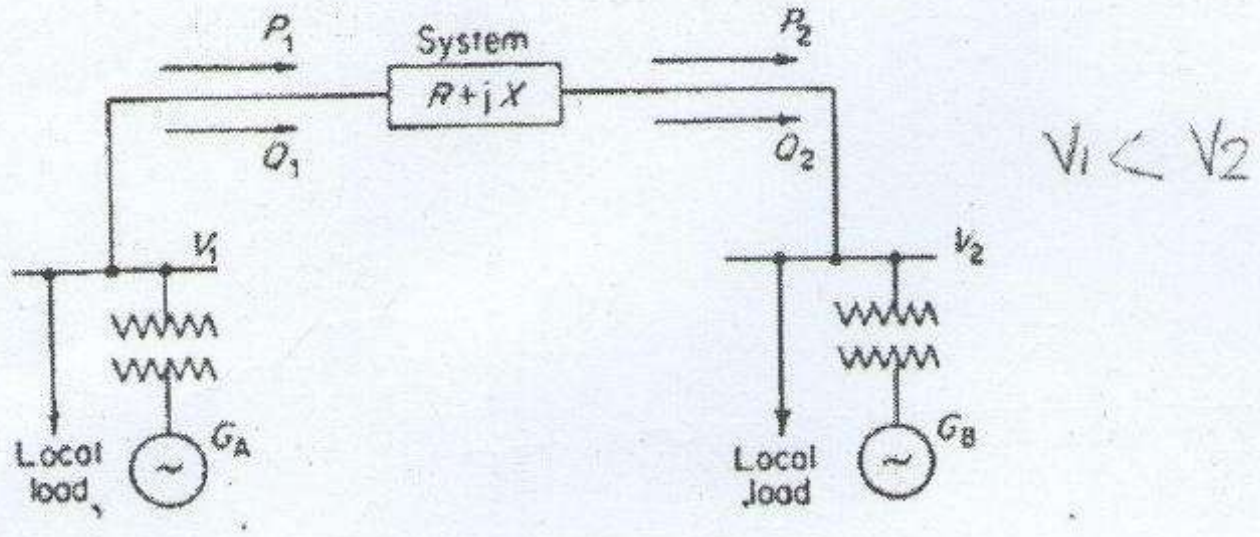
Unit	UEPOPS456A Perform switching to a switching program	Test Number	2/2
Total Marks	50	Time allowed	2 HR

Instruction to assessors
• Please provide the blank A4 sheets to students to write the answers on them • Please tell the students not to write on the question papers • Online test can also be supplemented. • The marking can be done by referring the attached marking guide • Giving the marks based on students' effort & demonstration of the absorbed study & competency rather than the final answer is to made • The necessary formulas can be provided on the white board. • The formula which can be provided will be advised separately. • No notes, digital storage devices, programmable calculators are allowed. • Page 1 = Instruction to assessors & students • Page 2+(3)= Question Paper • Page (3)+4 and the remaining pages= Marking Guide
Instruction to students
• Write the answers on provided A4 blank sheets • Do write the answers on the question papers • Online test can also be supplemented. • The marking can be done by referring the attached marking guide • The necessary formulas can be provided on the white board on request.. • The formula which can be provided will be advised separately. • No notes, digital storage devices, programmable calculators are allowed.

Unit		Test Number	2/2
Total Marks	50	Time allowed	2 HR

30 Marks

1.Find the real power supplied by Generator A and Generator B

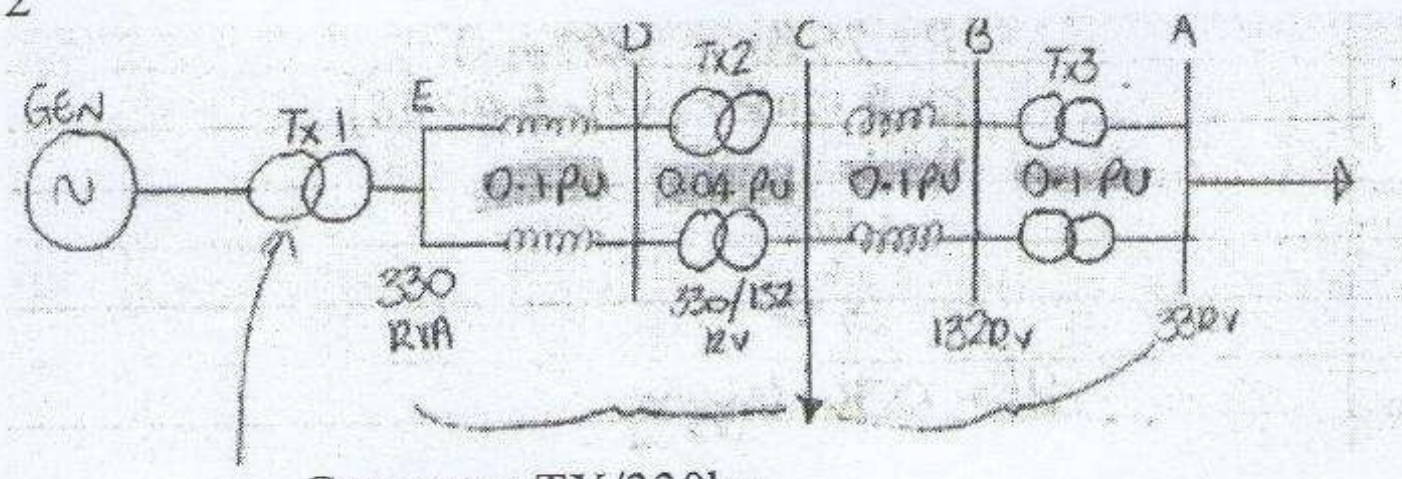


$V_1 < V_2$

GA- Generator A 200MW 6% Drop
GB- Generator B 400MW 7% Drop

(9 marks)

2



Load
60MW
Unity
PF

Generator TX/330kv

Load 300MW 0.9PF Lagging Base 100MVA

In above diagram, what total MW and MVAR must the generator supply and at what power factor? (9 marks)

3.Sketch power angle curve of synchronous machine.

