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16EPS21/EPE13/ECD13

Ph.D./M.S. (Engg.) by Research Degree Examination, April/May 2024

Power Electronic Converters

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain the importance of galvonically isolating input and output in a forward converter. Explain the circuit diagram showing the input and output waveforms. Show the design for the converter to ensure continuous conduction in choke. How to attract multiple outputs from single source? **(10 Marks)**

b. The push pull converter has $V_1 = 24V$, $N_1/N_2 = 1.5$, $D = 0.2$, $L_O = 100\mu H$, $R_L = 5\Omega$, $C = 1mF$ and $f = 25kHz$. The magnetization inductance of the transformer $L_m = 1mH$.

i) Determine the output voltage V_0 versus duty ratio D in continuous working mode.
ii) Determine maximum and minimum current in the inductor L_0.
iii) Determine currents of the transistor.
iv) Draw the waveforms of voltages and currents at the transistor and the diode for continuous working mode.

Draw the circuit diagram. **(10 Marks)**

OR

2 a. Explain the indirect converter with galvanic separation under discontinuous conduction mode with the help of circuit diagram and waveforms. **(08 Marks)**

b. A c'uk converter has an input of 12V and is to have an output of -18V supplying a 40W load. The switching frequency f = 50kHz. Select the duty ratio, the inductor sizes such that the change in inductor currents is no more than 10 percent of the average inductor current, the output voltage ripple is no more than 1 percent and the ripple voltage across link capacitor C_1 is no more than 5 percent. **(08 Marks)**

c. Explain the basics of transformer modeling used in isolated DC-DC converter. **(04 Marks)**

Module-2

3 a. With the help of block diagram, explain voltage controlled forward converter and hence derive an expression for output voltage interms of reference voltage V_{REF} and threshold voltages. **(10 Marks)**

b. With the help of block diagram, explain TL 494 control module. **(10 Marks)**

OR

4 a. Using timing diagram of output voltage and load current, explain single phase voltage inverter connected to RL load. **(06 Marks)**

b. Explain single phase voltage inverter fed with unipolar PWM pulset. **(06 Marks)**

c. With the help of line voltage and phase voltages, explain three phase inverter. **(08 Marks)**

Module-3

5 a. With circuit diagram and necessary output voltage expressions, explain the half wave and full wave single phase rectifiers. **(12 Marks)**

b. Draw the single phase Graetz bridge with an L-filter, and explain its operation with necessary characteristic waveforms. **(08 Marks)**

OR

6 a. With a circuit diagram and necessary output voltage waveforms, explain the 3-phase thyristor bridge rectifier. **(10 Marks)**

b. Explain the working of active rectifier with hysteresis current controller. Mention the table of control of switches. **(10 Marks)**

Module-4

7 a. Explain the half bridge series resonant dc/dc converter under discontinuous conduction mode. Show the configuration for full bridge series resonant DC/DC converter with transformer coupling. **(10 Marks)**

b. The parameters of the ZCS – QR converter are $V_{DC} = 12V$, $C_r = 0.1\mu F$, $L_r = 810\mu H$, $I_o = 1A$ and frequency f = 100kHz. Draw the circuit configuration and determine

i) The output voltage the max transistor current and the maximum reverse voltage of diode D.

ii) Frequency f at which the voltage is 6V, at the same current.

iii) The maximum frequency. **(10 Marks)**

OR

8 a. Explain the basic class E resonant inverter circuit. Show the waveform at the optimum and suboptimum operating conditions along with the equivalent circuits. **(08 Marks)**

b. What are the general characteristics of ZVS-MR converters? Explain the ZVS multiresonant forward converter with relevant waveforms? **(08 Marks)**

c. Explain the importance of soft switching PWM in DC/DC converters. **(04 Marks)**

Module-5

9 a. An AC/AC voltage converter mode of two thyristors in anti-parallel converters and driven by a harmonic 220V, 50Hz voltage is loaded by a resistor $R_L = 2.2\Omega$. The holding voltage of thyristors is 1V and the resistance while conducting $r_d = 5m\Omega$. If the required power of the load (Heater) is $P_L = 11Kw$, determine :

i) Angle of conduction of the thyristors.

ii) Load power factor.

iii) Power and dissipation in one of the thyristors. **(10 Marks)**

b. What are the advantages of matrix converter compared to standard AC/AC converter and hence explain 3ϕ AC/AC matrix converter with voltage input and current output. **(10 Marks)**

OR

10 a. List the advantage and disadvantages of multilevel converter compared to the traditional topologies and hence explain three level converter lag with a capacitive voltage divider and clamping diodes. **(10 Marks)**

b. With the help of circuit diagram and output voltage waveform explain 11-level inverter circuit. **(10 Marks)**

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