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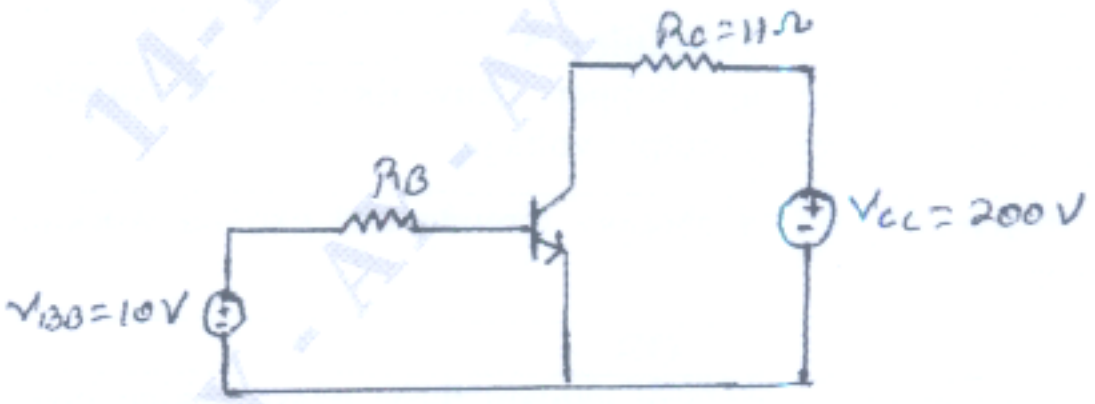
BEE503



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

Time: 3 hrs. Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.*
*2. M : Marks , L: Bloom's level , C: Course outcomes.*

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | With neat sketch, explain the reverse recovery characteristics of a diode. | 06 | L2 | CO1 |
| | b. | A single phase full bridge diode rectifier is supplied from 230 V, 50 Hz source. The load consists of R = 10 Ω. Determine (i) Average output current (ii) Average diode current. | 04 | L3 | CO1 |
| | c. | With neat circuit diagram and waveform, explain the single phase full wave bridge type diode rectifier with R load, derive average and RMS output voltage. | 10 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Mention the various characteristics and specifications of switches. | 06 | L1 | CO2 |
| | b. | Explain the significance of freewheeling diode. | 04 | L2 | CO2 |
| | c. | With necessary circuit diagram, waveform and derivation, explain diode circuit with DC source connected to RL load. | 10 | L2 | CO2 |
| | | **Module – 2** | | | |
| Q.3 | a. | With neat circuit diagram, explain steady state and switching characteristics of BJT. | 10 | L2 | CO3 |
| | b. | Give the comparisons between MOSFET and IGBT. | 04 | L4 | CO3 |
| | c. | The bipolar transistor in Fig.Q3(c) below is specified to have $\beta_f$ in the range of 8 to 40. The load resistance is $R_c$ = 11 Ω . The dc supply voltage is $V_{cc}$ = 200 V and the input voltage to the base current is $V_B$ = 10 V. If $V_{CE(out)}$ = 1.0 V, $V_{BE(out)}$ = 1.5 V, find (i) the value of $R_B$ that result in saturation with an ODF of 5 (ii) the $\beta_{forced}$ and (iii) the power loss in transistor.   Fig.Q3(c) | 06 | L3 | CO3 |
| | | **OR** | | | |
| Q.4 | a. | With neat circuit diagram, explain steady state and switching characteristics of power MOSFET. | 10 | L2 | CO3 |

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| | b. | Explain the importance of providing isolation of gate/base drive from power circuits. | 04 | L4 | CO3 |
| | c. | With a neat circuit diagram, explain how soft switching is implemented with antisaturation control of BJT. | 06 | L2 | CO1 |
| | | **Module – 3** | | | |
| Q.5 | a. | Explain the two transistor model of thyristor with neat diagram and derive the expression for anode current. | 08 | L3 | CO2 |
| | b. | A SCR is connected in series with a 0.5 H inductor and 20 Ω resistance. A 100 V DC voltage is applied to this circuit. If latching current of the SCR is 4 MA, find the minimum width of the gate trigger pulse required to properly turn-on the SCR. | 04 | L3 | CO3 |
| | c. | Discuss between series and parallel operation of thyristors with circuit diagram. | 08 | L4 | CO3 |
| | | **OR** | | | |
| Q.6 | a. | Explain UJT firing circuit for the SCR. | 08 | L2 | CO1 |
| | b. | Distinguish between (i) Converter grade and Inverter grade SCR (ii) Latching current and Holding current. | 04 | L4 | CO3 |
| | c. | A SCR has a $\frac{di}{dt} = 120$ A/μs and $\frac{dv}{dt}$ of 300 V/μs. It operates on a 250 V DC source with a load resistance of 10 Ω. Find the suitable values for the components of the snubber circuit. | 08 | L3 | CO2 |
| | | **Module – 4** | | | |
| Q.7 | a. | With neat circuit and waveforms, explain the single phase half wave controlled rectifier with RL load , derive the average output voltage. | 10 | L2<br>L3 | CO3 |
| | b. | List the applications of AC voltage controller. | 04 | L1 | CO1 |
| | c. | A single phase half wave controlled rectifier is used to supply power to 10 Ω load from 230 V, 50 Hz supply at a firing angle of 30. Calculate (i) average o/p $V_g$ (ii) Effective output voltage (iii) Average load current. | 06 | L3 | CO2 |
| | | **OR** | | | |
| Q.8 | a. | Explain the single phase full wave AC voltage controller with R load with neat diagram and waveform and derive the RMS output voltage. | 10 | L2<br>L3 | CO3 |
| | b. | Derive an expression for the RMS value of the output of bidirectional AC voltage controller employing ON-OFF control, with necessary explanations. | 10 | L3 | CO3 |
| | | **Module – 5** | | | |
| Q.9 | a. | Explain the working of step-up chopper. Draw the relevant waveforms, derive an expression for average output voltage. | 10 | L2<br>L3 | CO2 |
| | b. | Classify the different types of chopper circuits and explain working of class E chopper. | 10 | L4 | CO3 |
| | | **OR** | | | |
| Q.10 | a. | With circuit diagram and waveform explain three phase bridge inverter. Also derive line to line RMS voltage. | 10 | L2<br>L3 | CO2 |
| | b. | List the different types of voltage control techniques for single phase inverters. Briefly explain (i) single pulse width modulation (ii) sinusoidal pulse width modulation. | 10 | L1<br>L2 | CO3 |

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