Q.2 a. What is power electronics? Why is it needed? List out the applications of power electronics.

Answer: **Refer Page Numbers 2,3,14 & 15**

b. What is the basic difference between a PN junction power diode and an ordinary PN junction diode? Discuss various principal ratings for power diodes.

Answer: **Refer Page Numbers 19, 27 & 28.**

Q.3 a. Explain the operating principle of N-channel IGBT with a neat diagram. Draw the ideal IGBT V-I Characteristics.

Answer: **Refer Page Numbers 62 & 63.**

b. Draw and explain the V-I characteristics of a Power BJT.

Answer: **Refer Page Numbers 41 & 42**

Q.4 a. What is Silicon Controlled Switch? Draw and explain its structure, symbol and equivalent Circuit.

Answer: **Refer Page Numbers 111 & 112.**

b. Explain two-transistor model of SCR with a neat circuit diagram.

Answer: **Refer Page Numbers 75 & 76**

c. A gate-triggering circuit for an SCR provides a train of pulses with a frequency of 100 Hz and a pulse width of 2 ms. If the pulse has a peak power of 2 W. Find the average power dissipated by the gate.

Answer: Pulse Period $T = \dfrac{1}{f} = \dfrac{1}{100} = 10ms$

Duty Cyle $(d) = \dfrac{T_{ON}}{T} = \dfrac{2}{10} = 0.2$

Therefore, the **Average Power Dissipated by the gate** is
$$P_{O(avg.)} = 0.2 \, X \, 2 = 0.4W$$

Q.5   a.   With neat diagram, explain the working of Single Phase Full Wave Semi-Controlled Bridge Rectifier with an inductive load. Draw its various waveforms.

Answer: **Refer Page Numbers from 175 to 178.**

      b.   A Single Phase Full-wave controlled rectifier with an inductive load is connected to a 120 V source. The resistive portion of the load is equal to 10 Ω. If the delay angle (α) is $30°$. Find
        (i)   average load voltage   (ii)   average load current
        (iii)   form factor   (iv)   rectifier efficiency

Answer: Given data :   Source Voltage (V_s) = 120 V
                        Load Resistance (R) = 10 Ω
                        Delay Angle (α) = $30°$
            The peak load voltage (V_m) is given by:

$$V_m = \sqrt{2} X V_s = \sqrt{2} . X (120) = 208V$$

      (i)   Average Load Voltage,

$$V_{o(avg.)} = \frac{2}{\pi} V_m \cos\alpha = \frac{2}{\pi}(208)(\cos 30°) = 115V.$$

      (ii)   Average Load Current, $I_{o(avg.)} = \dfrac{115}{10} = 11.5 Amp.$

      (iii)   Form Factor, $FF = \dfrac{V_{o(RMS)}}{V_{o(avg.)}} = \dfrac{120}{115} = 1.04.$

      (iv)   Rectifier Efficiency, $\eta = \dfrac{V_{o(avg.)}}{V_{o(RMS)}} = \dfrac{115}{120} = 0.96 = 96\%.$

Q.6   a.   Draw the circuit of Three Phase Full Wave Half-Controlled Bridge Rectifier with freewheeling diode (FWD). Explain its working with the help of voltage & current waveforms, when delay angle is less than $60°$.

Answer: **Refer Page Numbers from 254 to 258.**

b. A three-phase half-wave controlled rectifier connected to a three-phase, 280 V, 60 Hz AC source supplies power to a 10 Ω resistive load. If the delay angle is $20°$. Find
   (i) maximum output current
   (ii) average output voltage
   (iii) average output current
   (iv) SCR average current

Answer: **Given Data:** The maximum output voltage (V_L) is equal to the V_m.

Hence (V_L) = (V_m) = 208 V and R = 10 Ω.

The Phase Votage, $V_{phase} = \dfrac{V_L}{\sqrt{3}} = \dfrac{208}{1.732} = 120 Volts.$

The peak load voltage (V_m) is given by:
$$V_m = \sqrt{2}X V_{phXase} = \sqrt{2}X120 = 170 Volts.$$

(i) Maximum Output Current, $I_m = \dfrac{V_m}{R} = \dfrac{170}{10} = 17 Amp.$

(ii) Average Output Voltage,
$V_{o(avg.)} = 0.827 V_m \cos \alpha = (0,827)(170)(\cos 20°) = 132 Volts.$

(iii) Average Output Current, $I_{o(avg.)} = \dfrac{V_{o(avg.)}}{R} = \dfrac{132}{10} = 13.2 Amp.$

(iv) SCR Average Current, $I_{SCR(avg.)} = \dfrac{I_{o(avg.)}}{3} = \dfrac{13.2}{3} = 4.4 Amp.$

Q.7 a. What is Buck-Boost DC Chopper? Draw its circuit diagram and explain its operation for the ON state and OFF state.

Answer: **Refer Page Numbers from 295 to 298**

b. What is DC chopper? Explain its principle of operation with circuit diagram and various waveforms.

Answer: **Refer Page Numbers from 269 to 272.**

Q.8 a. Draw the circuit of basic or Half-Bridge Inverter. Explain its working. List out the industrial applications of inverters.

Answer: **Refer Page Numbers from 305 to 307**

   b. What is the necessity of pulse width modulated inverter? Draw the circuit diagram of single phase full-wave pulse-width modulated bridge inverter. Explain its working with output waveforms.

Answer: **Refer Page Numbers 321 & from 324 to 326.**

Q.9   a. Discuss the principle of the integral cycle control method. Give its applications.

Answer: **Refer Page Numbers 357 & 358.**

   b. What is meant by static switch? Compare the advantages and disadvantages of semiconductor switches over mechanical switches.

Answer: **Refer Page Numbers 411 & 412.**

TEXT BOOK

I. Power Electronics for Technology, First Impression (2006), Ashfaq Ahmed, Purdue University - Calumet, Pearson Education.