ASSIGNMENT

Thursday

Week 39

30

0, three phase, 4 pole, 60 Hz, wye-
ous generator has a synchronous reactance
negligible stator reactance. The generator
nite bus (a) constant voltage magnitude and
of 415 V and 60 Hz

excitation voltage, E_a when the machine is deliv-
0.8 pf lagging

$E_a = V_t - jI_2 X_3$

$\frac{415}{\sqrt{3}} = 239.6V$

b) PF = 0.8 lagging $\therefore \theta = \cos^{-1}(0.8) = 143.13^\circ$

$= \frac{25000}{415\sqrt{3}} = 34.78A \angle 143.13^\circ$

$E_a = 239.6 - j(34.78 \angle 143.13^\circ)(1.5)$

$270.90 + j41.74$

$274.098V \angle 8.76^\circ$

eld excitation current I_f is increased by 20% without changing
power input from the prime mover. find the stator current
wer factor and reactive power Q applied by the machines
tion

20% increase $= 1 + 0.2 = 1.2$

$\delta = 8.76^\circ$

$E_2' = 1.2 \times 279.098 = 328.92V$

$\therefore \frac{V_t E_a \sin\delta}{X_s} = \frac{V_t E_2' \sin\delta'}{X_s} \therefore \sin\delta' = \frac{E_a}{E_a'} \sin\delta \rightarrow \frac{279.098}{328.92V} =$

@ $\sin 8.76^\circ$

$\sin\delta' = 0.1269 \therefore \delta = \sin^{-1}(0.1269)$

$\delta' = 7.29^\circ$

$I_A' = \frac{E_2' - V_t}{jX_s} = \frac{328.92 \angle 7.29^\circ - 239.6 \angle 0^\circ}{j1.5} = 27.82 - j57.77$

SEPTEMBER

M	T	W	T	F	S	S
30						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

21 Friday

Week 39

$I_{a1} = 64.13A \angle -64.28°$.

ii) Power factor = $\cos(-64.28°) = 0.434$ (lagging)

iii) $Q = 3V_t I_a \sin\theta = 3 \times 239.6 \times 64.13 \times \sin(64.28) = 415$ VA

c) With the field excitation current Ie as in part (a), the input power from the prime mover is increased very slowly. What is the steady state limit. Determine the Stator current I_a, power factor and reactive power Q

At max power $\delta = 90°$.

$P_{max} = 3E_a V_t = 3 \times 274.098 \times 239.6 = 131347.7$
1.5
$= 131.347$ KW

$I_{max} = \frac{E_a - V_t}{jX_s} = \frac{277.098 \angle 90° - 239.660}{1.5j} = 292.71$A

Power factor = $\cos(41.16°) = 0.7529$ leading.

$Q_{max} = 3V_t I_{a\,max} \sin(41.16°)$

$= 3 \times 239.6 \times 242.71 \times 0.6582 =$

114829.54 VAR $= 114.824$ KVAR.