Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Power Electronics

Time: 3 hrs.   Max. Marks : 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Explain the control characteristics of various power devices. **(08 Marks)**
   b. Explain the various types of power electronic circuits along with suitable waveforms. **(08 Marks)**

OR

2 a. Explain the construction, working and steady state characteristics of n-channel enhancement MOSFET. **(08 Marks)**
   b. With the help of neat circuit diagram and relevant waveforms, explain the transient characteristics of BJT. **(08 Marks)**

Module-2

3 a. In detail explain the two transistor model of a thyristor. **(08 Marks)**
   b. Mention and explain different thyristor turn-on methods. Mention the advantages of gate triggering. **(08 Marks)**

OR

4 a. Explain dynamic turn – off characteristics of SCR.
      For R – triggering circuit, the gate voltage required to trigger the SCR is $V_{GT} = 0.6V$ and corresponding $I_{GT} = 250\mu A$. The silicon diode is used and input voltage is $V = 100 \sin wt$. Find firing angle α if $R_1 = 10k\Omega$ and $R_2 = 220k\Omega$.
   b. Explain uJT relaxation oscillator and design uJT firing circuit using an uJT having the parameters η = 0.72, $I_P = 60\mu A$, valley voltage $V_V = 2.5$ V, $I_V = 4mA$, VBB = 15V and RBB = 5kΩ. The leakage current with emitter open is 3mA. The triggering frequency is 1kHz and $V_{g(min)} = 0.3V$. Also calculate the minimum and maximum values of triggering frequency. Assume C = 0.05μF. **(08 Marks)**

Module-3

5 a. A single phase full converter is connected to a supply of $(\sqrt{2}*120) \sin 2\pi * 50t$. The triggering angle of the SCR is 60°. The load inductance is very large. Calculate (i) DC of output voltage   (ii) rms output voltage   (iii) Harmonic fact (HF)   (iv) Input power factor   (v) rms value of fundamental component of supply current. Take the load current as 10A. **(08 Marks)**
   b. A DC motor is used in an electric train. The DC motor is controlled by a power electronic circuit. It is required that the power electronic circuit should be capable of operating the DC motor in all four quadrant of operation. Draw the necessary circuit, explain its operation along with waveforms and derive the expression for DC o/p voltage. **(08 Marks)**

OR

6 a. A single phase full-wave AC voltage controller delivers an output power of 719.95 W to a load of 10Ω. The input voltage is $V_s = (169.7) \sin \omega t$. Find:
      i)   rms o/p voltage
      ii) triggering angle α
   b. iii) rms value of SCR current
      iv) average value of SCR current
      v)   input power factor. **(08 Marks)**
      Draw the circuit of single phase bidirectional AC voltage controller with inductive load. Explain its operation along with relevant waveforms. Derive the expression for rms output voltage. **(08 Marks)**

Module-4

7 a. Explain the principle of operation of step up chopper and derive output voltage expression. **(06 Marks)**
   b. Explain the working of buck regulator and derive the expression for average output voltage. **(06 Marks)**
   c. A step down DC chopper has a resistive load of R = 15Ω and input voltage of $V_{dc} = 200V$.
      When the chopper remain ON its voltage drop is 2.5V. The chopper frequency is 1kHz if the duty cycle is 50%. Determine:
      i)   Average output voltage   ii) RMS output voltage. **(04 Marks)**

OR

8 a. Briefly explain classification of chopper with circuit, waveform and quadrant diagram. **(08 Marks)**
   b. A boost regulator has an input voltage of $V_s = 5V$. The average output voltage $V_a = 15V$ and average load current $I_a = 0.5A$. The switching frequency is 25kHz. If L = 150μH C = 200μf, determine: i) Duty cycle   ii) Ripple current at inductor (ΔI)   iii) The peak current of inductor   iv) Ripple voltage of filter capacitor ΔVc   v) Critical values of L and C. **(08 Marks)**

Module-5

9 a. What do you mean by inverters? Explain the operation of single phase full bride inverter. Draw the load current waveforms for R, RL and RLC loads. **(08 Marks)**
   b. Mention the applications of current source inverters. Explain any one type of single phase current source inverter. **(08 Marks)**

OR

10 a. Explain solid state relays. **(08 Marks)**
   b. Explain microelectronic relays. **(08 Marks)**

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