S J P N Trust's

HirasugarInstitute ofTechnology, Nidasoshi.

Inculcating Values, Promoting Prosperity

Approved by AICTE, Recognized by Govt. of Karnataka and Affiliated to VTU Belagavi.

EEE Dept.
Exam.
Internal Assessment
Even Sem(2017-18)

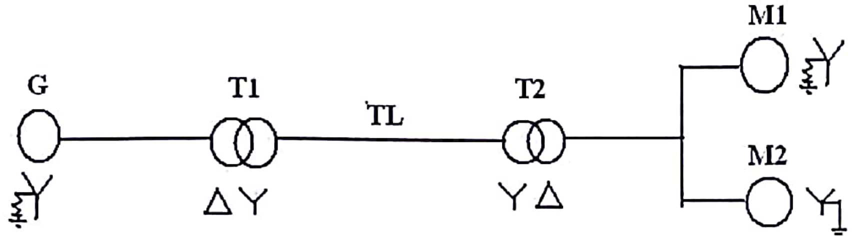
FIRST INTERNAL ASSESSMENT

Sem :VI **Sub: Power System Analysis-1** **Sub. Code: 15EE62**

Date:05/03/2018 **Time:03:00PM-04.00PM** **Max. Marks: 25**

Note: Answer two full questions, draw sketches wherever necessary.

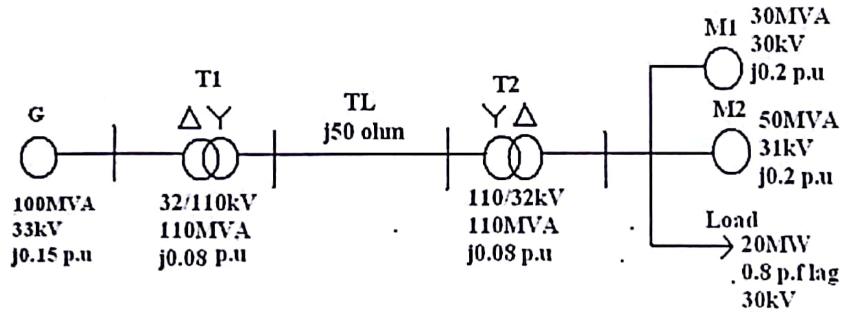
Q. No		Discription of Question	M	CO	RBT LEVEL
1	a	A 300 MVA, 20kV, 3-phase generator has a reactance of 20%. The generator supplies two motors M1 and M2 over a transmission line of 64km as shown in one line diagram shown below.The rating of the components are as follows,**T1**: 350 MVA, 230kV-Y/20 kV-Δ, X=10%, **TL**: L=64km, X=j0.5 ohm/km , **T2**: Componsed of three single phase transformers each rated 127kV/13.2kV, 100MVA with leakage reactance of 10%, **M1**: 200MVA, 13.2kV, X"=j0.2 p.u **M2**: 100 MVA, 13.2kV, X'=j0.2 p.u Draw the p.u reactance diagram, taking generator ratings as base.	8	CO316. 1	L4



Q. No		Discription of Question	M	CO	RBT LEVEL
	b	List the advantages of Per Unit computations?	5	CO316. 1	L4

OR

Q. No		Discription of Question	M	CO	RBT LEVEL
2	a	A 100 MVA, 33kV, three phase generator has a subtransient reactance of 15%. The generator is connected to the motors through a transmission line and transformers as shown in figure below. The motors have rated inputs of 30 MVA and 50 MVA at 30 kV and 31 kV respectively each with 20% subtransient reactance. The three phase transformers are rated at 110 MVA, 32kV Δ/ 110kV Y with leakage reactance 8%. The line has reactance of 50 ohm. The three phase load absorbs 20MW, 0.8 power factor lagging at 30kV. Select Base MVA as 100 and 33kV in the generator circuit, obtain the p.u impedance diagram.	8	CO316. 1	L4



Q. No		Discription of Question	M	CO	RBT LEVEL
	b	Show that per unit impedance of two winding transformer will remain same referred to primary as well as secondary.	5	CO316. 1	L4
3	a	Explain symmetrical system, balanced system, impedance diagram, reactance diagram.	6	CO316. 1	L4
	b	Explain the single line diagram and per unit system with examples.	6	CO316. 1	L4

