Problems:

Of Power Electronics & Batteries

Problem 1: A thyristor is connected in series with a 100 Ω resistor to a 230 V (rms) sinusoidal supply. If the thyristor is controlled to switch on at a firing angle of 30^0, determine the average current in the thyristor.

Solution :

The described circuit is half wave controlled rectifier

Given data: R = 100 Ω, V_{srms} = 230 V, Firing angle = 30^0.

Governing equations:

$$V_0 = \frac{V_m}{2\pi}(1 + Cos\,\alpha)$$

$$I_o = \frac{V_o}{R} = \frac{V_m}{R} \cdot \frac{1}{2\pi}(1 + Cos\,\alpha)$$

Problem 2: A sinusoidal source of ***v = 325.26 sin(wt)*** is applied as input to the full-bridge controlled rectifier feeding resistor of ***15 Ω***. The average output current measured flowing through the resistance is ***12.5 A***. Calculate the operating firing angle of the circuit and the average output voltage.

Solution: The circuit is bridge controlled rectifier

Given data: v = 325.26 sin(wt) , R = 15 Ω, I_0 = 12.5 A

To find: the operating firing angle and V_0.

Governing equations:

$$I_o = \frac{V_o}{R} = \frac{V_m}{R} \cdot \frac{1}{\pi}(1 + Cos\ \alpha)$$

Find alpha using this equation

$$V_0 = \frac{V_m}{\pi}(1 + Cos\ \alpha)$$

Problem 3: Assume that 20 Dry cells of 1.45 V emf are connected in series. When an external resistance of 12 Ohms is connected in series with the battery , the value of current flow is 2A. What is the value of internal resistance of each cell?

$$I = \frac{nE}{R + nr} \quad Amperes$$

$$r = \frac{nE}{nI} - \frac{R}{n} \quad Amperes$$

Ans.: 0.125 Ohms

Problem 4: A battery is formed of six cells connected in series. When the external resistance of 3 Ohms is joined across its terminals, the current is found to be 2.5 A and when it is 9 Ohms the current falls to 1.25 A. Find the emf of each cell and its internal resistance.

$$I = \frac{nE}{R + nr} \quad Amperes$$

First case

$$7.5 + 15r = 6E$$

Second Case

$$11.25 + 7r = 6E$$

Ans.: r = 0.5Ohms

E= 2.5 Volts

Problem 5: Calculate the i.) Ampere hour efficiency and ii.) Watt-hour efficiency of a secondary cell which is discharged at a uniform rate of 30 A for 6 hours at an average terminal voltage of 2 V. It is then charged at the uniform rate of 40 A for 5 hours to restore it to its original condition. The terminal voltage during charging is 2.5 V

Solution:

First case

A h output = 30 x 6 =

A h Input = 40 x 5 =

Ans.: A h- efficiency % = 90%

Second Case

The terminal voltage during charging is 2.5 V

W -h output = 2 x 30 x 6 =

W- h input = 2.5 x 40 x 5 =

Ans.: W h- efficiency % = 72%

$$Ah\,efficiency(\eta_{Ah})\% = \frac{Amperehours\,on\,discharging}{Amperehours\,on\,charging} \times 100$$

Thank You