Nirma University

Institute of Technology

Semester End Examination (RPR), January - 2019

B.Tech. in Electrical Engineering, Semester – V

EE504: POWER ELECTRONIC CONVERTERS

Roll / Exam No.		Supervisor's initial with date	

Time: 3 Hours Max. Marks: 100

Instructions:
1. Attempt all questions.
2. Figures to right indicate full marks.
3. Draw neat sketches wherever necessary.
4. Assume suitable additional data if required.
5. Notations and symbols have their usual meaning.

SECTION-I

Q.1 (A) Discuss the operating principle of buck-boost converter or step down/step-up chopper. Also draw the relevant waveforms. The basic dc-dc step down chopper has input dc voltage of 220 V and output voltage of 86 V. Find duty cycle of converter. (6)

(B) Analyze in detail with illustrative waveform operation of Two quadrant Type-A or Type-C chopper (4)

OR

(B) A buck converter is used to convert a 100 V dc supply to 75 V output. The inductor is 200 μH with a resistive load 2.2 Ω. If the main switch has an on time of 50 μs and current is continuous, calculate, (i) the switching frequency (ii) the average input and output current (iii) the minimum and maximum values of the output current (4)

(C) Discuss the operation of current commutated chopper feeding R-L-E load. Also draw the waveforms of load voltage, load current, commutating capacitor current and commutating capacitor voltage. (6)

Q.2 (A) A voltage commutated chopper feeds inductive load requiring a constant current of 260 A. The source voltage is 220 V dc and the chopping frequency is 400 Hz. Turn off time for main thyristor is 18 μs. Peak current through main thyristor is limited to 1.8 Times the constant load current. Taking a factor safety 2 for the main thyristor, calculate the value of (a) commutating components C and L (b) the minimum and maximum output voltage. (6)

(B) Analyze the basic operating principle of transistor series voltage regulator short circuit protection and also discuss the drawbacks of same. (4)

OR

(B) Sketch the circuit of forward converter. Also explain working principle of same. (4)

(C) Differentiate online and offline UPS. How does uninterrupted power supply (UPS) work as power conditioner? (6)

Q.3 (A) Discuss the operation of full-bridge converter based switched mode power supply with neat sketch. Also derive an expression for output voltage in terms of input voltage and draw waveforms of: (6)

a) Primary Voltage b) Inductor voltage c) Inductor current

d) Voltage across the switches e) Diode currents

(B) Explain the operation of push-pull converter based switched mode power supply. Derive an expression for output in terms of input voltage and draw waveforms of: (6)

a) Primary Voltage b) Inductor voltage c) Inductor current

d) Voltage across the switches e) Output voltage

(C) Why switching losses occur in switched mode converters? How does resonant switching converters overcome this issue? (4)

OR

(C) A voltage commutated chopper has following parameters: (4)
V_s = 220 V, load circuit parameters (series R-L-E load)= 0.5 Ω, 2 mH, 40 V and commutation circuit parameters: L= 20 μH and C= 50 μF. T_{on}=800 μSec and T=2000 μSec. For a constant load current of 80 A, compute the following

(i) Effective on period

(ii) Total commutation interval

(D) What are the advantages of PWM technique? (2)

SECTION – II

Q.4 (A) Draw the output voltage waveforms of following converters: (4)
(i) Phase voltage of three phase bridge inverter with balanced resistive load in 180^0 mode operation.
(ii) Output voltage of unipolar PWM single phase inverter.
(iii) Output voltage of buck-boost converter at 50% duty cycle.
(iv) Switching voltage of half bridge isolated dc-dc converter.

(B) Explain different types of wind machines and power electronic converter systems used for grid connected wind energy systems. (4)

(C) A three phase six step inverter is fed from 600 V dc link feeding star connected R-L load of 7 Ω and 10 mH per phase assuming fundamental frequency of 50 Hz. Calculate the following. (6)
(i) Peak value of line voltage
(ii) RMS value of line voltage
(iii) Total harmonic distortion in line voltage
(iv) RMS value of phase current

(D) Discuss the harmonic reduction techniques in inverter output voltage. Also draw the circuits of same. (4)

OR

(D) Draw the circuit of flyback converter. Also explain working principle of same. (4)

Q.5 (A) With neat circuit and waveforms, analyze the operation of zero current switching resonant converter. (6)

(B) Why maximum power point tracking is used in photovoltaic systems? What are the problems caused due to shading of PV modules connected in a string and explain the role of by-pass diodes in solving the same. (5)

OR

(B) Draw output line voltage, pole voltage and phase voltage waveform of three phase voltage source inverter (120^0 mode of conduction) and derive line voltage equations for the same. (5)

(C) Draw schematic diagram of single phase switched mode (boost) rectifier with power factor correction and discuss the control strategies for same with necessary waveforms. (5)

Q.6 (A) Write disadvantages of PWM. Explain the concept of space vector modulation technique. Also draw the switching combination of all the vectors for three phase inverter with detailed explanation. (6)

(B) Discuss two-pulse modulation technique and unipolar sine-triangle PWM control technique for single-phase full bridge inverter. (6)

(C) Establish the relationship between dc link voltage, modulation index, duty cycle and pole voltage thus explain the operation of sine triangle PWM technique. (4)

OR

(C) A single phase square wave inverter is fed from 300 V dc link, feeding 10 ohm resistive load. Calculate the following. (4)
(i) Peak value of load voltage
(ii) RMS value of load voltage
(iii) Total harmonic distortion in load voltage
(iv) RMS value of load current

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