OR

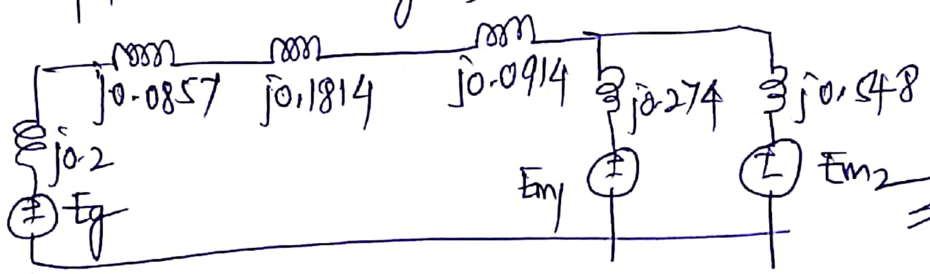
Q. No		Discription of Question	M	CO	RBT LEVEL
4	a	Explain change of base concept and derive the formula for new per unit reactance.	6	CO316. 1	L4
	b	Write the importance and advantages of three winding transformer.	6	CO316. 1	L4

Course Coordinator **Module Coordinator** **HOD**

IA - I

SCHEME OF EVALUATION

Sem : 6 | Subject : PSA-I | Sub Code : 15EE62 | Date : 5/3/18

Q. No.	Bit	Description	Marks	CO's
1	a	$(MVA)_{B,new} = 300$, $(KV)_{Bnew}$ Gen region $= 20$ KV	1M	
		TL region $(KV)_{B\,new} = 230/20 \times 20 = 230$	1M	
		Motor region $(KV)_{B\,new} = 13.2/220 \times 230 = 13.8$		
		G : $X_{pu\,new} = j0.2$ (generator ratings as base)		
		T_1 : $X_{pu\,new} = j0.1 \times 300/350 \times 20^2/20^2 = j0.0857$	4M	
		T_2 : $X_{pu\,new} = j0.1 \times 300/300 \times 220^2/230^2 = j0.0914$		
		TL : $X_{pu\,new} = j(0.5 \times 64) \times 300/230^2 = j0.1814$		
		M_1 : $X_{pu\,new} = j0.2 \times 300/200 \times 13.2^2/13.8^2 = j0.274$		
		M_2 : $X_{pu\,new} = j0.2 \times 300/100 \times 13.2^2/13.8^2 = j0.548$		
		New pu reactance diagram 	2M	
			8M	
1	b	list advantages of PU computations at least 5	1 each 1×5=5	
OR				
2	a	$(MVA)_{Bnew} = 100$		
		Gen region : $(KV)_{Bnew} = 33$	2M	
		Tr line region : $(KV)_{Bnew} = 33 \times 110/32 = 113.43$		
		Motor/load region : $(KV)_{Bnew} = 113.43 \times 32/110 = 33$		
		Calculations $X_{pu\,new}$		
		G : $X_{pu\,new} = j0.15$ (∵ gen ratings as base		

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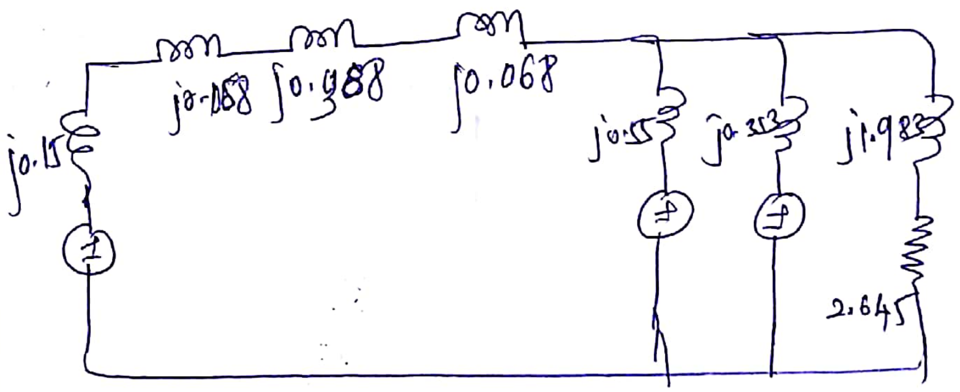
SCHEME OF EVALUATION

Sem: 6 | Subject: PSA-I | Sub Code: 15EE62 | Date: 5/3/18

Q. No.	Bit	Description	Marks	CO's
		T_1 : $X_{pu\,new} = j0.08 \times 100/110 \times 32^2/33^2 = j0.068$		
		T_2 : $X_{pu\,new} = j0.08 \times 100/110 \times 32^2/33^2 = j0.068$		
		TL : $X_{pu\,new} = j50 \times 100/113.43^2 = j0.388$		
		M_1 : $X_{pu\,new} = j0.2 \times 100/30 \times 30^2/33^2 = j0.55$		
		M_2 : $X_{pu\,new} = j0.2 \times 100/50 \times 31^2/33^2 = j0.353$		
		load $Z_{pu} = \frac{Z_{L\,actual}}{Z_{L\,base}} = \frac{30^2/(20/0.8)\angle\cos^{-1}0.8}{33^2/100}$		
		$= \frac{30^2/25\angle-36.86}{33^2/100} = \frac{28.8+j21.6}{10.89}$	4M	
		$Z_{pu} = 2.645 + j1.983$		
		pu impedance diagram		
			2M	
2	b	To show $Z_{eq1\,pu} = Z_{eq2\,pu}$ of Transformer	8M / 5M	

