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Fourth Semester B.E. Degree Examination, January/February 2005

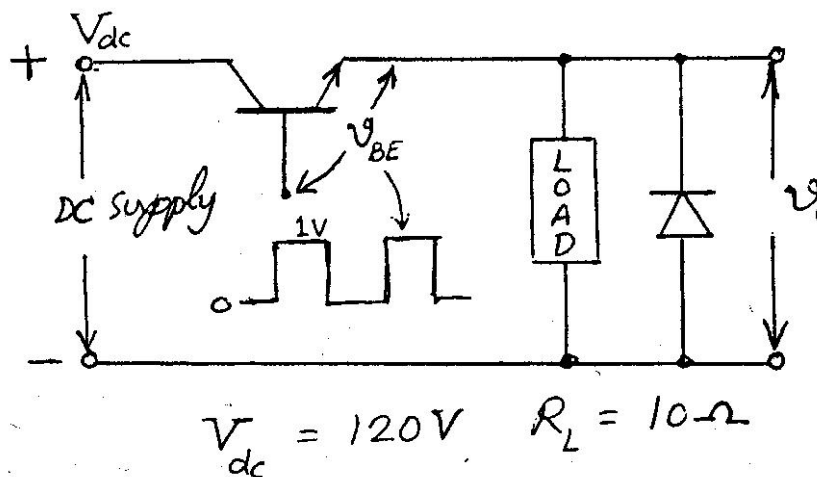
EC/TE/BM/ML/EE/IT
Power Electronics

Time: 3 hrs.]

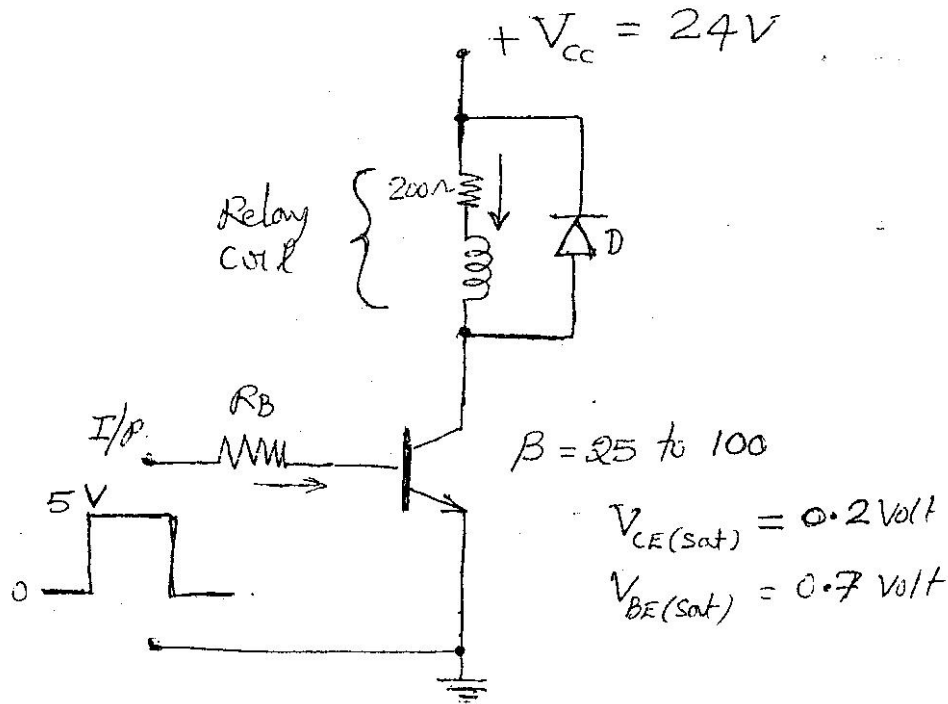
[Max.Marks : 100

Note: 1) Answer any FIVE full questions.
2) Sketch neat diagrams and wave forms.

1. (a) Briefly explain the different types of thyristor power converters and mention two applications for each. (10 Marks)
- (b) A transistor chopper circuit is shown in the fig. If a DC supply of 120 Volts is applied and the transistor is switched by applying periodic base pulses of voltage varying between 0 to 1 Volt. Sketch the load voltage with reference to the input base pulses. Calculate the
- Average/DC output voltage and
 - Average load current assuming the chopper frequency as 200 Hz, duty cycle of operation as 33.33%, and load resistance of 10Ω . (10 Marks)



