B.Sc. Engg. (EE) / HDEE (5th Semester)
B.Sc. TE (2-Yr) (1st Semester)

Date: 04 October 2023 (Morning)

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4503
Course Title: Power Electronics

Winter Semester, A. Y. 2022-2023
Time: 90 Minutes
Full Marks: 75

Answer **ALL 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Do not write on this question paper. Assume reasonable value for any missing data and assume that the power devices are ideal.

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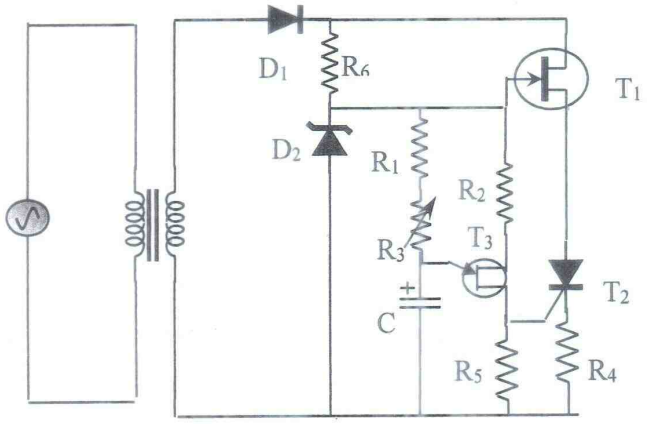
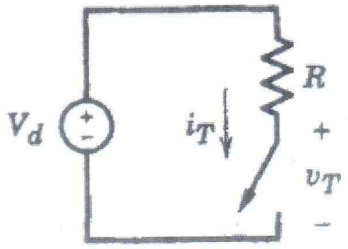
1. a) Describe briefly the function of a power processor in a power electronic system with the help of a block diagram. 09 [CO1, PO1]

(ii) Following is a circuit used for power processing purpose. Identify the power electronic devices used in this circuit and mention their control characteristics (Which devices are controlled/uncontrolled turned on and turned off) .



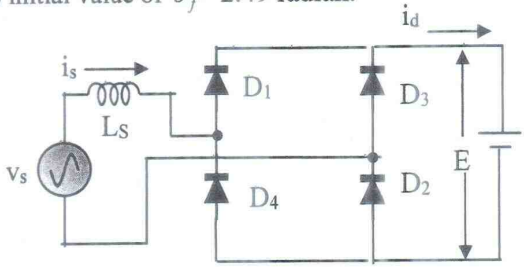
b) The data sheets of a switching device specify the following switching times corresponding to the linearized characteristics of a clamped-inductive switching as shown in the following figure: 07 [CO2, PO2]

t_{ri} = 100 ns, t_{fv} = 50 ns, t_{rv} = 100 ns, t_{fi}= 200 ns. Calculate and plot the switching loss as function of frequency. Assume V_d= 300 V and I_o= 4 A

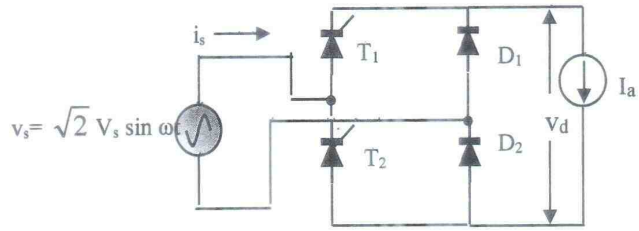


c) Sketch the circuit diagram of a uncontrolled full bridge rectifier. Two kinds of load will be connected, one is a resistive with a resistance 'R' and another one is highly inductive load with a constant current I_d. Sketch (i) the output voltage and input current waveshapes for both the loads (ii) compare the THD of both cases, (iii) determine the fundamental value of input current for both load and (iv) determine the average value of output voltage. The input is sinusoidal 09 [CO2, PO2]

2. a) For the following rectifier, L_S=1 mH and the input is sinusoidal with the rms value of 120 V at 60 Hz. The battery voltage is 150 V. Assuming discontinuous load current i_d, (i) find the value of angles at the beginning of conduction and ceasing of conduction and (ii) calculate the average value of current. Take initial value of θ_f =2.49 radian. 08 [CO2, PO2]

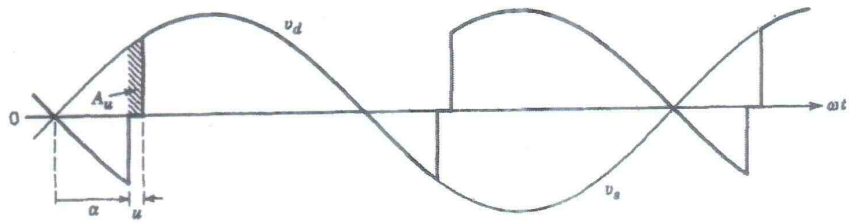


b) For the following converter circuit T_1 is fired at $\omega t=\alpha$ and T_2 is fired at $\omega t=\pi+\alpha$, respectively. The converter is supplied with V_s=220 V at 50 Hz. (i) Identify the devices operating at different regions of one complete cycle of the input voltage; (ii) sketch the output voltage and input current wave-shapes and (iii) calculate DPF, PF and %THD for $V_d=0.5V_{do}$, where V_{do} is the dc voltage at $\alpha=0$ 08 [CO2, PO2]



c) A single phase bridge rectifier with a finite source inductance L_S=5 mH has a load of constant current of 10 amp. It has a frequency of 50 Hz. The input voltage is a sinusoid with frequency 50 Hz and RMS value 230 V. (i) Sketch the wave shapes of source current and output voltage; (ii) calculate the commutation angle and average value of the output voltage. 09 [CO2, PO2]

3. a) A ac to dc converter has given the following wave-shapes. Sketch the circuit diagram of the converter, If the load is a highly inductive load, (i) sketch the wave-shapes of the input current (ii) determine the input power factor and also (iii) determine fundamental component of input current. 12 [CO1, PO2]



b) Following is a converter supplying a specific load, (i) explain what kind of practical load that could be connected (ii) sketch the waveshapes of input current and output voltage wave-shapes it would generate if the load current is continuous, (iii) determine the expression of average output voltage. 13 [CO1, PO2}