Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M. TECH (POWER ELECTRONICS AND DRIVES)

END SEMESTER EXAMINATIONS, APRIL - MAY 2024

ADVANCED POWER ELECTRONIC CONVERTERS (ELE 5212)

REVISED CREDIT SYSTEM

Time: 3 Hours **Date:30 MAY 2024** **Max. Marks: 50**

Instructions to Candidates:

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

1A. Explain the problem of Hard switching? Discuss the possible solutions ***(02)***

1B A certain power converter has the following specification. (i) input voltage varying between 30 V to 40 V, output voltage is 60 V. ii) output power is 75 W, switching frequency is 250 kHz, peak-to-peak inductor current ripple 40% of the average inductor current, peak-to-peak output capacitor voltage ripple 2% of the average output voltage. State the power converters which can be considered for the above specifications. Considering yourself to be the designer, which power converter will you choose for realizing the above-mentioned specifications? Determine the values of L and C for your converter. Make necessary assumptions to simplify your design calculations. ***(04)***

1C. Design a suitable converter for stable power supplies with tight voltage regulation for portable devices. It requires a 6V input supply and it has an output voltage -9V supplying a 20W load. Switching frequency 25 kHz, the change in inductor current is no more than 10% of the average inductor current, peak-to-peak output capacitor voltage ripple 1% of the average output voltage. Considering yourself to be the designer, which power converter will you choose for realizing the above-mentioned specifications? Determine the values of L_1, L_2 and average voltage across the C_1 for your converter. Make necessary assumptions to simplify your design calculations. ***(04)***

2A You are assigned to design a power supply to television sets which consume 5W power with a voltage rating of 24 V power from the source and load is 5 Ω. Select the Fly-back converter type DC-DC converter suited for this application. (i) Find maximum and minimum values of inductor currents (ii) Design the number of turns and capacitors for this converter. Assume the output voltage ripple is 5%, the magnetizing inductor L_m= 500μH, the duty ratio is 0.4, and the switching frequency is 40kHz. ***(04)***

2B Explain the role of tertiary winding in the case of Forward converter. Hence, derive an expression for the output voltage. Analyze the magnetizing current and inductor current waveform. ***(04)***

2C. With reference to Fig. 2C. Examine the waveform and identify a suitable topology that could result in the above waveforms.

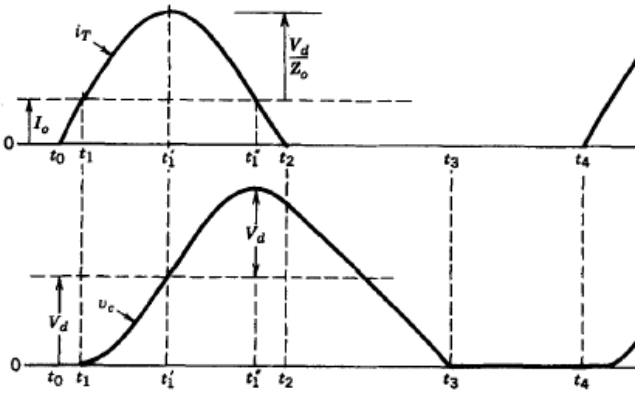

Fig. 2C ***(02)***

3A. Design a parallel loaded resonant dc-dc Converter with the following parameters source voltage is 200V and C_r= 0.62μF, L_r=16μH, load resistance is =20Ω switching frequency is 60kHz. Determine the output voltage of the converter. The current and voltage output filter components L_0 and C_0 are assumed to produce a ripple free output. Justify the output voltage of the converter. Refer Fig. 3A.

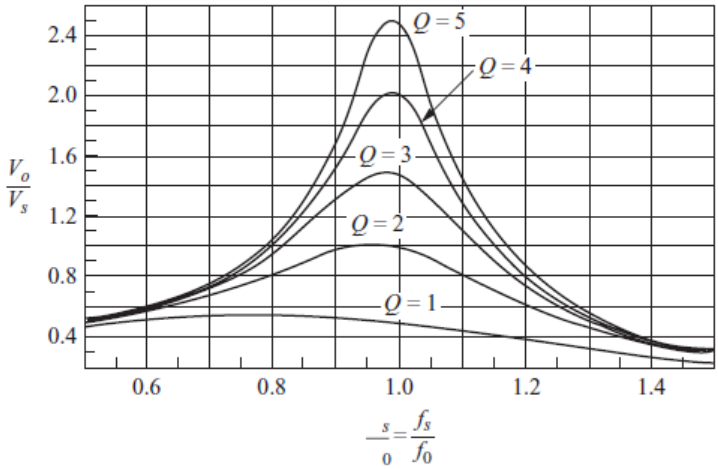

Fig. 3A ***(04)***

3B. The Zero Voltage Switching (ZVS) resonant converter delivers a maximum power of 150W. The source voltage is 50V and the output voltage is 25V. Estimate the value of the resonant inductor and capacitor. Select the proper value of switching frequency. ***(04)***

3C. Make a technical comparison between AT and ATX Power supply. ***(02)***

4A Explain the working of a series load resonant converter. Analyse the resonant inductor current and capacitor voltage waveforms operating under the leading power factor. ***(04)***

4B. With a step-by-step procedure design a high-frequency transformer for the Full-bridge converter configuration that has the following specifications. The output voltage is 24V and the power consumption is 72W. The switching frequency is 20kHz supply voltage is 48V is ±10%. Assume the output voltage ripple is 1%. Refer to the core characteristics in Table 1. ***(04)***

4C. With the help of a neat diagram explain the interconnection renewable energy source and energy storage system to the utility grid. ***(02)***

5A. Design an inductor for buck converter has the following specifications. The output voltage is 5V and the power consumption is 25W. The switching frequency is 40kHz. The input voltage is 12V± 10%. Assume the output voltage ripple is 1%. Refer the core characteristics in Table1. ***(04)***

5B. With suitable block schematic, develop a negative feedback system used in buck converter results in reduction of transfer functions of the converter. ***(03)***

5C. Assuming ideal components and continuous conduction mode, develop the small-signal ac equivalent circuit model of a buck-boost converter. ***(03)***

Table 1: Physical Electrical and Magnetic characteristic of ferrite core

Core	Mean Length(mm)	Mean Magnetic length lm(mm^4)	Core cross-section (Ac*100mm^2)	Window area (Aw*100mm^2)	Area Product (Ap*10^4 mm^2)	Effective relative permeability μr ± 25%	A_L $_{nh/TURNS^2}$ ±25%
P18/11	35.6	26	0.43	0.266	0.114	1480	3122
P 26/16	52	37.5	0.94	0.53	0.498	1670	5247
P30/19	60	45.2	1.36	0.747	1.016	1760	6703
P36/22	73	53.2	2.01	1.01	2.010	2030	9500
P42/29	86	68.6	2.64	1.81	4.778	2120	10250
P66/56	130	123	7.15	5.18	37.03		