Sheet (1)

(1) Draw the symbol, state the conditions of turning on and off and determine the direction of current for the following power electronics switches:
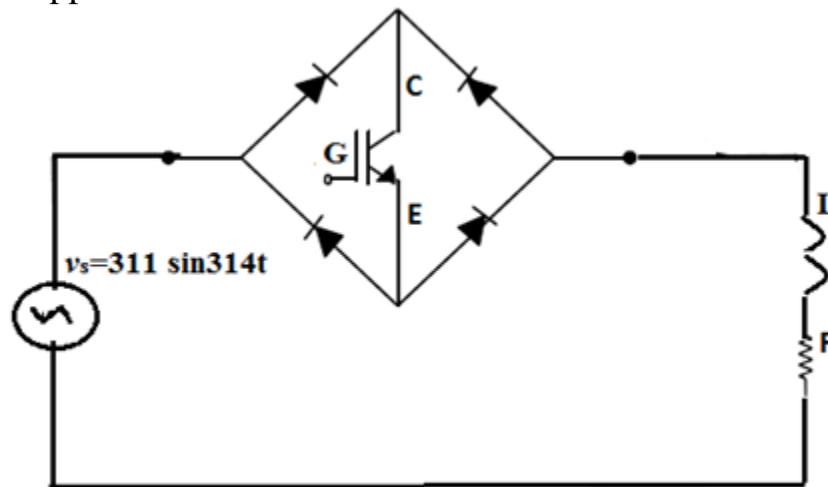
Thyristor- Triac- IGBT

(2) If the gate voltage (V_G) of IGBT, fig.(1), is applied from ($30^\circ \leq \omega t \leq 120^\circ$) and from ($210^\circ \leq \omega t \leq 300^\circ$) and repeated to each cycle of the AC supply:

(a) Draw the waveform of load voltage, if the load is a resistive load.
(b) Find the average value of the load voltage
(c) What would be happened if the load is an inductive load?

Fig.(1)

(3) A single-phase, half-wave, uncontrolled rectifier circuit feeds an inductive load of R=10Ω and L=31.3 mH. The ac supply is 220-V, 50-Hz. Determine:

(i) The extinction angle
(ii) The average value of the load current
(iii) Determine the RMS value of the load current using FOURIER series
(iv) Draw the waveforms of the diode voltage and diode current

(4) A three-phase, fully-controlled bridge rectifier feeds a highly inductive load of R=10Ω at a firing angle α= 30°. The AC supply-voltage is 380-V, 50-Hz.

(i) Draw the waveforms of the phase voltage and phase current.
(ii) Explain, using a simple drawing, the commutation process of the thyristors.