ROLL NO. _____

Code: AE123 **Subject: POWER ELECTRONICS**

AMIETE – ET (New Scheme)

Time: 3 Hours **DECEMBER 2018** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

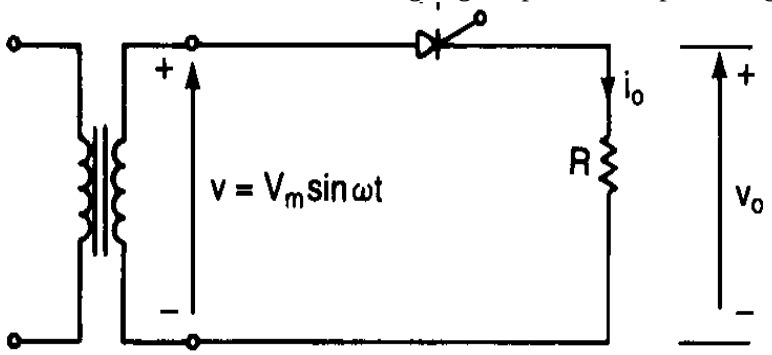
Q.1 Choose the correct or the best alternative in the following: **(2× 10)**

a. Ideal device will have
(A) Infinite conduction losses
(B) Finite conduction losses
(C) Zero conduction losses
(D) Loss depends on the amount of current flow

b. For silicon diode, cut in voltage will be
(A) 0 V **(B)** 1 V
(C) 0.5 V **(D)** 0.8 V

c. Latching current of SCR
(A) < holding current of SCR **(B)** > holding current of SCR
(C) = holding current of SCR **(D)** All of these

d. For the circuit shown below, for a firing angle alpha, the output voltage contains

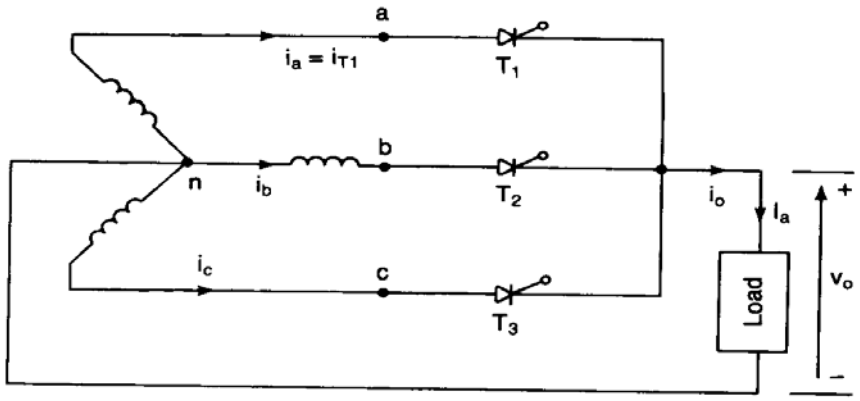


(A) One pulse/cycle **(B)** Two pulses/cycle
(C) Three pulses/cycle **(D)** Zero voltage

e. In a step down chopper, the value of input resistance in terms of load resistance 'R' and duty cycle 'k' can be written as.
(A) kR **(B)** k/R
(C) 2kR **(D)** R/k

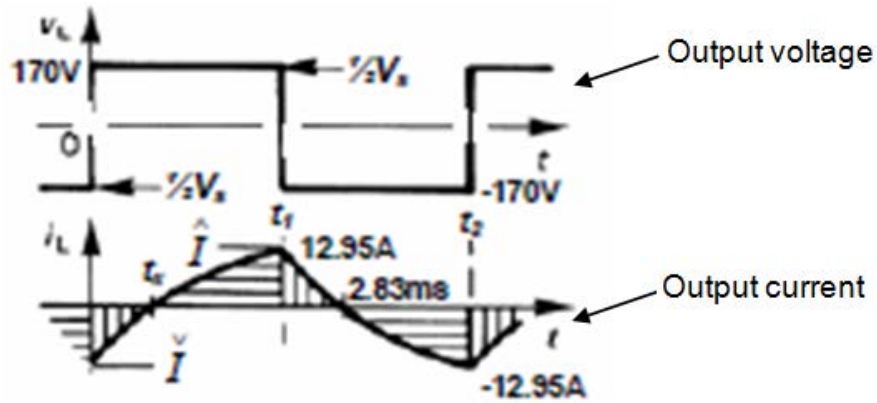
f. Increasing the value of switching frequency in an SMPS will
(A) Increase the size of filter **(B)** Increase the output voltage
(C) Decrease the size of filter **(D)** Decrease the switching losses

