Nirma University

Institute of Technology

Semester End Examination (IR), December - 2017

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. Notations and symbols have their usual meaning.
5. Assume suitable additional data if required.

Q.1 (A) Draw the power schematic of current commutated chopper and sketch following waveforms associated with it. (6)

i. Gate pulses ii. Capacitor current iii. Main thyristor current
iv. Capacitor voltage v. Load voltage vi. Voltage across main thyristor

(B) Explain in detail with illustrative waveforms operation of type-C and type-D chopper. (6)

(C) Discuss constant switching frequency control of chopper. A step down chopper is used to deliver load voltage of 100 V from a 200 V source. If the turn-off period of the thyristor is 60 μs, compute the duty cycle, turn-on time and switching frequency of circuit. (6)

OR

(C) A step-up chopper has input voltage of 200 V and output voltage of 600 V. If conducting time of the thyristor chopper is 80 μs, compute pulse width of the output voltage. If the output voltage pulse width is halved, for constant frequency operation, find average output voltage. (6)

Q.2 (A) Explain with neat schematic and illustrative waveforms operation of buck converter for continuous as well as discontinuous conduction mode. (6)

(B) Discuss the drawbacks of linear power supply. With neat schematic explain the operation of transistor series voltage regulator with and without error amplifier. (6)

(C) Discuss the normal short circuit protection and fold back short circuit protection strategies for linear power supply. (4)

OR

(C) Discuss voltage regulator of linear power supply with adjustable output using operational amplifier. (4)

Q.3 (A) Explain with schematic and necessary waveforms operation of the forward converter with tertiary winding. Also, derive relationship between output and input voltage of this forward converter. (6)

(B) Answer the following True/False and correct it if FALSE. (6)

(i) In SMPS, continuous conduction mode and discontinuous conduction mode are defined with respect to Load Voltage.

(ii) Line frequency transformer is used in SMPS.

(iii) Magnetizing inductance of transformer used in flyback converter is kept high.

(iv) In half-bridge SMPS voltage across the primary winding of transformer is equal to the input voltage.

(v) Efficiency of linear power supply is more as compared to SMPS.

(vi) To operate a buck-boost converter in boost mode the duty cycle is to be maintained below 0.5.

(C) A boost converter is transferring power from 50 V source to 250 V source. Switching frequency is 30 kHz, duty cycle is 50 %. Inductance in a circuit is 100 μH. Calculate the power transfer by this circuit. Assume steady state conditions achieved and discontinuous mode of operation. (4)

OR

(C) A buck-boost converter is used to convert a 100 V dc supply to 500 V output. The inductor is 100 μH and switching frequency is 10 KHz. If the current is just continuous, evaluate, (i) on-period of the converter (ii) peak value of inductor current (4)

Q.4 (A) Discuss the advantages of using resonant converters over switched mode converters. State different types of resonant converters. (4)

OR

(A) ZVS buck converter operates in half wave mode with dc supply voltage 40 V, output voltage 25 V, resonant frequency 500 kHz and output power 30 W. Determine the following. (4)

1) Values of resonant component L_r and C_r
2) Peak voltage rating of the resonant capacitor

(B) Discuss in detail operation of Zero Voltage Switching resonant converter with circuit diagram and illustrative waveforms. (6)

(C) Draw the line voltage waveforms for a three phase bridge inverter feeding star connected resistive load for 180^0 mode of conduction. A three phase bridge inverter is fed from 600 V dc link feeding star connected resistive load of 10 Ω per phase. Assuming fundamental frequency of 50 Hz, calculate for 180^0 mode of conduction the following. (6)

1) RMS value of load current
2) RMS value of thyristor current
3) Load power

Q.5 (A) Discuss single pulse modulation and multiple pulse modulation technique applied to single phase bridge inverter. Also, provide comparative analysis between them. (6)

(B) Analyze the application of selective harmonic elimination technique for eliminating two dominant harmonics from the output voltage of single phase bridge inverter, considering ten commutation per cycle. (6)

(C) Explain with necessary waveforms operation of three phase bridge inverter feeding star connected resistive load for 120^0 mode of conduction. (6)

OR

(C) Draw voltage space phasor structure for two-level (three phase bridge) inverter. Discuss Space vector modulation technique. (6)

Q.6 (A) Explain in detail different types of generators and power electronic converter systems used for grid connected wind energy systems. (6)

(B) Discuss the unipolar and bipolar PWM techniques with necessary waveforms for single phase inverter. (6)

(C) What are the limitations of diode/thyristor bridge rectifier in view of input side power factor? How does it overcome by using active boost rectifier? (4)

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