2. (a) Explain the important characteristic features of power transistors. With the aid of output and transfer characteristics discuss the different operating regions of a power BJT. (10 Marks)
- (b) A simple transistor switch is used to connect a 24 Volt DC supply across a relay coil, which has a DC resistance of 200Ω . An input pulse of 0 to 5 Volt amplitude is applied through a series base resistor R_B at the base so as to turn on the transistor switch. Sketch the device current wave form with reference to the input pulse. Calculate
- I_{cs}
 - Value of resistor R_B , required to obtain over drive factor of 2.
 - Total power dissipation in the transistor that occurs during the saturation state. (10 Marks)



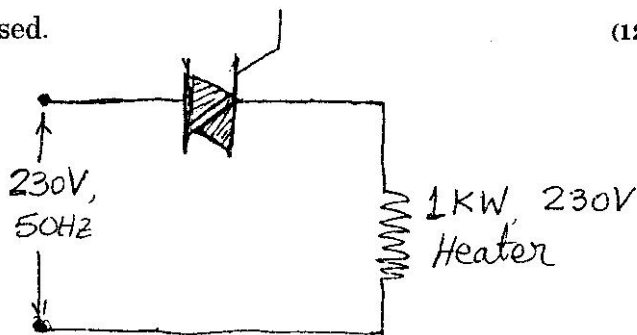
3. (a) What are thyristors? Draw the thyristor symbol and its semiconductor structure. Sketch the static anode V-I characteristics of a unidirectional switching triode thyristor device and indicate the different regions on the characteristics. Mention the different modes of operation of a thyristor. (10 Marks)
- (b) Explain the different types of turn-on methods (triggering mechanisms) used to switch ON a thyristor device. Use the two transistor model of a thyristor as the basis to explain the switching behaviour of the thyristor. (10 Marks)
4. (a) Discuss the process of thyristor commutation and differentiate between :
- i) Natural commutation and forced commutation.
 - ii) Self commutation and impulse commutation. (10 Marks)
- (b) A complementary commutation circuit operator from a DC supply of 200 Volts and has resistances $R_1 = R_2 = 10\Omega$, commutating capacitance $C = 10\mu F$. Sketch the thyristor voltage waveform for one complete cycle of operation, when the two thyristors T_1 and T_2 in the circuit are triggered periodically one after the other. Calculate :
- i) Peak transient repetitive on state thyristor current that flows, at the instant of triggering the thyristor device and
 - ii) The circuit turn off time. (10 Marks)

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5. (a) Draw the circuit and explain the operation of a single phase fully controlled bridge converter feeding an RL load. Sketch the input, output, and the source, current waveform assuming a constant, continuous, ripple free load current. Derive the expression for the average output voltage and show the variation of the average output voltage with the variation in the delay angle. (10 Marks)
- (b) A three phase half wave controlled rectifier circuit is operated from 3 phase star connected, supply transformer with a line to line ac supply voltage of 440 Volts RMS, 50 Hz. If the thyristors are triggered at a delay angle of $\alpha = 30^\circ$ load resistance $R_L = 20\Omega$, sketch the waveform of
- 3 phase, phase supply voltage
 - Load voltage and
 - Thyristor current through T_1 connected to line A.

Derive the expression for the average output voltage for continuous, ripple free load current and calculate :

- V_{dc}
 - $V_{dc(max)}$,
 - I_{dc}
 - $I_T(Avg)$
- (10 Marks)
6. (a) With the aid of a basic circuit and waveform explain the basic principles of operation of a step-down chopper with resistive load. Obtain the expressions for
- DC output voltage
 - Output power and
 - Chopper efficiency.
- (10 Marks)
- (b) Explain how the DC choppers are classified, with reference to load voltage and load current. Write the circuits of Class - B, Class - C and Class - D choppers and briefly explain to show the type of load voltage and load current wave form they give. (10 Marks)
7. (a) Draw the circuit of a single phase AC voltage controller and explain the principle of ON-OFF control, with the help of relevant wave forms. Derive the expression for the RMS output voltage in terms of the RMS supply voltage and the duty cycle of operation of the controller. (8 Marks)
- (b) The single phase full wave AC-voltage controller operates on a single phase supply voltage of 230 V RMS, at 50 Hz. If the triac is triggered at a delay angle of 45° , during both the half cycles of input supply. Calculate
- RMS value of output voltage
 - RMS value of current through the heater
 - Average value of triac current
 - RMS value of triac current.
 - Input PF.
- Derive any expression used. (12 Marks)



8. (a) Explain the basic principle of operation of

- i) Single phase half bridge inverter and
- ii) Single phase full bridge inverter.

With the help of appropriate waveform, mention the advantages and disadvantages of each. (10 Marks)

(b) Draw the circuit of a single phase, current source inverter employing power switching transistors. Sketch the gating signal waveforms and the load current waveform. Explain the operation of the circuit. (10 Marks)

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