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Exam
IA Scheme
2017-18 Even Sem

SCHEME OF EVALUATION

Sem : 6th | Subject : PSA-I | Sub Code : 15EE62 | Date : 5/3/18

Q. No.	Bit	Description	Marks	CO's
3	a	Explain Brief symmetrical system, Balanced system	3M	
		& Impedance diagram, Reactance diagram	3M	
			6M	
3	b	Explain single line diagram with example	3M	
		PU system with example	3M	
			6M	
OR				
4	a	To obtain change base formula/concept $X_{pu\,new} = X_{pu\,old} \times \frac{(MVA)_{B\,new}}{(MVA)_{B\,old}} \times \frac{(KV)^2_{B\,old}}{(KV)^2_{B\,new}}$	6M	
4	b.	importance and advantages of 3 winding T/fs at least 6 → 1 each	1X6	
			6M	

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SECOND INTERNAL ASSESSMENT

Sem :VI **Sub: Power System Analysis-1** **Sub. Code: 15EE62**
Date:11/04/2018 **Time:03:00PM-04.00PM** **Max. Marks: 25**

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	M	CO	RBT LEVEL
1	a	A synchronous generator and motor are rated for 30,000 KVA, 13.2KV and both have subtransient reactance of 20%. The line connecting them has a reactance of 10% on the base of machine ratings. The motor is drawing 20,000 KW at 0.8 p.f. leading. The terminal voltage of the motor is 12.8 KV. When a symmetrical three-phase fault occurs at motor terminals, find the subtransient current at the fault point i_f"	8	CO302.2	L4
	b	Write a short note on selection of circuit breakers.	5	CO302. 2	L4
		OR			
2	a	Show that the subtransient reactance of the synchronous machine is the smallest and the steady state reactance of the machine is highest among all the reactance's. i.e $X''_d < X_d' < X_d$	8	CO302. 2	L4
	b	Write the procedure for the analysis of three phase symmetrical faults using thevenin theorem.	5	CO302. 2	L4
3	a	Derive the expression for phase voltages in terms of symmetrical components.	6	CO302. 3	L4
	b	The current flowing to a delta connected load through a line 'a' is 10A. With the current in line 'a' as reference and assuming that line 'c' is open, find symmetrical components of line current.	6	CO302. 3	L4
		OR			
4	a	Show that symmetrical components transformation is power invariant.	6	CO302.3	L4
	b	Explain phase shift in star-delta transformer bank.	6	CO302. 3	L4

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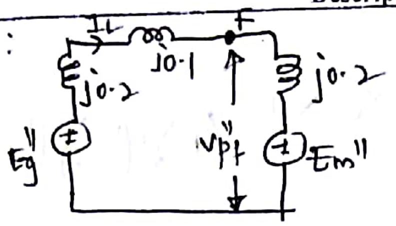
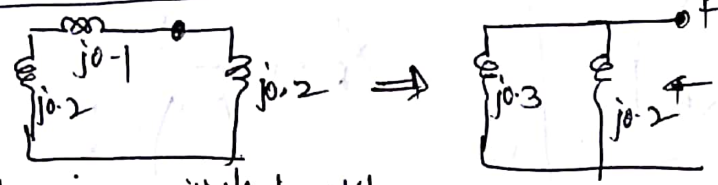
SCHEME OF EVALUATION