(4 marks)

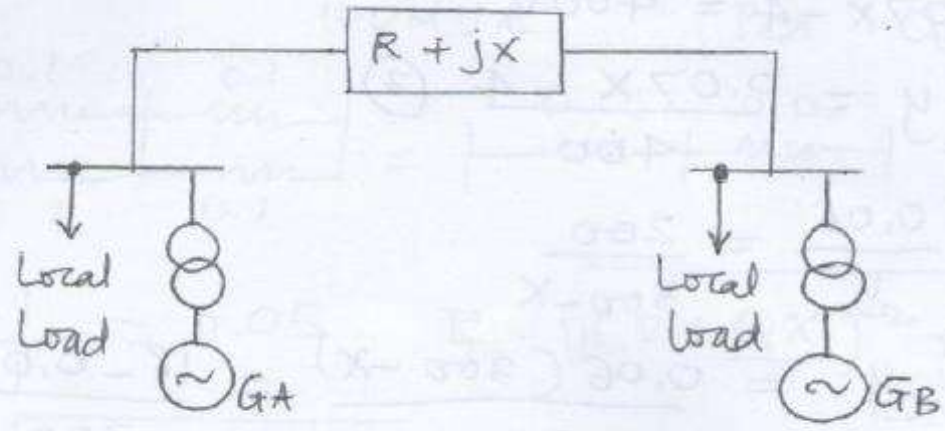
4. Explain how reactive power is controlled by using Static Var Compensation system (4 marks)

5.How will you connect reactive power control capacitor bank to 3 phase power supply system? (4 marks)

Unit		Test Number	

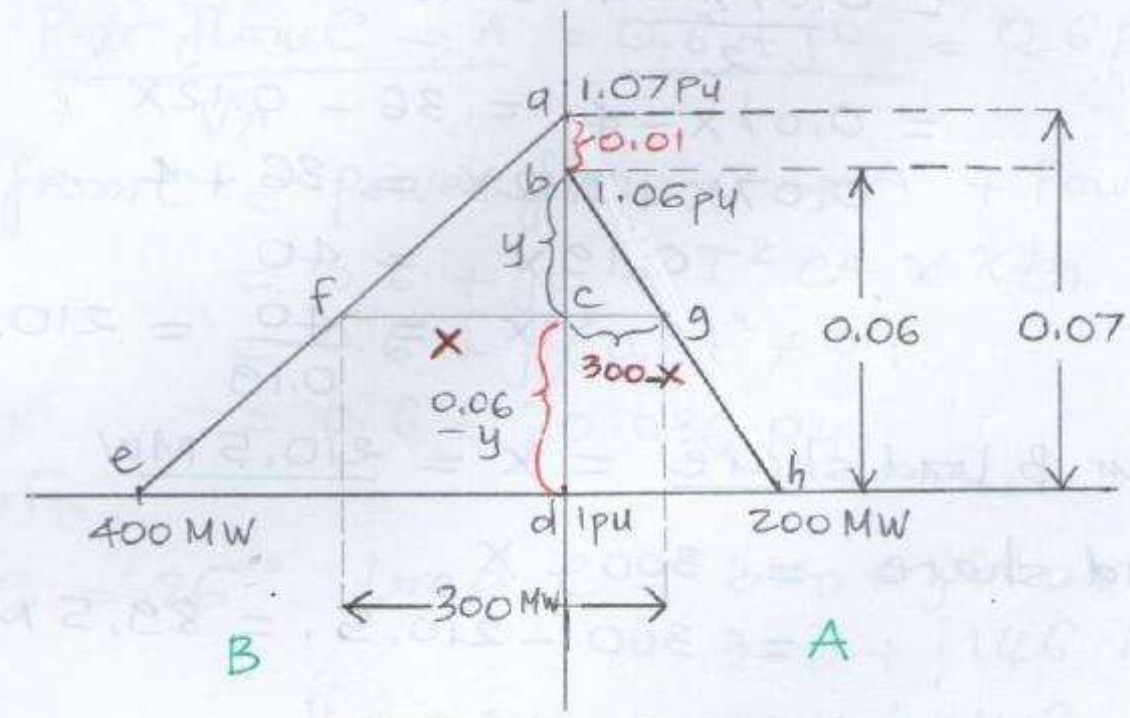
Total Marks		Time allowed	

Answer	Marks
KHANH NGUYEN POWER SYSTEM OPERATION Test 2 29/30 ① Find the real power supplied by Gen. A & Gen. B	10



* Generator A - 200 MW 6% Drop
* Generator B - 400 MW 7% Drop

Both machines are supplying 300 MW load



B load share = X

A load share = 300 - X

• Δaed & Δafc are similar

$$\frac{ad}{ac} = \frac{ed}{fc} \rightarrow \frac{0.07}{0.01+y} = \frac{400}{X} \quad (1)$$

• Δbdh & Δbcg are similar

$$\frac{bd}{bc} = \frac{dh}{cg} \rightarrow \frac{0.06}{y} = \frac{200}{300-X} \quad (2)$$

Unit		Test Number	
Total Marks		Time allowed	

Answer	Marks

a) From (1) $\rightarrow \frac{0.07}{0.01+y} = \frac{400}{x}$

$0.07x = 400(0.01+y)$

$0.07x = 4 + 400y$

$0.07x - 4 = 400y$

Hence $y = \frac{0.07x - 4}{400}$ (3)

b) From (2) $\rightarrow \frac{0.06}{y} = \frac{200}{300-x}$

$\therefore y = \frac{0.06(300-x)}{200} = \frac{18 - 0.06x}{200}$ (4)

c) (3) = (4):

