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Total Number of Pages : 03

B.Tech
PEE51101

5th Semester Regular Examination 2017-18

Power Electronics
BRANCH: ELECTRICAL

Time: 3 Hours

Max Marks: 100

Q.CODE: B360

Answer Question No.1 and 2 which are compulsory and any four from the rest.

The figures in the right hand margin indicate marks.

Q1 Answer the following questions: *multiple type or dash fill up type* (2 x 10)

- a) In a load commutated DC chopper, the maximum chopper frequency is given by (V =input voltage, C = capacitor value, I -load current)
(a) $2VC/I$ (b) $I/2VC$ (c) I/VC (d) VC/I
- b) For reliable gate triggering of thyristors, it is advisable to employ
(i) slight over triggering
(ii) very soft triggering
(iii) very hard triggering
(iv) none of the above
- c) A half-wave thyristor converter supplies a purely inductive load. If the triggering angle of the thyristor is 120° , the extinction angle will be _____.
(i) 240° (ii) 180°
(iii) 200° (iv) 120°
- d) The average reduction in DC voltage for a three phase fully wave fully controlled rectifier for a DC load when source inductance is considered is _____
- e) Which of the following does not cause permanent of an SCR,
(i) high current rating
(ii) high rate of rise of current
(iii) high temperature rise
(iv) high rate of rise of voltage
- f) The sinusoidal pulse modulation of a thyristor inverter gives control over
(a) output voltage only (b) both output voltage and frequency (c) output frequency only (d) output voltage, frequency and harmonic content.
- g) In a single phase full converter, for discontinuous load current and extinction angle $\beta > \pi$, each SCR's conduct for _____.
- h) In a three-phase six-step thyristor inverter, the frequency of firing is (a) the same as output frequency (b) twice the output frequency (c) three times the output frequency (d) independent of the output frequency.
- i) A driver circuit is required between the controller and the power circuit mainly for,
(i) isolation (ii) voltage level change
(iii) polarity change (iv) necessary drive power
- j) A single phase to single phase step-up cycloconverter changes f to $4f$. Then, one half-wave of input voltage will give rise to,
(i) two half-waves of output voltage
(ii) four half-waves of output voltage
(iii) two full-waves of output voltage
(iv) four full-waves of output voltage

Q2 Answer the following questions: Short answer type (2 x 10)

- a) Give some important characteristics of a controllable switch.
- b) What do you mean by latching current and holding current of an SCR?
- c) Define power circuit, control circuit and triggering circuit ?
- d) What is the difference between the line frequency converter and switching converter ?
- e) What are the advantages of free wheeling diode in a phase controlled converter?
- f) Write down the conditions for inverting mode of operation of a single phase full wave controlled rectifier.
- g) In a three phase semi converter, for firing angle equal to 90° and for continuous conduction, what is the conduction period of each SCR and diode?
- h) For a single phase full wave converter, if the load current is ripple free having value I , then what is the average value of each thyristor current?
- i) What is the difference between the voltage source inverter and current source inverter ?
- j) How cyclo-converter differs from rectifier–inverter for converting static ac frequency to variable ac frequency.

Q3 a) Sketch the turn-on and turn-off switching characteristics of an SCR switch. (10)

- b) With neat circuit diagram, explain the need of need of Snubber circuit and a series inductor in SCR switch? (5)

Q4 a) Draw the output voltage, thyristor current and supply voltage waveform with neat diagram for single phase fully controlled rectifier of R-L load considering the source inductance. Derive the fundamental supply current, power factor of the rectifier and average DC voltage with the source inductance. (10)

- b) A single phase fully control rectifier has load of $R=15$ ohm and $V_s = 220 \sin 314t$ and unity transformer ratio. If it is required to obtain an average output voltage of 70% of the maximum possible output voltage, Calculate (a) the delay angle (b) the efficiency (c) ripple factor of the output voltage (d) the transformer utilization factor (e) the peak inverse voltage (PIV) (f) the crest factor of the input current (5)

Q5 a) Draw the neat circuit diagram, trace and explain the load voltage waveform and find the total harmonic distortion (THD) of the source current for a three phase half wave controlled rectifier with DC load. (10)

- b) Draw and explain the current-voltage characteristic of a GTO thyristor switch and how it differs from an ordinary three wire thyristor switch ? (5)

Q6 a) Explain details the working operation of buck-boost converter with neat diagram and trace the output voltage, current through and voltage across the inductor in converter element. (10)

- b) A step up chopper has input voltage of 220 V and output voltage of 660 V. if the conducting time of thyristor chopper is $100 \mu s$, compute the pulse width of output voltage. In case out put voltage pulse width is halved for constant frequency operation, find the average value of new output voltage. (5)

Q7 a) What are the advantages of pulse width modulation? Describe the technique of technique of single pulse-width modulation in detail with the expression for modulation index and RMS output voltage. (10)

- b) Write short notes on R-C Triggering Circuit (5)

Q8 a) Discuss the operation of 3 phase inverter with 120° conduction mode for 3 phase star connected resistive load. Draw the switching pattern, phase and line voltage waveforms. Enumerate the advantages as compared to 180° conduction mode. **(10)**

b) Write short notes UPS. **(5)**

Q9 a) A buck converter is supplied by a DC source of 48V. It produces an output voltage of 18V across a 10 ohm load resistor. Assume that the capacitor is large enough so that the output voltage is kept constant. Determine (a) the duty cycle D (b) Find the minimum inductor size L_{min} if the switching frequency is 40kHz. (c) Calculate the minimum and maximum value of ripple current. **(10)**

b) Explain single phase cycloconverter with suitable diagram. **(5)**