Sem : 6 | Subject : PSA-1 | Sub Code : 15EE62 | Date : 11/04/18

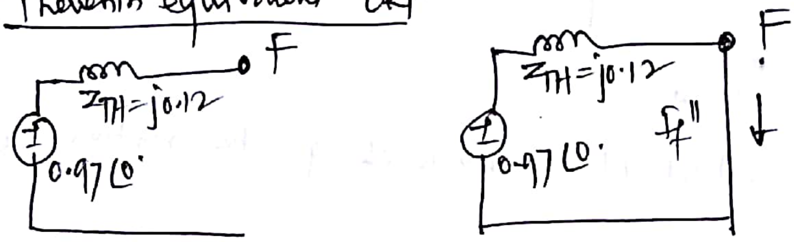
Q. No.	Blt	Description	Marks	CO's
Q1	a	Soln: $(MVA)_B = 30$, $(KV)_B = 13.2\,KV$	1M	CO 302.2
		$V_{pf} = 12.8\,KV$		
		$V_{pf\,pu} = 0.97\angle 0^\circ$	1M	
		$V_{TH\,pu} = V_{pf\,pu} = 0.97\angle 0^\circ$	2M	
		By Thevenin Theorem: $Z_{TH} = j0.12$	2M	
		Thevenin equivalent ckt: $I_f'' = \frac{0.97\angle 0^\circ}{j0.12} = 8.06\angle{-90^\circ}$	1M	
		$I_{factual} = 8.06\angle{-90^\circ} \times 1312 = 10581.3\angle{-90^\circ}\,A$	1M	
			8M	
Q1	b	selection of circuit Breakers (Not less than 8 lines)	5M	CO 302.2
		OR		
Q2	a	$X_d = X_l + X_a$	2M	CO 302.2
		oscillogram Diagram	2M	

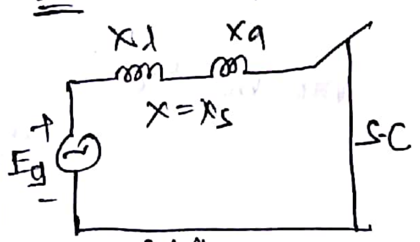


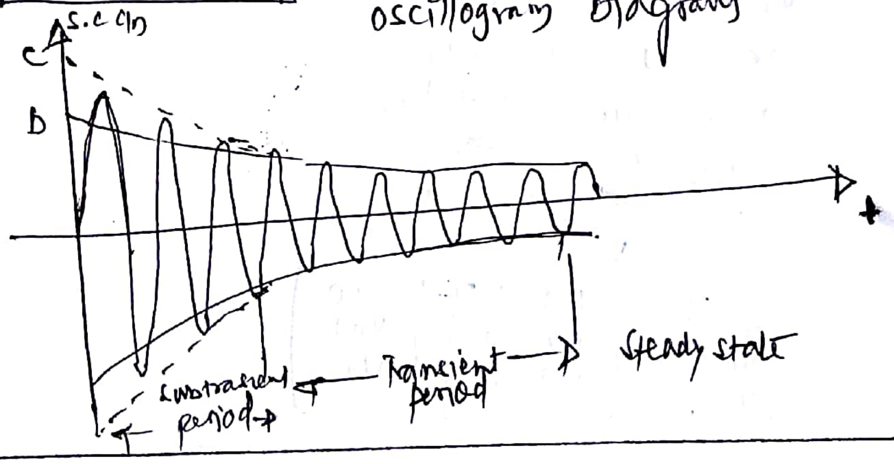
By Thevenin Theorem



Thevenin equivalent ckt







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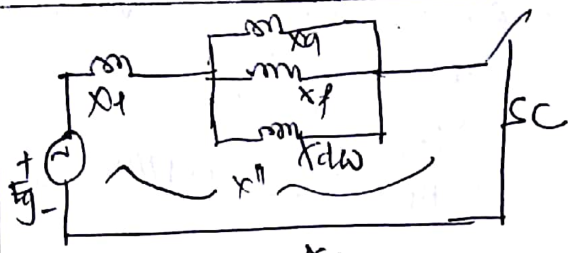
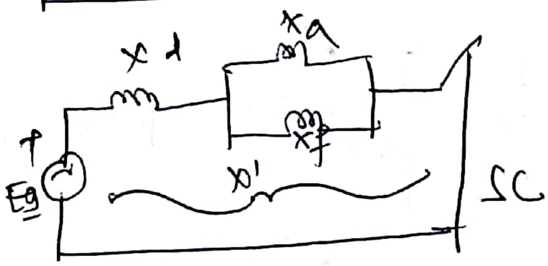
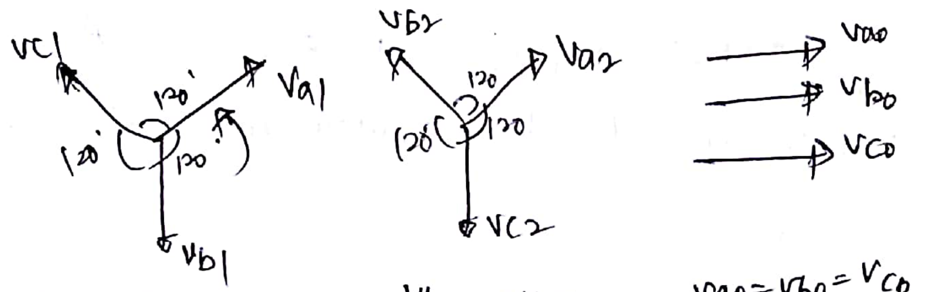
SCHEME OF EVALUATION