g. The below power converter circuit with resistive load will operate in



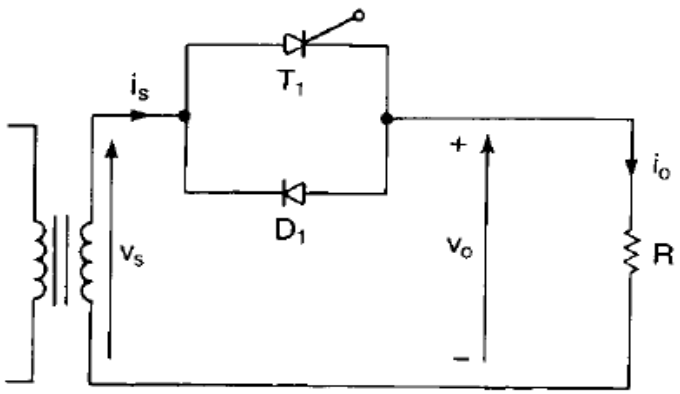
(A) One quadrant **(B)** Two quadrant
(C) Third quadrant **(D)** Fourth quadrant

h. The below waveforms indicate,

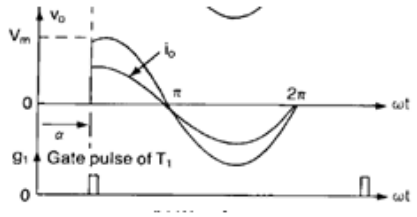


(A) Inverter waveforms with resistive load
(B) Inverter waveforms with inductive load
(C) Inverter waveforms with Resistive-Inductive load
(D) Inverter waveforms with capacitive load

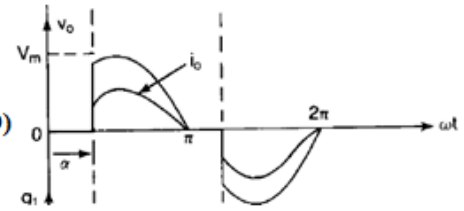
i. In the below circuit, for a firing angle alpha, the output voltage will be (Assume x axis as variation of ωt)



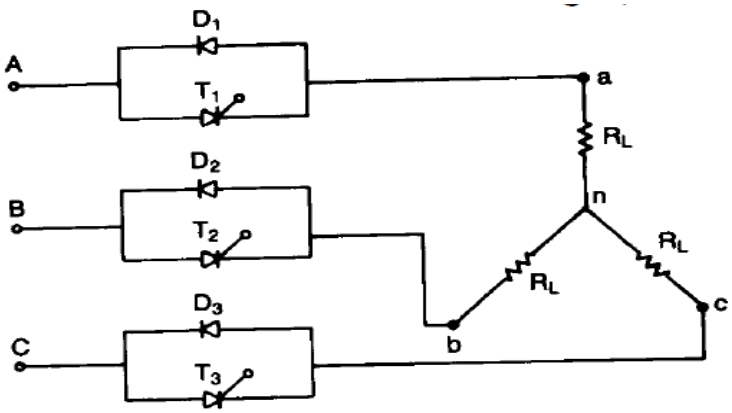
(A) 

(B) 

(C) No output voltage

(D) 

j. The below circuit is a



(A) Three phase uncontrolled rectifier **(B)** Three phase inverter
(C) Three phase full converter **(D)** Three phase diode and thyristor ac switch

