

5b)

Per unit regulation

$$= I_1 (R_e \cos \theta_2 + X_e \sin \theta_2)$$

θ_2 = phase angle of Secondary current

R_e = equivalent resistor referred to primary

X_e = " reactance " " "

$$R_e = R_1 + R_2 \left(\frac{V_1}{V_2} \right)^2$$

$$R_1 = 10 \text{ m}\Omega \quad V_1 = 415 \text{ V} \quad V_2 = 11 \text{ kV}$$

$$P_f = 1 \quad \theta_2 = 0$$

$$I_1 = \frac{200 \times 10^3}{415} = 481.928 \text{ to } 3 \text{ d.p.}$$

S_o

$$0.02 = \frac{481.928 (R_e \times 1 + X_e \times 0)}{415}$$

5b)

$$0.02 = \frac{481.928 R_e}{415}$$

$$415 \times 0.02 = 8.3$$

$$\frac{8.3}{481.928} = R_e$$

$$R_e = 0.0172 \quad \text{to} \quad 4 \text{ d.p.}$$

$$R_e = 0.01 + R_z \left(\frac{415}{11600} \right)^2$$

$$R_e = 0.01 + R_z (1.423 \times 10^{-3}) \quad \text{to} \quad 3 \text{ d.p.}$$

$$7.2 \times 10^{-3} = R_z (1.423 \times 10^{-3})$$

$$R_z = 5.0598 \quad \text{to} \quad 4 \text{ d.p.}$$