Ex(1):- The reference winding of 4-pole two phase servomotor is excited from 240V, 50 Hz supply, the control signal after the amplification is found to be 200V. Find the positive seq rotor current if the motor is driving a load at speed of 1000 rpm. The motor parameter as follows:-

$R_1 = 2.5 \quad X_1 = 4.2 \quad \bar{R}_2 = 8\Omega \quad \bar{X}_2 = 4.8\Omega \quad X_m = 18\Omega$

Sol

For the positive sequence impedance of servomotor

$$Z_p = R_1 + jX_1 + \frac{jX_m\left(\frac{\bar{R}_2}{s} + j\bar{X}_2\right)}{\frac{\bar{R}_2}{s} + j(X_m + \bar{X}_2)}$$

$$N_s = \frac{120f}{P} = \frac{120 * 50}{4} = 1500 \text{ rpm}$$

$$s = \frac{N_s - N}{N_s} = \frac{1500 - 1000}{1500} = 0.3333 \text{ or } 33.33\%$$

$$\therefore Z_p = 2.5 + j4.2 + \frac{j18\left(\frac{8}{0.3333} + j4.8\right)}{\frac{8}{0.3333} + j(18 + 4.8)} = 9.6 + j15.46\ \Omega$$

The input current is $\frac{V_{r1}}{Z_p} = I_{r1}$

$$V_{r1} = \frac{1}{2}(V_R + jV_C) = \frac{1}{2}(240 + j200) = 120 + j100 \quad V$$

$$\therefore I_{r1} = \frac{120 + j100}{9.6 + j15.46} = 8.147 + j2.7 \quad A$$

∴ The positive seq rotor current $\bar{I}_{2r_1}$

$$\bar{I}_{2r_1} = I_{r1}\frac{jX_m}{\frac{\bar{R}_2}{s} + j(X_m + \bar{X}_2)} = (8.147 - j2.7)\frac{j18}{\left(\frac{8}{0.3333}\right) + j(18 + 4.8)}$$

$$\bar{I}_{2r} = 4.11 + j2.193 \quad A$$

Ex①:- The reference winding of 6-pole two phase servomotor is fed from 220 V, 50 Hz. The control winding is fet from servo amplifier with an amplification factor equal to 16. The control signal is varying from 1 volt to the highest value allowed. At highest value of signal, the input current is found to be 23% increased of its value at lower signal of control.
Find the highest value of the control signal?

Sol

When the control signal = 1 V $\quad V_c = 1*16 = 16$ V

$\therefore \quad V_{r_1}^{16} = \frac{1}{2}(220 + j16)$

when the control signal has highest value

$V_{r_1}^{h} = \frac{1}{2}(220 + V_c^h)$

$\because$ Input current $I_{r_1} = \frac{V_{r_1}}{Z_f} \Rightarrow \frac{I_{r_1}}{1.23 I_{r_1}} = \frac{V_{r_1}^{16}/Z_f}{V_{r_1}^{h}/Z_f}$

$$0.813 = \frac{V_{r_1}^{16}}{V_{r_1}^{h}} = \frac{\frac{1}{2}(220 + j16)}{\frac{1}{2}(220 + jV_c^h)}$$

$$0.813 = \frac{\sqrt{(220)^2 + (16)^2}}{\sqrt{(220)^2 + V_c^2}} = \frac{220.5811}{\sqrt{(220)^2 + V_c^2}}$$

$$\sqrt{(220)^2 + V_c^2} = \frac{220.581}{0.813}$$

$$48400 + V_c^2 = (271.3148)^2 \Rightarrow V_c = \sqrt{(271.3148)^2 - 48400}$$

$\therefore V_c = 158.78$ V

$\therefore$ The signal of control $= \frac{158.78}{16} = 9.9$ V