$y = \frac{(0.07x)-4}{400} = \frac{18-0.06x}{200}$

$\frac{0.07x-4}{2} = 18 - 0.06x$

$0.07x - 4 = 36 - 0.12x$

$0.07x + 0.12x = 36 + 4$

$0.19x = 40$

$x = \frac{40}{0.19} = 210.5\,MW$

Then B load share $= x =$ 210.5 MW

d) A load share $= 300 - x$

$= 300 - 210.5 = 89.5\,MW$

A load share $= 89.5\,MW$

Unit		Test Number	
Total Marks		Time allowed	

Answer	Marks

CHANH NGUYEN

base VA = 100 MVA VA = 1pu

load A = 60 + j0 MVA

load A (pu) = $\frac{60 + j0 \text{ MVA}}{100 \text{ MVA}} = 0.6 + j0$

PCA QCA

X_{CA} = 0.1 and 0.1 in parallel = 0.05 and 0.05 in series = 0.1 X_{CA}

$= 0.1$ pu

$\frac{0.1 \times 0.1}{0.1 + 0.1} = 0.05$ $E = \sqrt{\left(V + \frac{QX}{V}\right)^2 + \left(\frac{PX}{V}\right)^2}$

$V_C = \sqrt{\left(1 + \frac{0. \times 0.1}{1}\right)^2 + \left(\frac{0.6 \times 0.1}{1}\right)^2}$

$= \sqrt{1^2 + 0.06^2}$

$V_C = 1.002$ pu

$I_{CA} = \frac{\text{Power flow } C \to A}{VA} = \frac{0.6 + j0}{1} = 0.6$ pu

Power from C = Power flow C → A + Power loss

$= 0.6 + j0 + I^2_{CA} \times X_{CA}$

$= 0.6 + j(0.6)^2 + 0.1$

$= 0.6 + j0.036$ pu

0.9 pF

Cos 0.9 = 26° load C = 300 + j300 x tan 26

= 300 + j146 MVA

load C/VA = $\frac{300 + j1.46}{100} = 3 + j1.46$

$PEC + jQEC = 3 + j1.46 + 0.6 + j0.036$

$= 3.6 + j1.496$ pu

X_{EC} = 0.1 and 0.04 in parallel = 0.05 and 0.02 in series = 0.07 X_{EC}

$= 0.07$ pu

$V_E = \sqrt{\left(V_C + \frac{QEC + VEC}{VS}\right) + \left(\frac{PEC \times XEC}{VC}\right)^2}$

Unit		Test Number		
Total Marks		Time allowed		

Answer	Marks

$$= \sqrt{1.002 + \left(\frac{1.496 \times 0.07}{1.002}\right)^2 + \left(\frac{3.6 \times 0.07}{1.002}\right)^2}$$