Sem : 6 | Subject : PSA-1 | Sub Code : 15EE62 | Date : 11/04/18

Q. No.	Bit	Description	Marks	CO's
		 $X_d'' = X_l + \frac{1}{(1/X_a)+(1/X_f)+(1/X_{dw})}$	2m	
		 $X_d' = X_l + \frac{1}{\left(\frac{1}{X_a}\right)+\left(\frac{1}{X_f}\right)}$	2m	
			8m	
		Here $X_d'' < X_d' < X_d$		
Q2	b	Symmetrical short ckt analysis using Thevenin's thm	5m	CO 302.2
Q3	a		2m	CO 302.3
		$V_{b1} = a^2 V_{a1}$; $V_{c1} = a V_{a1}$ $V_{b2} = a V_{a2}$; $V_{c2} = a^2 V_{a2}$ $V_{a0} = V_{b0} = V_{c0}$	2m	
		$V_a = V_{a0} + V_{a1} + V_{a2}$ $V_b = V_{b0} + V_{b1} + V_{b2}$ $V_c = V_{c0} + V_{c1} + V_{c2}$ $V_a = V_{a0} + V_{a1} + V_{a2}$ $V_b = V_{a0} + a^2 V_{a1} + a V_{a2}$ $V_c = V_{a0} + a V_{a1} + a^2 V_{a2}$	2m	
		$\begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} V_{a0} \\ V_{a1} \\ V_{a2} \end{bmatrix}$	6m	

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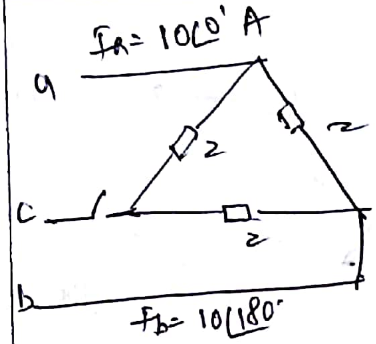
SCHEME OF EVALUATION

Sub Code : 15EE62 | Date : 11/04/18

Sem : 6 | Subject : PSA-1

Q. No.	Bit	Description	Marks	CO's
Q3	b	 $I_a + I_b + I_c = 0$ in 3ϕ, 3wire system	1m	Co 302.3
		$I_b = -I_a$	1m	
		$I_a = 10\angle 0°$ A	1m	
		$I_b = 10\angle 180°$ A	1m	
		$I_{a1} = 5.78\angle -30°$ A	1m	
		$I_{a2} = 5.78\angle 30°$ A	1m	
		$I_{a0} = 0$ | ∵ 3ϕ, 3wire system	6m	
Q4	a	Power Invariance		
		$S = V_p^T I_p^* = V_a I_a^* + V_b I_b^* + V_c I_c^*$	1m	
		$S = [A V_s]^T [A I_s]^*$		
		$= V_s^T A^T A^* I_s^*$	1m	
		$A^T A^* = 3U$	1m	
		$S = 3 V_s^T U I_s^*$	1m	
		$S = 3 V_s^T I_s^*$		
		$S = 3 V_{a1} I_{a1}^* + 3V_{a2} I_{a2}^* + 3V_{a0} I_{a0}^*$		
		= sum of symmetrical component powers	2m	
			6m	

