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VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKE UP EXAMINATIONS, DEC/JAN 2015

SUBJECT: MODERN POWER CONVERTERS [ELE 455]

REVISED CREDIT SYSTEM

Time: 3 Hours

01 January 2016

MAX. MARKS: 50

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Instructions to Candidates:

- * Answer ANY FIVE FULL questions.
- * Missing data may be suitably assumed.
- 1A. A buck converter has an input which varies between 10 V and 30 V and an output voltage of 5 V. The output current is 10 A. The switching frequency is 40 kHz. Current ripple has to be limited to 20% of its average value and voltage ripple should not exceed 1%. Determine the duty ratio, value of inductor and capacitor so as to comply with the ripple condition for the variation in input voltage.
- **1B.** A boost converter is required to have an output voltage of 8 V and supply a load current of 1 A. The input voltage varies from 2.7 V to 4.2 V. A control circuit adjusts the duty ratio to keep the output voltage constant. Determine the value for the inductor such that the variation in inductor current is no more than 40% of the average inuctor current for all operating conditions. Determine a value of an ideal capacitor such that the output voltage ripple is no more than 2%. Determine the maximum capacitor equivalent series resistance for a 2% ripple. Take fs = 200 kHz.
- 2A. A Cuk converter is producing an output voltage of -18V from a source of 12V DC. The load power is 40 W.Calculate the output capacitor necessary if voltage ripple is not to exceed 1% and its current ripple to be 10% of load current. Take fs = 50 kHz.
- **2B.** Discuss, the performance of a flyback DC-DC converter, and hence draw suitable waveforms to develop expressions for calculating average load voltage, the necessary filter circuit to be used for a particular ripple condition.
- **2C.** With suitable explanation, deduce the transformer model for high frequency application. **02**
- **3A.** A Push-Pull converter has the following parameters: $V_s = 30$ V, $N_P/N_S = 2$, D=0.3, $L_x = 0.5$ mH, R= 6 Ω , C= 50 μ F and $f_s = 10$ kHz. Determine average output voltage, maximum and minimum values of inductor current and the output voltage ripple. Assume all components to be ideal.

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3B.	The Zero Current Switch resonant converter has following parameters, $V_s = 100V$, $I_o = 1.5$ A, $L_r = 10\mu$ H, $C_r = 0.01\mu$ F and $f_s = 50$ kHz. Determine the Output voltage of converter. Draw the waveforms of inductor current and capacitor voltage for the operation.	05
4A.	Explain the continuous-conduction mode operation of SLR dc-dc converter working in $\omega_s < \omega_o$; using suitable circuit diagram and waveforms.	05
4B.	A parallel resonant dc-dc converter supplying a resistive load of 10 Ω from a source voltage of 100 V. The switching frequency is 20% excess of the resonant frequency of 100 kHz, and characteristic impedance $Z_o = 5 \Omega$. Select suitable values of L _r and C _r for the converter and hence determine the output voltage.	05
5A.	Explain the different current mode control techniques with reference to dc-dc converters. Also discuss slope compensation technique.	05
5B.	A ZCS buck converter has the following data: $V_s = 100$ V, $L_r = 10 \mu$ H, $C_r = 0.01 \mu$ F. The load changes current changes from 0.5 A to 3 A. Determine the range of switching frequency required to regulate the output voltage at 50 V.	05
6A.	Discuss the steps involved in developing the state space averaged model for a dc-dc converter and hence obtain the generalized expression for the small signal transfer function	06
6B.	Write a technical note on Off-line UPS and On-line UPS systems.	04