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Reg. No. : .....

Name : .....

First Semester M.Tech. Degree Examination, February 2015
(2013 Scheme)
ELECTRICAL AND ELECTRONICS ENGINEERING
Stream : Power Control and Drives
EDC 1001 : Power Converters and Analysis

Time : 3 Hours Max. Marks : 60

***Instruction** : Answer **any two** questions from **each** Module.*

MODULE – 1

1. a) A Single-Phase bridge rectifier, fed from a transformer, supplies a very high inductive load such as a dc motor. The turns ratio of the transformer is unity. The load is such that the motor draws a ripple-free armature current of I_a. Determine (a) the HF of the input current and (b) the input PF of the rectifier. 7

   b) A three phase bridge rectifier supplies a highly inductive load such that the average load current is $I_{dc} = 60$ A and the ripple content is negligible. Determine the ratings of the diodes if the line to neutral voltage of the Y-connected supply is 120 V at 60 Hz. 3

2. Draw the power circuit diagram of a three phase fully controlled bridge rectifier with RLE load and explain the converter and inverter operation with voltage waveform for both cases. 10

3. Explain the effect of source inductance on the performance of controlled rectifiers. For a single phase fully controlled rectifier, draw the voltage and current waveforms with source inductance and derive the expression for average output voltage. 10

MODULE – 2

4. a) Explain the operation of a Buck converter with circuit diagram and relevant waveforms. 5

   b) A Cu'k converter has a source voltage $V_s = 12$ V. The duty ratio $D = 0.25$ and the switching frequency is 25 kHz. The filter capacitance $C_2 = 220\ \mu F$, inductance $L_2 = 150\ \mu H$. The energy transfer capacitance $C_1 = 200\ \mu F$ and inductance $L_1 = 180\ \mu H$. The average load current is 1.25 A. Determine (i) the average output voltage (ii) the average input current and (iii) the peak-to-peak ripple current of inductor L_1. 5

5. a) With circuit diagram and necessary waveforms, explain the operation of flyback converter. Derive the expression for average output voltage. 5

   b) Explain the working of a push-pull type switched mode power supply. 5

6. a) A DC-DC converter has a load resistance R = 0.25 Ω, input voltage V_s = 550 V and battery voltage E = 0V. The average load current I_a = 200 A and chopping frequency f = 250 Hz. Use the average output voltage to calculate the load inductance L, which would limit the maximum ripple current to 10% of I_a. 4

   b) A boost regulator has an input voltage of V_s = 5 V. The average output voltage V_a = 15 V and the average load current I_a = 0.5 A. The switching frequency is 25 kHz. If L = 150 μH and C = 220 μF, determine (a) the duty cycle k, (b) the ripple current of inductor ΔI, (c) the peak current of inductor I_2, (d) the ripple voltage of filter capacitor ΔV_c and critical values of L and C. 6

MODULE – 3

7. a) With the relevant diagram, explain the voltage control methods of three phase voltage source inverter using, sinusoidal PWM. 5

   b) Explain PWM technique for reduction of harmonic currents in inverters. 5

8. a) Describe the operation of a single-phase current source inverter feeding a purely inductive load with necessary waveforms and equations. 5

   b) A 1Φ CSI is operating with full square wave output with 40 Hz output frequency. The load is an RC load, with R = 15Ω and C = 12 μF. If the source is 10 A dc, calculate the fundamental output voltage (rms) and the third harmonic rms output voltage. Neglect commutation time. Draw the output current waveform and the fundamental and third harmonic output voltages. Mark all the salient features in the waveforms. 5

9. A three-phase bridge inverter is operated in 180 degree conduction mode. Draw the output line voltage waveforms and obtain :

   a) Fourier series for the line voltage.

   b) RMS value of the fundamental component of the line voltage.

   c) RMS value of the nth harmonic line voltage.

   d) First four harmonics present at the output in the line voltage waveform.

   e) RMS value of the line voltage.

   f) Distortion and harmonic factor. 10