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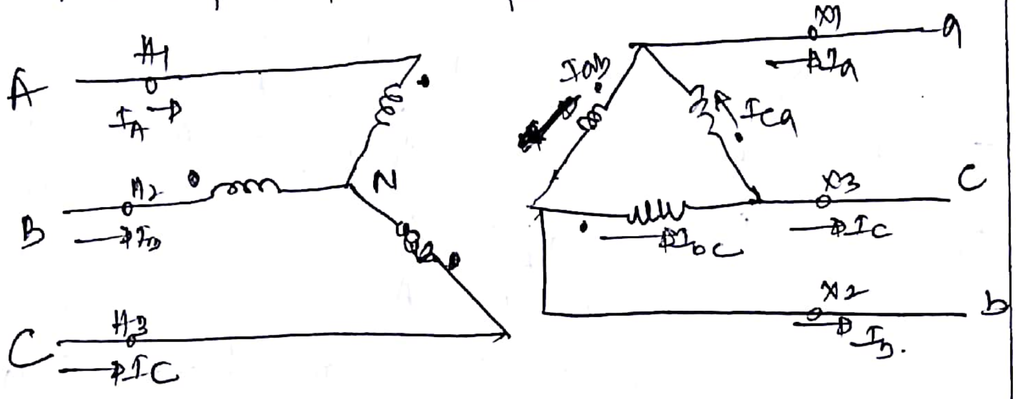
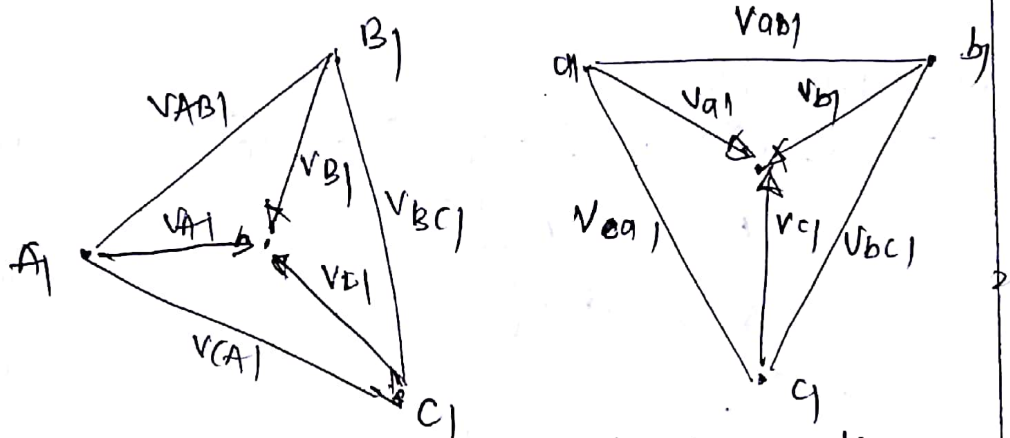
SCHEME OF EVALUATION

Sem : 6 | Subject : PSA-1 | Sub Code : 15EE62 | Date : 11/04/18

Q. No.	Bit	Description	Marks	CO's
Q 4	b	Phase shift in Y-Δ Tfr Bank		CO 302.3

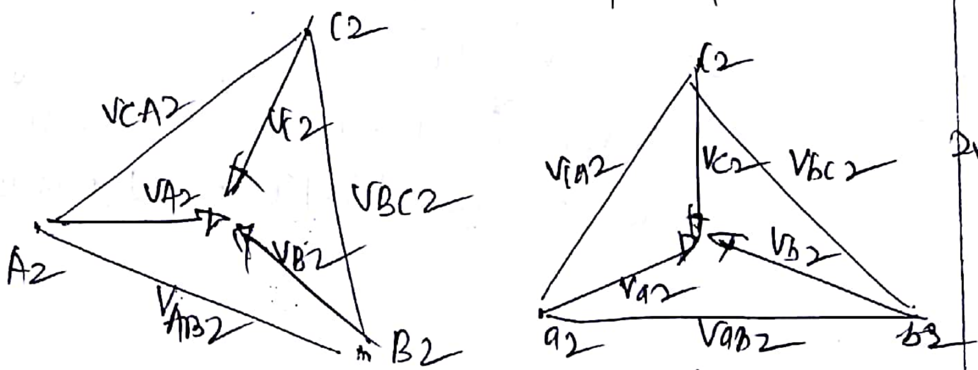


(2m)



(a) positive seq. components

2m



(b) -ve seq-components

2m

$V_{A1} = \frac{\sqrt{3} N_1}{N_2} V_{a1} \angle 30^\circ$ $\quad$ $V_{A2} = \sqrt{3}\frac{N_1}{N_2} V_{a2} \angle -30^\circ$

2m

6m

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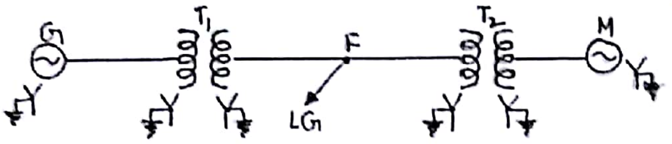
EEE Dept.
Exam.
Internal Assessment
Even(2017-18)

THIRD INTERNAL ASSESSMENT

Sem :VI **Sub: Power System Analysis-1** **Sub. Code: 15EE62**
Date:18/05/2018 **Time:03:00PM-04.00PM** **Max. Marks: 25**

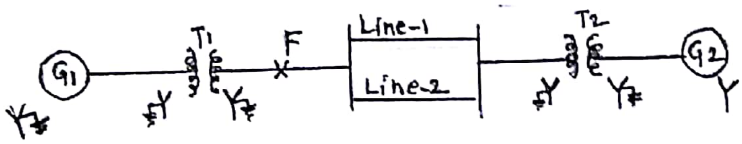
Note: Answer two full questions, draw sketches wherever necessary.

