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V Semester EE/EL B.Tech

Supplementary Examination February – 2019

EL/**EE-301 Power Electronics**

Time: 3:00 Hours Max. Marks: 40

Note: Question **No. 1 is compulsory**. Attempt **any four** from the **remaining questions.** Assume suitable missing data, if any.

Q.1 Answer in brief: -

(a) Draw the symbol and VI characteristics of the GTO. [1]

(b) Why doesn't IGBT exhibit secondary break-down phenomenon? [1]

(c) Why is high interdigitation of the gate design preferred in GTO? [1]

(d) Draw the thermal equivalent circuit of SCR and list the various parameters involved in it. [1]

(e) A single phase voltage controller is connected to a load of resistance 10Ω and a supply of $200 \sin 314t$ volts. Find the average thyristor current for a firing angle of $\frac{\pi}{2}$ [1]

(f) Why is the switching frequency of MOSFET higher than that of other semi-conductor devices? [1]

(g) A single phase full wave mid-point thyristor converter uses a 230/200 V transformer with centre tap on the secondary side. Find the peak inverse voltage of the thyristor. [1]

(h) What are the effects of high $\frac{dv}{dt}$ and high $\frac{di}{dt}$ on an SCR? [1]

Q.2 (a) Describe various types of power diodes indicating clearly the differences amongst them. [4]

(b) Draw the switching characteristics of a thyristor during its' turn-on and turn-off processes. Show the variation of voltage across the thyristor and the current through it during switching and also indicate the various time intervals of turn-on and turn-off times. [4]

Q.3 (a) A single phase full converter is supplied from a 230V, 50Hz source. The load consists of R=10Ω and a large inductance so as to render the load current constant. For a firing angle of 30°, determine: [4]

(i) average output voltage and average output current.

(ii) average thyristor current and rms thyristor current.

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(b) Describe the operating principle of a single phase to single phase step up cyclo-converter with the help of a bridge configuration. Also draw the appropriate circuit and wave forms. [4]

Q.4 (a) A single phase semi-converter feeds power to RLE load. Draw the source voltage, output voltage, load current, source current and free-wheeling diode current waveforms as a function of time when the extinction angle $\beta > \pi$. [4]

(b) Explain how the step up chopper can be used for regenerative breaking of motors with suitable circuit diagram and waveforms. [4]

Q.5 (a) A three – phase full converter is operated from a three – phase star connected 208V, 60Hz supply and the load resistance is R=10Ω. If it is required to obtain an average output voltage of 50% of the maximum possible output voltage, calculate: - [4]

(i) The firing delay angle α.
(ii) The rms and average output currents.
(iii) The rms and average thyristor currents.
(iv) The rectification efficiency.

(b) A Type A chopper feeds power to an RLE load with R=2Ω, L=10mH and E=6V. If this chopper is operating at a chopping frequency of 1kHz and duty cycle of 10% from a 220V DC source, compute the maximum and minimum currents drawn by the load. [4]

Q.6 (a) Determine the Fourier Series expression for the output voltage and current obtained from a single phase half bridge inverter. [4]

(b) A single phase voltage controller feeds power to a resistive load of 3Ω from a 230V, 50Hz source. Calculate: - [4]

(i) The maximum values of average and rms thyristor current for any firing angle α.
(ii) The minimum circuit turn off time for any firing angle α.
(iii) The ratio of third harmonic voltage to fundamental voltage for $\alpha = \frac{\pi}{3}$

Q.7 (a) Discuss the principle of working of a three-phase bridge inverter using an appropriate circuit diagram. Draw the phase and line voltage wave forms on the assumption that each thyristor conducts for 180° and the resistive load is star-connected. [4

(b) For a single pulse modulation used in inverters with pulse width $= 2d$, show that the output voltage can be expressed as [4

$$v_0 = \sum_{\alpha=1,3,5}^{\infty} \frac{4V_s}{n\pi} \cdot \sin\frac{n\pi}{2} \cdot \sin nd \cdot \sin n\omega t$$