$$= 1.135 \text{ pu}$$

I_{EC} = Power from $\frac{E \rightarrow A}{V_C}$ $= \frac{3.6 + j1.496}{1.002}$

$$= \sqrt{\frac{3.6^2 + 1.496^2}{1.002}}$$

$$= 3.89 \text{ pu}$$

Power from E = Power from $E \rightarrow A$ + Power loss

$= 3.6 + j1.496 + jI_{EC} \times X_{EC}$

$= 3.6 + j1.496 + j(3.89)^2 \times 0.07$

$= 3.6 + j1.496 + j1.06$

$= 3.6 + 2.556$

Power $= \sqrt{3.6^2 + 2.556^2}$

$= 4.41 \angle 35.37° \text{ pu}$

Power supplied by generator = pu × 100 MVA

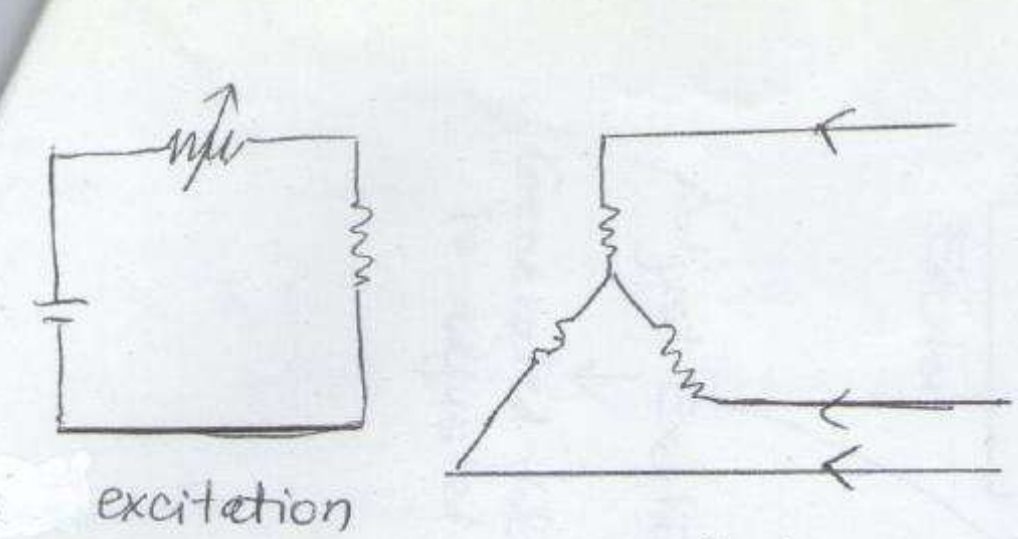
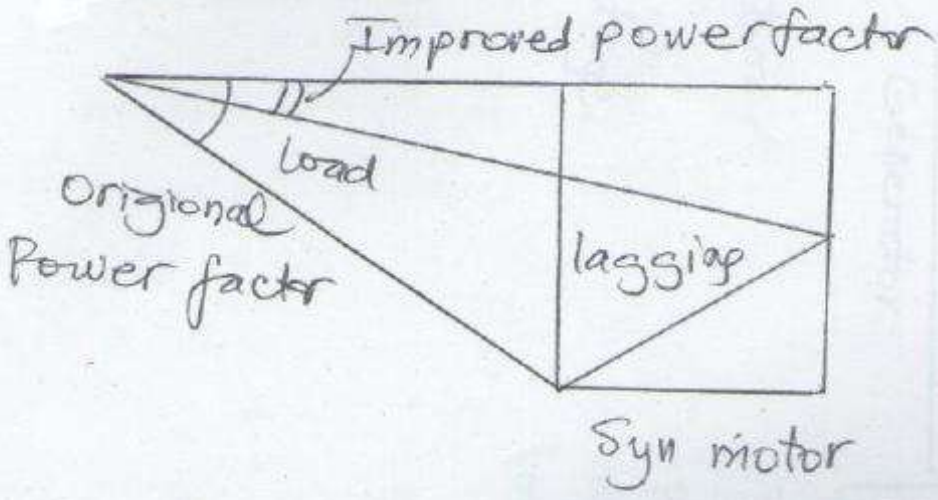
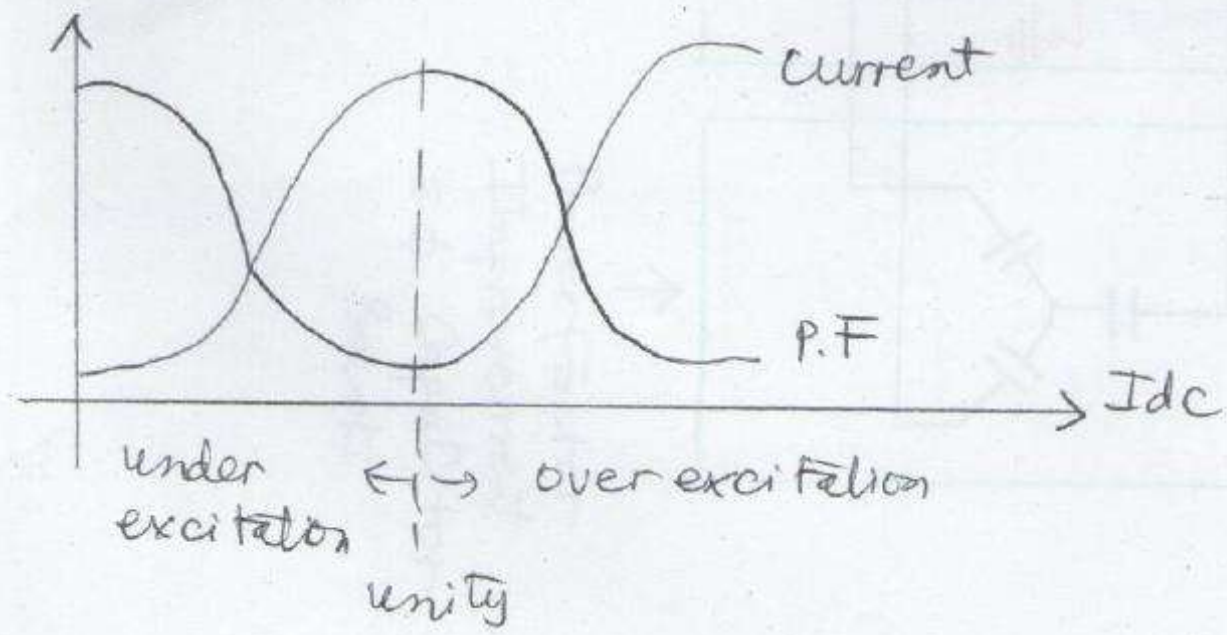
$= 4.41 \times 100 \text{ MVA}$