QN		Discription of Question	M	CO	RBT LEVEL
1	a	Derive an expression for fault current for the case of LG fault on the terminals of synchronous generator with fault impedance Zf.	6	CO302.3	L4
	b	A synchronous motor is receiving 10MW of power at 0.8pf lag at 6kV. An LG fault takes place at the middle point of the transmission line as shown in fig below. Find the fault current. The ratings of the generator motor and transformer are as under. Generator: 20MVA, 11kV, X_1=0.2p.u; X_2=0.1p.u; X_0=0.1p.u. Transformer T1: 18MVA, 11.5Y-34.5Y kV, X=0.1p.u. Transmission line: X_1=X_2=5Ω; X_0=10Ω. Transformer T2: 15MVA, 6.9Y-34.5Y kV, X=0.1p.u. Motor : 15MVA, 6.9kV, X_1=0.2p.u; X_2=X_0=0.1p.u. Take generator ratings as base.	7	CO302. 3	L4



OR

QN		Discription of Question	M	CO	RBT LEVEL
2	a	Derive an expression for fault current for a fault taking place at point F on power system with Zf (LL Fault)	6	CO302. 3	L4
	b	Draw the sequence networks for the system shown in fig 1. Determine the fault current if LL fault occurs at point 'F'. The p.u reactances all referred to the same base are as follows. Both the generators are generating 1 pu. G1: Xo=0.05, X_1=0.30, X_2=0.20, G2: Xo=0.03, X_1=0.25, X_2=0.15 Line-1: Xo=0.70, X_1=0.30, X_2=0.30, Line-2: Xo=0.70, X_1=0.30, X_2=0.30 T1: Xo=0.12, X_1=0.12, X_2=0.12, T1: Xo=0.10, X_1=0.10, X_2=0.10	7	CO302. 3	L4



QN		Discription of Question	M	CO	RBT LEVEL
3	a	Derive swing equation. Draw Swing Curve.	6	CO302.4	L4
	b	Derive an expression for power angle curve of non salient pole synchronous machine. Draw power angle curve.	6	CO302. 4	L4

OR

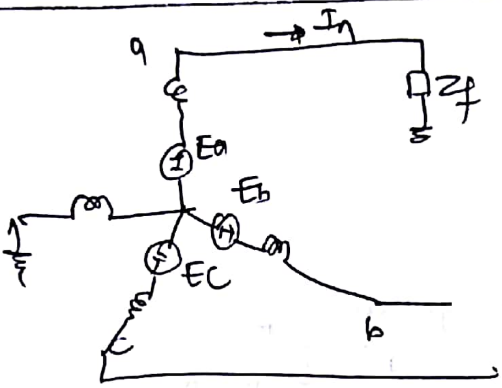
QN		Discription of Question	M	CO	RBT LEVEL
4	a	Derive an expression for power angle curve of salient pole synchronous machine. Draw power angle curve.	6	CO302.4	L4
	b	Define steady state stability, transient stability, SSSL and TSL.	6	CO302. 4	L4

Course Coordinator **Module Coordinator** **HOD**

SCHEME OF EVALUATION

Sem : 6 | Subject : PSA-1 | Sub Code : 15EE62 | Date : 18/05/18

Q. No.	Bit	Description	Marks	CO's
Q1	a	(see below)		302.3



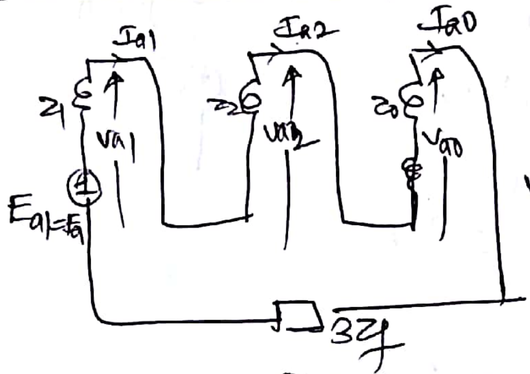
$V_a = I_a \cdot Z_f$

$I_b = 0$

$I_c = 0$

$I_{a1} = I_{a2} = I_{a0} = \frac{1}{3} I_a$

$V_{a0} + V_{a1} + V_{a2} = 3 I_{a0} Z_f$



$I_{a0} = I_{a1} = I_{a2} = \frac{E_a}{Z_1 + Z_2 + Z_0 + 3Z_f}$

$V_{a1} = E_a - I_{a1} Z_1$

$= E_a \left(\frac{Z_2 + Z_0 + 3Z_f}{Z_1 + Z_2 + Z_0 + 3Z_f} \right)$

$V_{a2} = -I_{a2} Z_2 = \frac{-E_a Z_2}{(Z_1 + Z_2 + Z_0 + 3Z_f)}$

$V_{a0} = -I_{a0} Z_0 = \frac{-E_a Z_0}{Z_1 + Z_2 + Z_0 + 3Z_f}$

$I_f = I_a = 3 I_{a0} = 3 \left(\frac{E_a}{Z_1 + Z_2 + Z_0 + 3Z_f} \right)$

Z_n absent $Z_0 = \infty$ $I_f = 0$.

