Que no - 5) (a) $V_{ph} = 6351 V$ --- (1m)

$Z_s = 30 \Omega$ ----- (1m)

$\theta = 88.1°$ ------ (1 m)

$\phi = 36.9°$

$E_R = I_a Z_s = 1800 V$ ---- (1 m)

$E_b = 7529 V$ ---- (1m)

E_b (line) = 13040 V --- (1 m)

(b) 'V' curve - 2M

'Λ' curve - 2M

Que no - 6) (a) operation at constant load & variable excitation → 5 M

(b) any 5 points of comparison - 4M (1×5 = 5M)

~~(c) [illegible]~~

Scheme of marking & soln to numericals

TE/Insem. - 123

Que No-1) (a) Advantages of rotating field over rotating armature

(Any 4 advantages — 4 m) (1×4 = 4 M)

(b)

$$\alpha = 2\beta$$

$$= 2 \times \frac{180}{27}$$

$$\alpha = 13.3^\circ \quad \text{---------- (1m)}$$

$$K_c = \cos \alpha/2 = 0.9932 \quad \text{--- (1m)}$$

$$K_d = \frac{\sin m\beta/2}{m \cdot \sin \beta/2} = 0.955 \quad \text{--- (1m)}$$

$$T_{ph} = \frac{54 \times 4}{3 \times 2} = 36 \quad \text{---- (1m)}$$

$$\phi = \frac{E_{ph}}{4.44 \times K_c \times K_d \times f \times T_{ph}}$$

$$\therefore \phi = 0.457 \text{ wb} \quad \text{------ (2m)}$$

Que No-2) (a) Armature reaction def^n — (1m)

effect of arm reaction at ZPF lag — (3 M)

(waveform + vecte digram + expl.)

(b)

$$I_a = \frac{3 \times 1000}{\sqrt{3} \times 415} = 4.17 \text{ Amp} \quad \text{----- (1m)}$$

$$X_d = \frac{V_{max}/\sqrt{3}}{I_{min}} = 31.97 \, \Omega \quad \text{------ (1m)}$$

$$X_q = \frac{V_{min}/\sqrt{3}}{I_{max}} = 20.94 \, \Omega \quad \text{------ (1m)}$$

$$\tan \psi = \frac{V \sin\phi + I_a X_q}{V \cos\phi + I_a R_a} = 1.08$$

$$\therefore \psi = 47.39 \quad \text{---------- (1m)}$$

$$I_d = I_a \sin\psi = 4.17 \times \sin 47.39 = 3.069 \text{ Amp}$$

$$\delta = \psi + \phi = 84.25$$

$E_0 = V\cos\delta + I_a R_a \cos\psi + I_d X_d$

$E_0 = 136.23$ volts ——————— (1m)

$\therefore \%\ reg = \frac{E_b - V}{V} \times 100$

$= \frac{136.23 - 239.6}{239.6} \times 100$

$= -43.14\%$ ——————— (1m)

Que No-3) (a) $I_a = \frac{100 \times 10^3}{\sqrt{3} \times 3000} = 19.2$ Amp ——— (1m)

$Z_s = \frac{(1040/\sqrt{3})}{200} = 3\ \Omega$ ——— (1m)

$X_s = 2.99\ \Omega$ ——————— (1m)

$E_{0(ph)} = \sqrt{(V\cos\phi + I_a R_a)^2 + (V\sin\phi + I_a X_s)^2}$

$E_0 = 1768$ V ——————— (2m)

$\%$ volt reg $= \frac{E_b - V}{V} \times 100$

$= 2.2\%$ ——————— (1m)

(b) Dark lamp method diagram – 2M
expl – 2M

Que No-4) (a) Derivation of $P_{sy} = \frac{\alpha E^2}{2X_s}$ ——— (6M)

(b) SCR depth ——— 1m
Significance ——— 3m
(any 3 points)