$= 4.41 \text{ MVA}$

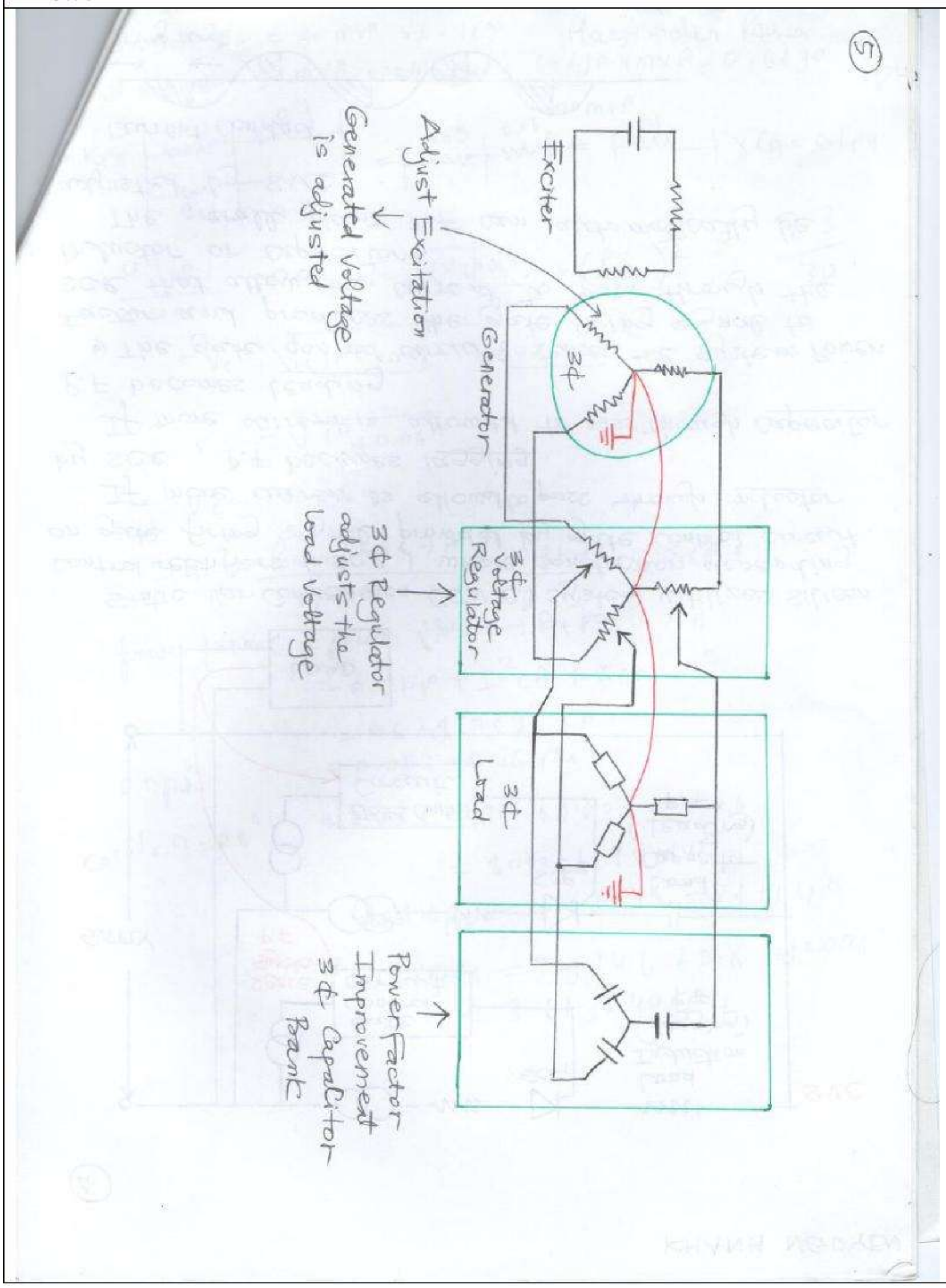
$\cos 35.37° = 0.815$

PF = 0.815 lagging PF

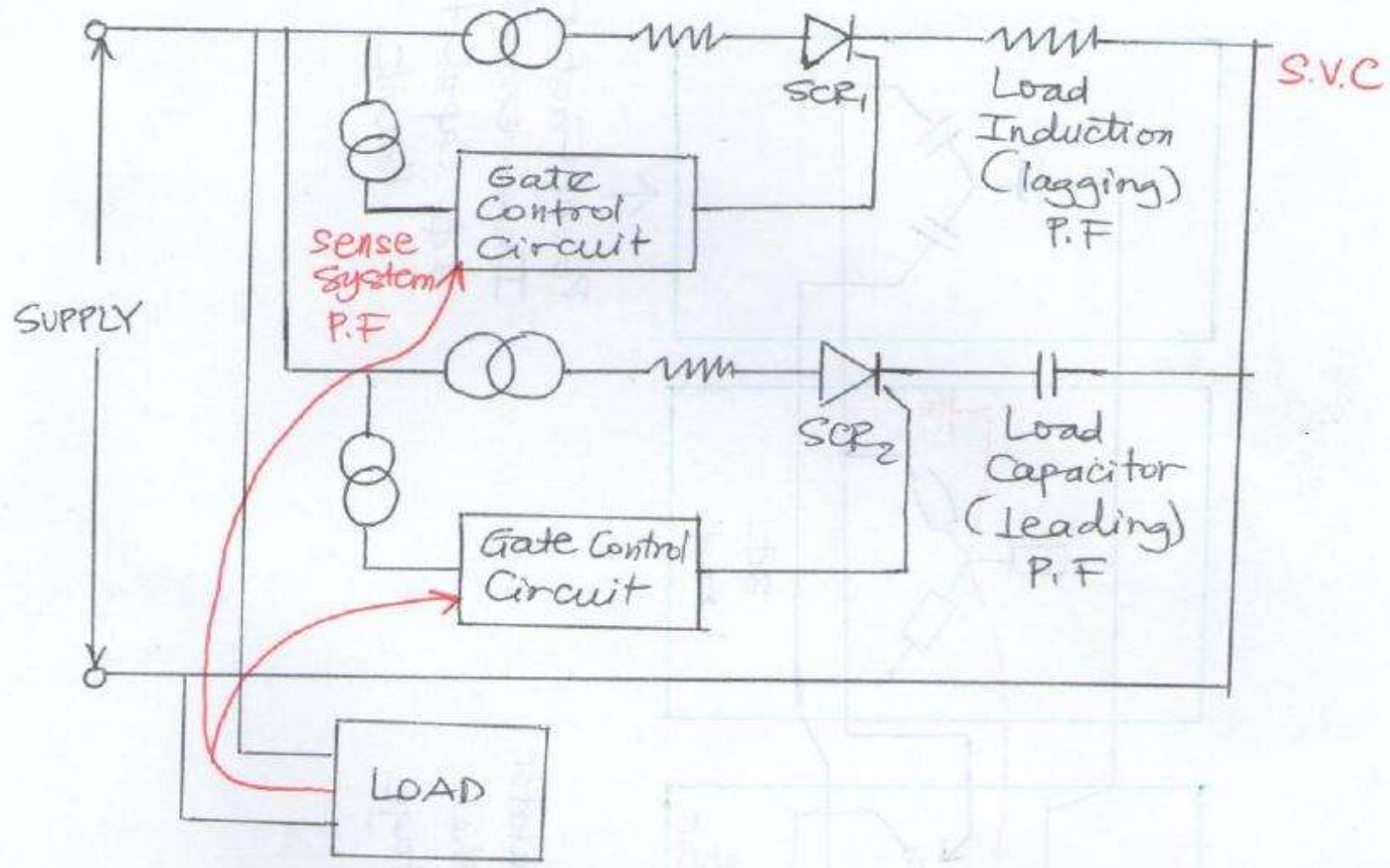
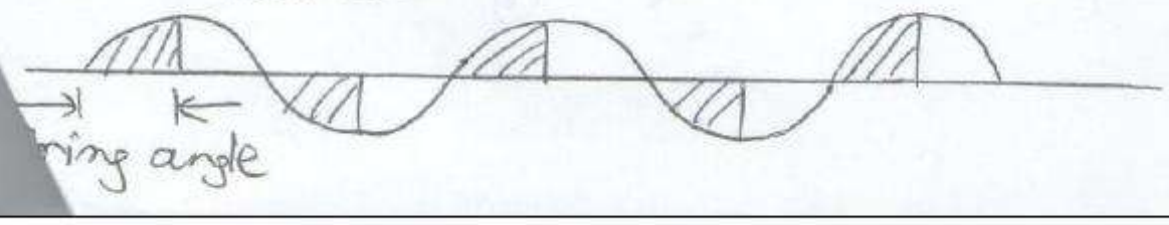
Unit		Test Number	
Total Marks		Time allowed	

