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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent Institution of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKE-UP EXAMINATIONS, DECEMBER 2018

SUBJECT: MODERN POWER CONVETERS [ELE 4010]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 27, December 2018** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. A non-ideal buck converter is modeled by including MOSFET on state resistance Ron, an inductor resistance R_L and a diode voltage drop V_D. Derive the expression for Vo/Vs that includes the above effects. ***(04)***

1B. Find Duty cycle and Efficiency of a non-ideal buck converter. Given specifications: Vs=30V, Vo=15V, Ro=5Ω, Ron=0.016 Ω, R_L=0.06 Ω, V_D=0.9V. ***(02)***

1C. Derive a dc transformer model of a non-ideal buck boost converter having inductor winding resistance R_L and MOSFET on state resistance Ron. All other losses can be ignored. ***(04)***

2A. Draw the circuit schematic of a Cuk converter and derive an expression for output voltage Vo. (Apply inductor volt sec balance and capacitor charge sec balance.) ***(02)***

2B. Design a Cuk converter for the following specifications: Vs=45V, VO=-15V, PO=25W, fs=150kHz.

(a) Maximum inductor ripple currents should not exceed 10% of its average value.

(b) Maximum voltage ripple across C1 should not exceed 5% of its average value.

(c) Maximum output voltage ripple is less than 1%. ***(04)***

2C. Draw the circuit schematic of a SEPIC converter and derive the expressions for output voltage Vo, inductors L_1 and L_2, Capacitors C_1 and C_2. (Apply inductor volt-sec balance and capacitor charge sec balance) ***(04)***

3A. With a neat circuit schematic of a flyback DC-DC converter, draw suitable waveforms to develop expressions for calculating average load voltage, the necessary filter circuit to be used. ***(04)***

3B. A forward converter has the following parameters Vs=100V,N1/N2= N1/N3=1,Lm=1mH, Lx=70μH,R=20Ω,C=33μF and D=0/35.The switching frequency is 150kHz . Determine (i) the output voltage and output voltage ripple (ii) the average, maximum and minimum values of current in Lx . ***(04)***

3C. With suitable circuit diagram and waveforms of a Push-Pull dc-dc converter, deduce an expression for the output voltage. ***(02)***

4A. Draw the circuit schematic a SLR dc-dc converter. Also sketch waveforms of inductor current and capacitor voltage of the tank circuit for ωs<ωo. ***(03)***

4B. A series resonant dc dc converter has the following parameters: V_S=24V, Lr=1.2µH, Cr=12nF, f_S=1.5MHz and Ro=5Ω. Determine the output voltage. ***(03)***

4C. A parallel resonant dc-dc converter supplying a resistive load of 10Ω from a source voltage of 100V. The switching frequency is 20% excess of the resonant frequency of 100 KHz, and characteristic impedance Zo = 5 Ω. Select suitable values of Lr and Cr for the converter and hence determine the output voltage. ***(04)***

5A. ZCS converter has the following data: Vs=25V, V0=12V, Io=1A, Zo=12Ω, fs=200kHz. Determine time interval for each mode. (Assume fs=0.4fo). ***(04)***

5B. Make a comparison between ZCS and ZVS switching schemes ***(02)***

5C. Discuss the steps involved in developing the small signal model of a Buck converter using state space averaging technique ***(04)***