Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B. TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, DECEMBER 2023

MODERN POWER CONVERTER [ELE 4085]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 05 DECEMBER 023** **Max. Marks: 50**

Instructions to Candidates:

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

1A. Make a technical comparison between AT and ATX Power supply. ***(02)***

1B. State and prove ampere-second balance and volt-second balance. Also, establish the relationship between input voltage and output voltage for Boost-type DC-DC converters by applying ampere-second balance to the capacitor. ***(04)***

1C. Design a suitable converter to charge a battery voltage of 400V. The input to the converter varies from 380V to 420V. The operating frequency is 20kHz and the converter is supplying a load of 1.6kW. Assume all are ideal components. ***(04)***

2A. You are assigned to design a power electronic LED driver suitable for a Honda City car LED Bumper Light of 100W with a voltage rating of 12V power from the car battery supply of 48V. (i) Select Forward converter type dc-dc converter suited for this driver. 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 0.5%, inductor Lx= 0.5mH, the duty ratio is 0.4, and the switching frequency is 35 kHz. ***(04)***

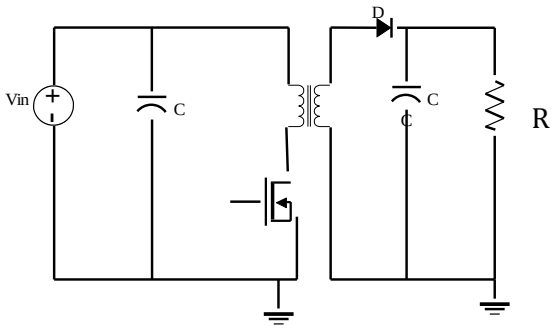
2B. Classify the different soft switching techniques that can be developed to enhance the efficiency of the converters. ***(03)***

2C. Analyze the load current, diode current, and inductor voltage of a current-fed DC-DC converter. Derive an expression to estimate the output voltage. ***(03)***

3A. Design a fly-back converter and its component selection with the step-by-step procedure. Converter Operating with continuous conduction mode as shown in Fig.Q.no.3A.

Vin	40 to 90V
V_{out}	24V
I_0	1 AMP

(04)



D	0.5
F_{sw}	150kHz
KRF	1
η	80%

Fig.Q.no. 3A

3B. Describe the working of series load resonant converter with waveform of resonant inductor current and capacitor voltage operating under leading power factor. ***(04)***

3C.

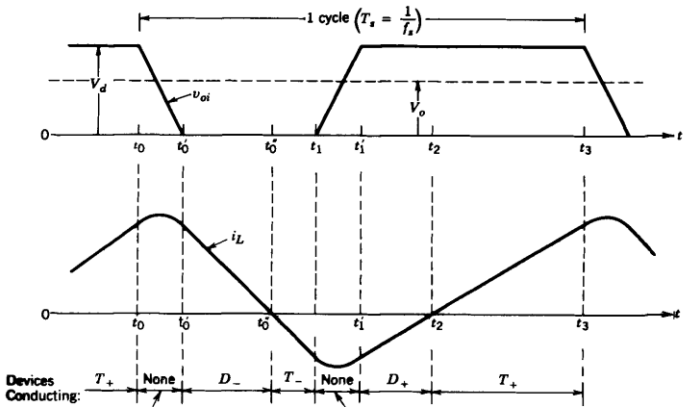


Fig.no.3C.

With the reference of Fig.Q.no 3C. identify suitable converter Topology in switched mode power converter. ***(02)***

4A. Analyze the waveform of resonant inductor current and capacitor voltage of a buck converter. The switch is required to conduct a peak Voltage that is higher than the source voltage Vs by an amount I_0Z_0 and explain its circuit properties. ***(04)***

4B.

A parallel loaded resonant converter is having the source voltage of 150V, resonant inductor and capacitor are 18µ H *Cr*= 0.82 µF, load resistance is *RL* = 10Ω, and switching frequency is *fs* = 120 kHz. Determine the output voltage of the converter. Assume the output filter components *Lo* and *Co* produce a ripple-free output current and voltage. Justify the output voltage of the converter. Refer Fig.Q.no 4B.

(04)

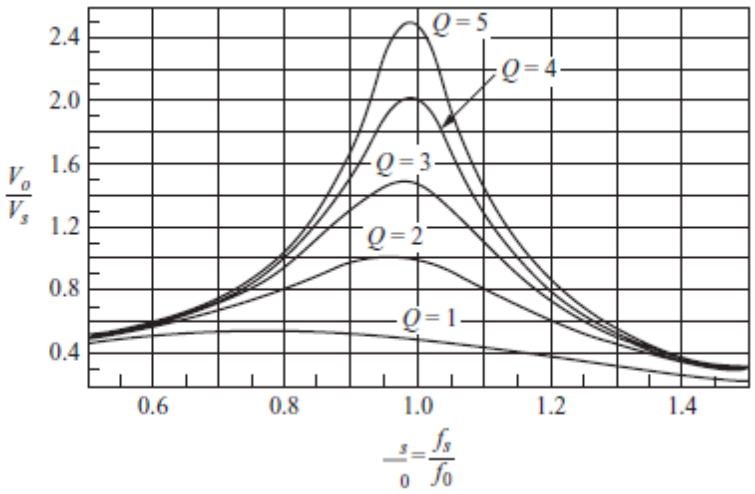


Fig.Q.no.4B.

4C. Explain steady state characteristics and its important properties of a parallel-loaded resonant dc-dc converter ***(02)***

5A. Explain the parameters that need to be calculated for the inductor design in switched mode power supply. ***(03)***

5B. Develop a small signal AC model of the buck-boost converter with step-by-step procedure. Assuming ideal components and continuous conduction mode. ***(04)***

5C. Design a high-frequency transformer for the full bridge dc-dc converter. The source voltage is 48V the output voltage is 24V, the operating frequency of the converter is 20KHz, the load has 8Ω resistance. Assume the output voltage ripple is 1% and input voltage fluctuation is 10%, refer to the core selector chart in Table 1. ***(03)***

Table 1: Physical Electrical and Magnetic characteristics of ferrite core

Core	Mean Length(mm^2)	Mean Magnetic length lm(mm^2)	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 $^{nh/TURNS^2}_{\pm 25\%}$
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		