

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY (VSSUT), ODISHA
Even Mid Semester Examination for Academic Session 2024-25

COURSE NAME: BTech

SEMESTER: 4th

BRANCH NAME: ELECTRICAL (4th Sec A & B)

SUBJECT NAME: **POWER ELECTRONICS**

FULL MARKS: 30

TIME: 90 Minutes

Answer All Questions.

The figures in the right hand margin indicate Marks. *Symbols carry usual meaning.*

- Q1. Answer all Questions. [2 × 3]
- a) Which of the power electronics devices is a *majority carrier* device. Show its circuit symbol and static I-V characteristics. - CO1
- b) Which of the *forced* commutation circuits is also known as Voltage Commutation circuit and Why? - CO2
- c) In single phase half wave-controlled rectifier, delivering R-L load, if triggering angle is 30° and extinction angle is 210° , then find the angle duration (in degree) for which power drawn by load from source is positive and duration for which it is negative. - CO3
- Q2. [3+5]
- a. Explain the dynamic characteristics of SCR showing different intervals of time during Switch ON and Switch OFF operation of the device. - CO1
- b. A string of SCR connected in series to withstand a dc voltage of $V_s = 10\text{KV}$, the maximum leakage current and recovery charge differences of the thyristors are 10mA and $100\ \mu\text{C}$ respectively. A derating factor of 20% is applied for steady state and transient voltage sharing of thyristors. If the maximum voltage sharing is 1000V. Determine (i) R_s , (ii) C_s
- OR [4+4]
- a. Explain the principle of operation of RC Triggering circuit with clear circuit diagram and waveforms. Discuss its limitations. - CO1
- b. One SCR has a gate cathode V_g - I_g characteristics of $V_g = 1 + 10 I_g$. The gate source voltage is rectangular pulse of 15 V with $20\ \mu\text{s}$ duration. If average and maximum gate power $P_{g_{avg}}$ and $P_{g_{max}}$ are 0.3 W and 5 W respectively, then determine the i) source resistance (R_s) to be connected in series in gate circuit and ii) Triggering frequency.

Q3.

[4+4]

- a. With clear circuit diagram and waveforms explain the operation of Single Phase half wave controlled rectifier supplying R-L Load, when the load current is discontinuous. Derive the expression of form factor of output voltage (V_o) for the same. - CO2

A thyristor used for single phase half sine wave application, has RMS On state current rating $I_{T_{rms}} = 25$ Amp. What will be $I_{T_{avg}}$ rating of the device with 180° conduction angle? If the average power dissipation P_{avg} is 8 times $I_{T_{avg}}$, then determine the casing temperature θ_c , if the junction temperature θ_j is 125° C. Use $\theta_{jc} = 0.15^\circ\text{C/W}$.

OR

- a. With clear circuit diagram and waveforms explain the operation of Single-Phase half controlled rectifier delivering R-Load. Determine the average and rms value? - CO2
- b. In Series connected SCRs, discuss the need of static equalization circuit that is necessary and thus derive the expression of resistance R needed for the same.

Q4.

[4+4]

- a. With clear circuit diagram and waveforms explain the operating of Single-Phase Full wave controlled rectifier delivering continuous ripple free current to R-L load. Also determine the RMS and average output voltage (V_o) considering triggering angle α . - CO3
- b. Design snubber circuit parameters for a thyristor considering supply voltage $V_s = 440$ V, repetitive peak current $I_p = 200$ A. $(di/dt)_{max} = 40$ A/ μ S $(dv/dt)_{max} = 220$ V/ μ S with minimum load resistance of 10Ω . Take factor of safety of 2.

OR

- a. A single phase full wave controlled bridge rectifier is delivering from 230 V(rms) source is supplying a constant continuous load (R-L Type) current and gives a rippled DC output voltage of ripple factor 0.75. Find out the firing angle of operation. - CO3

With clear circuits and necessary derivations, explain the two-transistor analogy of a thyristor and show how a gate current helps in building the regenerative process to make it ON.