Answer	Marks
KHANH NGUYEN   Synchronous machine power factor is adjustable. Depending on field excitation current, it can be lagging or leading or unity. The synchronous motor is connected to busbar terminal of the substation. By adjusting its powerfactor by field excitation. The power of over all plant can be adjusted.  	10

Unit		Test Number	
Total Marks		Time allowed	

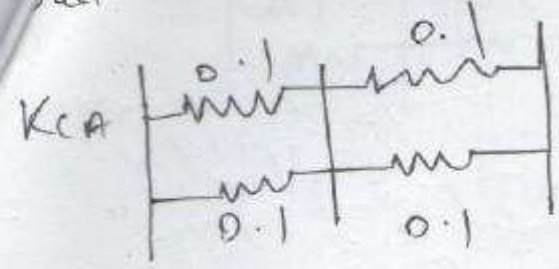
Answer	Marks
	10

Unit		Test Number	
Total Marks		Time allowed	

Answer	Marks
KHANH NGUYEN (4)  Static Var Compension (S.V.C) system utilizes Silicon control rectifiers (SCR) whose conduction depending on gate firing signal provided by gate control circuit. If more current is allowed to pass through inductor by SCR, P.F becomes lagging. If more current is allowed to pass through capacitor P.F becomes leading • The gate control circuits senses the system Power Factor and produces the gate firing signal to SCR that allow the current to pass through the inductor or capacitor. The overall plant P.F can automatically be adjusted by SVC. Current Conduct 	10

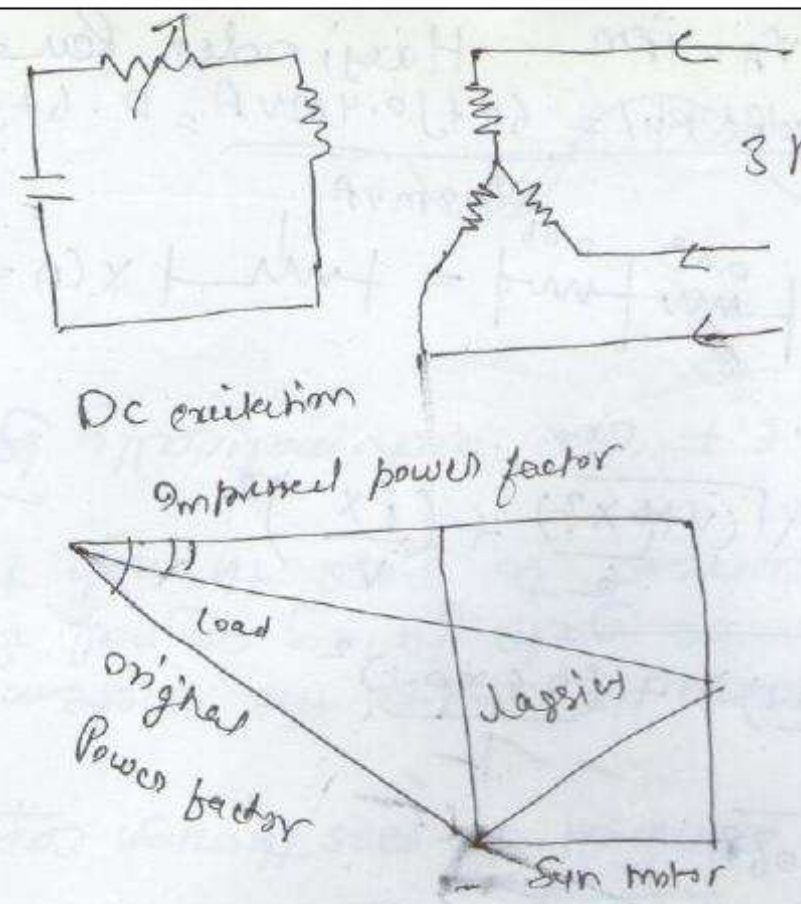
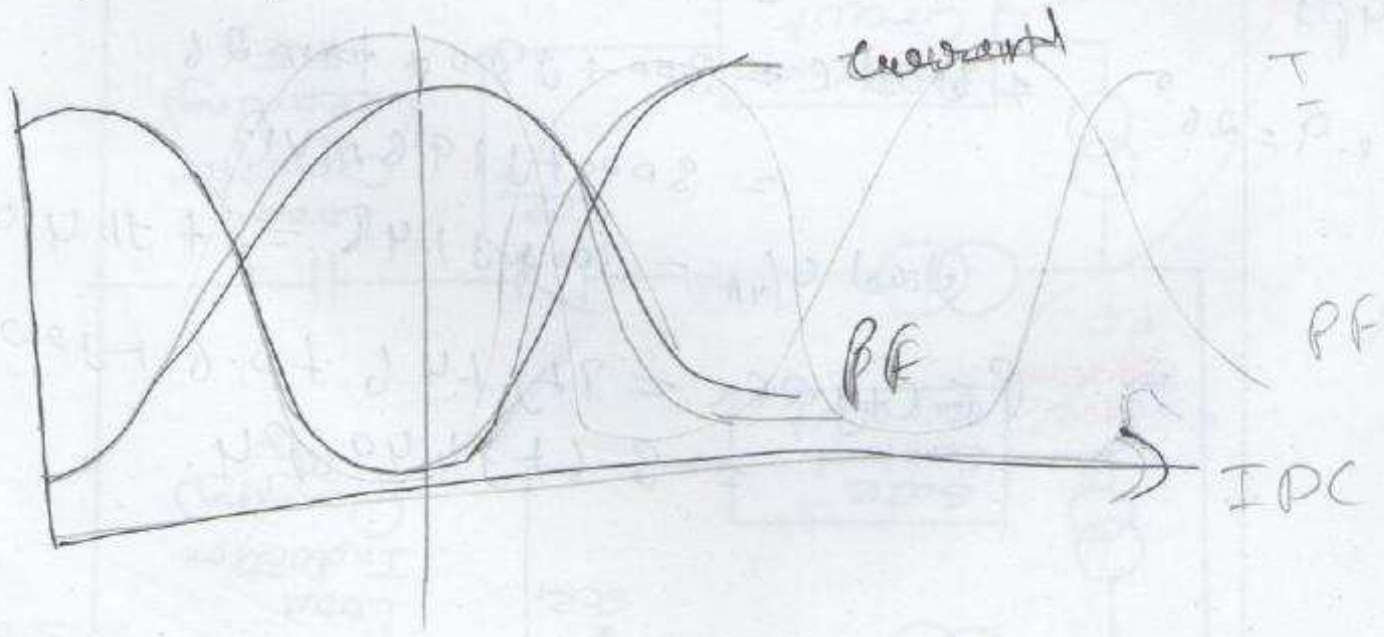
Unit		Test Number	

