Final Exam : Answer the following questions

Question (1):

a. List the characteristics of an ideal power electronics switch.

b. Derive the power losses in a transistor switch: Conduction losses, and Switching losses. Use needed diagrams and waveforms to support your answer.

c. A transistor switch with the following characteristics controls power to a 25 kW load:

I_{RATED}	V_{RATED}	$I_{LEAKAGE}$	$V_{CE(SAT)}$	$t_{SW(ON)}$	$t_{SW(OFF)}$	Source voltage V_S	Load resistance R_L	Switching frequency f_s	Duty cycle (d)
50 A	500 V	1 mA	1.5 V	1.5 µs	3 µs	500 V	10 Ω	100 Hz	50%

Find:

1. On-state and off-state power losses.
2. Maximum power loss during turn-on.
3. Energy losses during turn-on and turn-off.
4. On-state and off-state energy losses.
5. Total energy loss.
6. Average power loss.

[15] Mark

Question (2):

a. Sketch the schematic of a single phase full wave centre tapped transformer **uncontrolled** rectifier with a resistive (R) load, and an inductive (RL) load and explain the operation.

b. A single phase full wave centre tapped transformer **uncontrolled** rectifier is supplied from a 50 V source. If the load resistance is 100 Ω. Find:

1. The average load voltage and the average load current.
2. The maximum value & the RMS value of the load current.
3. The peak inverse voltage (PIV) rating of a diode.
4. The rectifier efficiency.
5. Calculate the form factor, pulse number, ripple factor, conduction angle, and the power factor.

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Question (3):

a. Sketch the schematic of a single phase half wave **controlled** rectifier with a resistive (R) load, and an inductive (RL) load and explain the operation.

b. A single phase half wave **controlled** rectifier is supplied from a 120 V source. Calculate the firing angle necessary to deliver 150 W of power to a load resistance of 10 Ω.

c. Sketch the schematic of a single phase full wave **controlled** bridge rectifier with a **freewheeling diode** that supplies an inductive (RL) load. If the supply voltage is 120 V and the resistive portion of the load is 10 Ω. Given that the delay angle is 30°. Find:

1. The average load voltage and the average load current.
2. The maximum value & the RMS value of the load current.
3. The average current in each SCR & the average current in the FWD.

[15] Mark

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Answer the following:

1- Sketch a collector steered base triggering circuit. Show the triggering waveforms, and explain the circuit functions. (10)

2- Sketch the logic symbol and the timing diagram forJK flip flop. Explain how JK flip flop differs from SC and D flip flops. (10)

3- Discus the current and voltage requirements of a LED. Sketch the circuit symbol for the device and show how it employed in a seven segment numerical display.(10)

4- Sketch the whole circuits initiated from a counter of diode matrix for driving a seven segment display. Explain the operation of the circuit and identify the segment of the input display that are energized for each decimal.(15)