) the inductor voltage, inductor current waveforms.

### B.TECH/EE/6<sup>TH</sup> SEM/ELEC 3202(BACKLOG)/2021

(b) Explain briefly the operation of class C chopper along with necessary waveforms.

5 + 7 = 12

## Group – D

6. Compare  $180^{\circ} \& 120^{\circ}$  mode of operation for three phase VSI.

12

- 7. (a) Explain the operation of single phase full bridge VSI with R-L load.
  - (b) A single phase full bridge inverter is supplying power to a resistive load of  $20\Omega$  and is operated from a battery of 96V. Calculate:
    - (i) RMS value of the output voltage by direct integration method and harmonic summation method.
    - (ii) Fundamental component of the output voltage.
    - (iii) First 5 harmonics of the output voltage.
    - (iv) Fundamental power consumed by the load.
    - (v) RMS power consumed by the load.
    - (vi) Switch Ratings.

5 + 7 = 12

## Group – E

- 8. (a) Explain the operation of single phase half wave ac voltage controller for R load along with necessary waveforms.
  - (b) Derive the average and RMS values of output voltage for the above case.
  - (c) Write any two typical application of AC Voltage controller.

5 + 5 + 2 = 12

- 9. (a) Explain in detail the operation of a single-phase to single-phase step up bridge type cycloconverter.
  - (b) Write briefly on different types of SMPS.

5 + 7 = 12

Department & Section	Submission Link
EE	https://classroom.google.com/c/MjI2MjE5NDQ2MDMy/a/MzY0MzE0Njc3MjM1/details