Total Marks		Time allowed	

Answer	Marks
Haejinder Rana Base $V_A = 100\ MVA$ $V_A = 1PM$ load A $= 60 + j0.4\ MVA$ (load A PU) $= \frac{60 + j0.4\ MVA}{100\ MVA} = 0.6 + j0$ PU K_{CA}  $= \frac{0.05 \quad 0.05}{} = 0.1$ PU $\times C_A = 0.1$ PU $\frac{0.1 \times 0.1}{0.1 + 0.1} = 0.05$ $E = \sqrt{(V + \frac{PX^2}{2}) + (\frac{PX}{V})^2}$ $\frac{23}{30}$ $= V_C = \sqrt{\frac{(1 + 0 \times 0.1)^2}{1} + \frac{(0.6 \times 0.1)^2}{1}}$ $= \sqrt{1^2 + 0.06^2}$ $V_L = 1.002$ PU $I_{CA} = \frac{\text{Power flow } C \to A}{V_A} = \frac{0.6 + j0}{1} = 0.6$ PU power from C = power flow $C \to A$ + power loss $= 0.6 + j0 + I^2_{CA} \times X_{CA}$ $= 0.6 + j(0.6)^2 \times 0.1$ $= 0.06 + j0.036$ PU 0.9pf $\cos^{-1} 0.9 = 26°$ load C = 300 + j300 + form 26 $= 3000 + j196$ MVA load C/VA $= 300 + j1.46 = 3 + j1.4°$ PEC + jQEC $= 3 + j1.46 + 0.6 + j0.036$ $= 3.6 + j1.496$ PU.	10

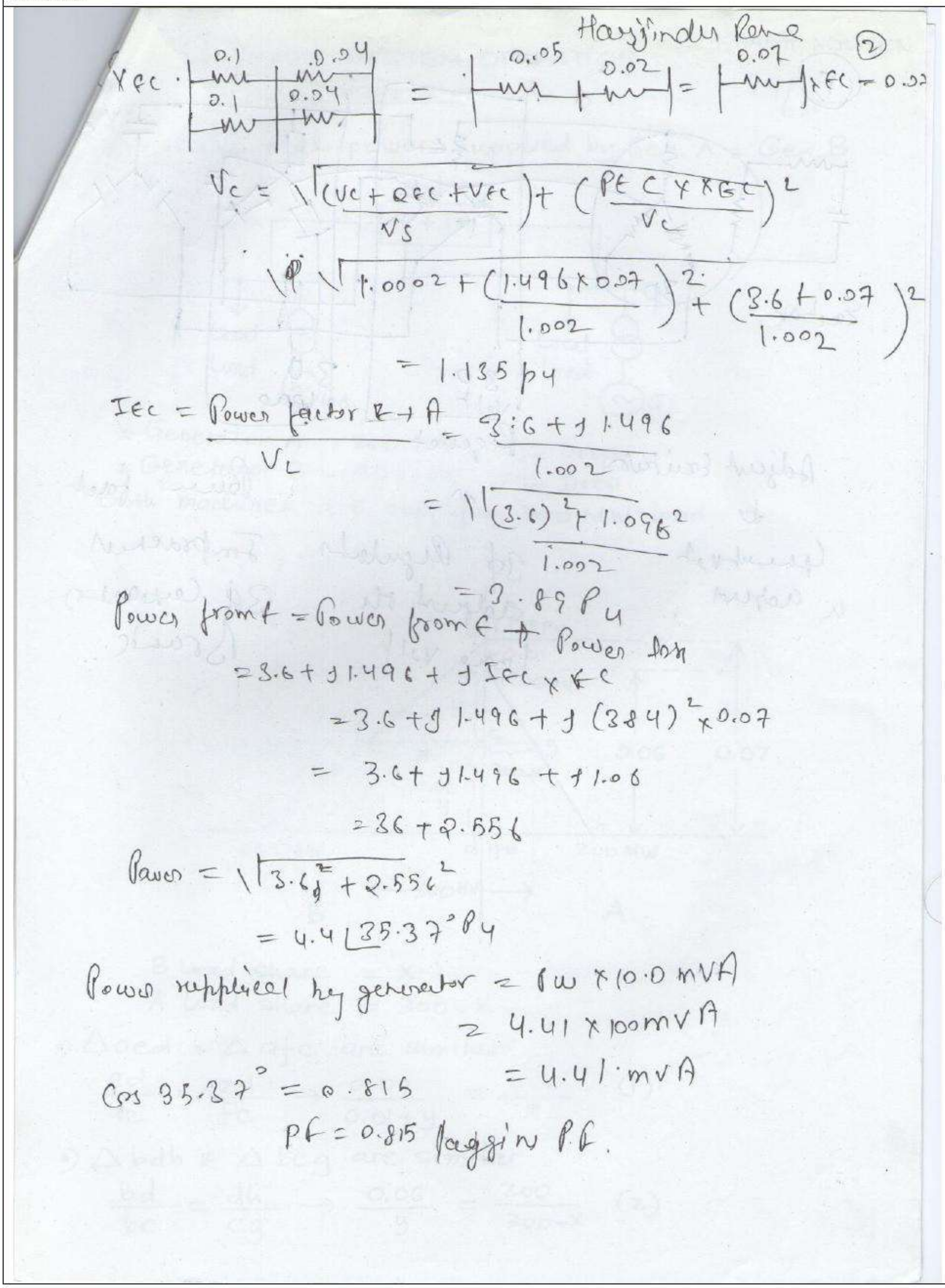
Unit		Test Number	

Total Marks		Time allowed	

Answer	Marks
③ →  • Synchronous machine power factor is adjustable depending on field excitation current it can be lagging or leading or unity. The Synchronous motor is connected to ~~busbar~~ busbar terminal of the substation By adjusting its power factor by field excitation The power of over all plant can be adjusted. 	10