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Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Name four power converter circuits. **(2)**

b. The recovery time of a diode is 3 microseconds and the rate of fall of the diode current is 30 A/μs. Determine the storage charge and peak reverse current. **(6)**

c. Draw and explain the output characteristics of BJT **(8)**

Q.3 a. The capacitance of reverse biased junction J_2 in a thyristor is 20 pF and can be assumed to be independent of the off state voltage. The limiting value of charging current to turn on the thyristor is 16 mA. Determine the critical value of dv/dt. **(4)**

b. Ten thyristors are used in a string to withstand a dc voltage of 15 kV. The maximum leakage current and recovery charge differences of thyristors are 10 mA and 150 μC respectively. Each thyristor has a voltage sharing resistance of 56 kΩ and capacitance of 0.5μF. Determine the following:
(i) Maximum steady state voltage sharing
(ii) Steady state voltage derating factor
(iii) Maximum transient voltage sharing
(iv) Transient voltage derating factor **(12)**

Q.4 a. A semiconverter is connected to a 120 V, 60 Hz supply. For a firing angle of 90 degrees, calculate V_{rms}, HF, DF and PF **(12)**

b. Derive the expression for the average voltage of full wave controlled rectifier with resistive load. Draw the necessary waveforms also. **(4)**

Q.5 a. Explain the working principle of three phase half wave controlled rectifier. **(8)**

b. Explain three phase dual converter with necessary circuit and waveforms. **(8)**

Q.6 a. In a DC chopper with resistive load of value R = 10 ohms and the input voltage of 220 V. The chopper is operated at a switching frequency of 1 kHz with an on state drop of 2 V. For 50 % duty cycle, find

(i) Average output voltage (ii) RMS output voltage

(iii) Chopper efficiency (iv) Effective input resistance **(12)**

b Draw the schematic of boost converter and discuss its modes of operation. Also draw the current waveform during each mode of operation. **(4)**

Q.7 a. Explain three phase voltage source inverter with star connected resistive load. Draw the necessary waveforms under 180 degree mode of operation. **(10)**

b. A single-phase half-bridge inverter has load R = 2Ω, and dc source voltage $\frac{V_s}{2} = 115V$ **(6)**

(i) Sketch the waveforms for output voltage v_o, load current i_o, currents through diode and thyristor (Harmonics other than fundamental components are neglected).

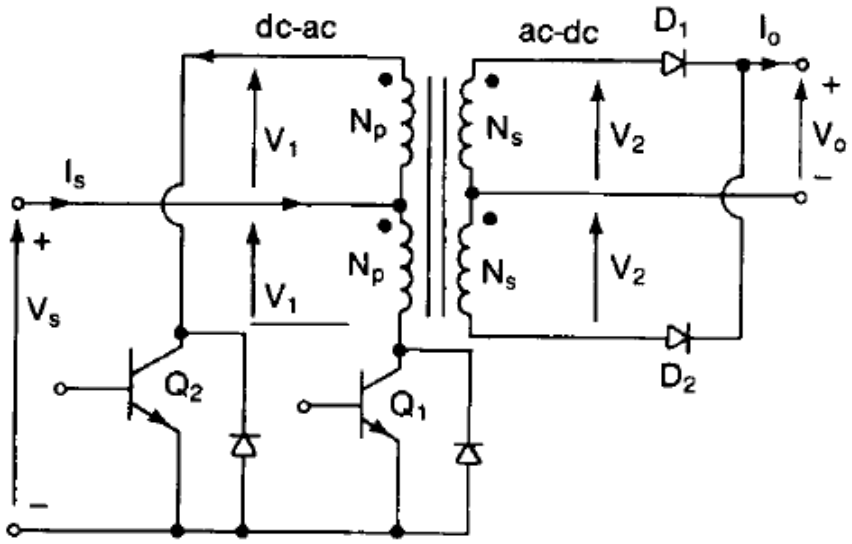
(ii) Find power delivered to load due to fundamental current.

(iii) Check whether forced commutation is required.

Q.8 a. Explain single phase cycloconverter with necessary circuit and waveforms. **(10)**

b. Explain single phase AC switch with necessary waveforms. **(6)**

Q.9 a.



The average (or dc) output voltage of the push-pull circuit shown above is 24 V with the resistive load of 0.8 ohms. The on-state voltage drops of transistors and diodes are 1.2 V and 0.7 V respectively. The turns ratio of the transformer is 0.25. Determine

(i) Average input current (ii) Efficiency

(iii) Average transistor current (iv) Peak transistor current **(2+3+2+3)**

b. What is SMPS? Give its operating principle and industrial applications. **(6)**