Unit		Test Number	

Total Marks		Time allowed	

Answer	Marks
	10

Harjfinder Rana

Y_{EC} : 0.1, 0.04, 0.1, 0.04 = 0.05, 0.02 = 0.07 = $Y_{EC} = 0.02$ (2)

$$V_C = \sqrt{\left(\frac{V_C + Q_{EC} \cdot V_{EC}}{V_S}\right) + \left(\frac{P_{EC} Y X_{EC}}{V_C}\right)^2}$$

$$\text{pi} \sqrt{1.0002 + \left(\frac{1.496 \times 0.07}{1.002}\right)^2 + \left(\frac{3.6 + 0.07}{1.002}\right)^2}$$

$$= 1.135 \text{ pu}$$

$$I_{EC} = \frac{\text{Power factor } E \to A}{V_L} = \frac{3.6 + j\,1.496}{1.002}$$

$$= \sqrt{\frac{(3.6)^2 + 1.096^2}{1.002}}$$

$$= 3.89 \text{ pu}$$

Power from t = Power from ϵ + Power from

$= 3.6 + j\,1.496 + j\,I_{EC} \times X_{EC}$

$= 3.6 + j\,1.496 + j\,(3.84)^2 \times 0.07$

$= 3.6 + j\,1.496 + j\,1.06$

$= 36 + 2.556$

Power $= \sqrt{3.6^2 + 2.556^2}$

$= 4.4 \angle 35.37^\circ$ pu

Power supplied by generator = pu × 10.0 mVA

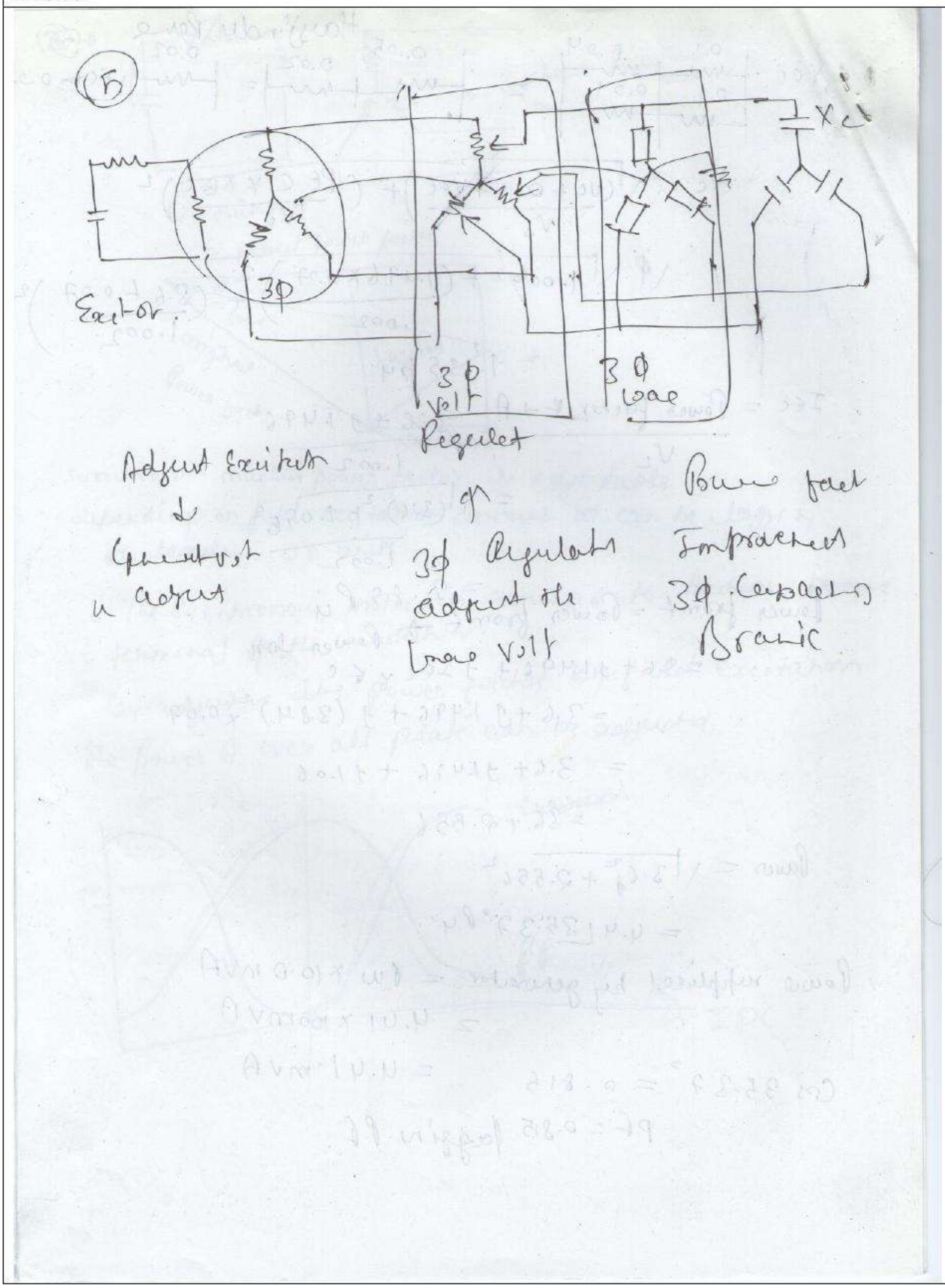
= 4.41 × 100 mVA

$\cos 35.37^\circ = 0.815$ = 4.41 mVA

pf = 0.815 lagging P.F.

Unit		Test Number	

Total Marks		Time allowed	

Answer	Marks
	10