Q1	b			302.3

$(MVA)_B = 20$

G : $(kV)_B = 11$

TL : $(kV)_B = 33$

M : $(kV)_B = 6.6$ kV

G : $X_1 = 0.2$ pu, $X_2 = 0.1$ pu, $X_0 = 0.1$ pu

T_1 : $X_1 = 0.12$, $X_2 = 0.12$, $X_0 = 0.12$

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SCHEME OF EVALUATION

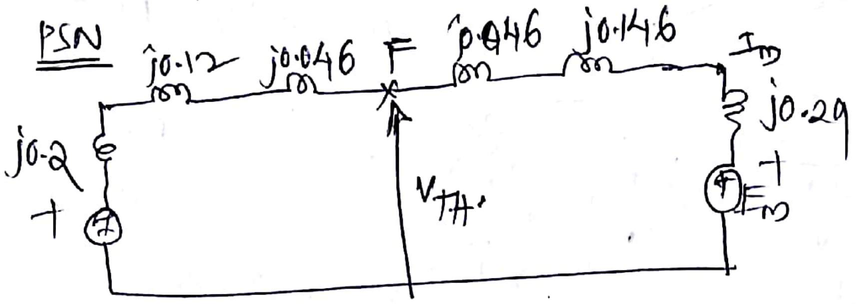
Sem : 6	Subject : PSA – I	Sub Code : 15EE62	Date : 18/05/18	
Q. No.	Bit	Description	Marks	CO's

TL : $x_1 = x_2 = 0.092$
$x_0 = 0.184$

T2 : $x_1 = x_2 = x_0 = 0.146$

M : $x_1 = 0.29$
$x_2 = x_0 = 0.145$

PSN



$I_m = 1202.8 \angle -36.87^\circ$ A

$I_B = 1749.55$ A

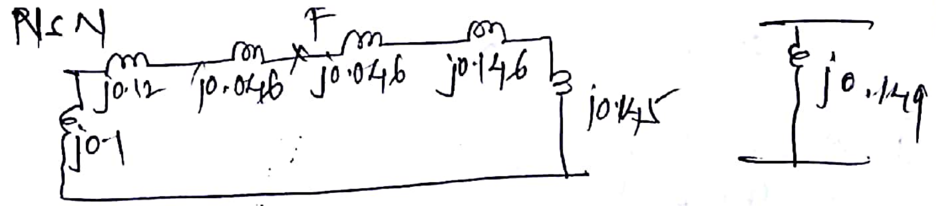
$I_{m\,pu} = 0.687 \angle -36.87^\circ$ A

$V_{m\,pu} = 0.909 \angle 0^\circ$ pu

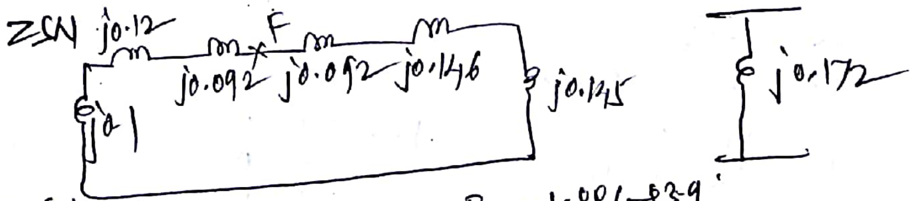
$V_{TH} = V_m + I_m Z_{fm} = 0.994 \angle 6.1^\circ$ pu

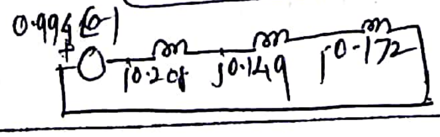
$Z_{1TH} = j0.208$

NSN



ZSN





$I_{a0} = 1.88 \angle -83.9$

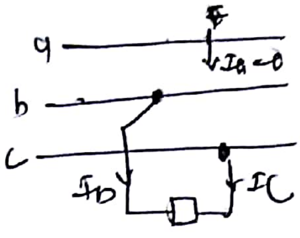
$I_f = 3 I_{a0} = 5.64$ pu

$= 1973.49$ A

SCHEME OF EVALUATION

Sem : 6	Subject : PSA-1	Sub Code : 15EE62	Date : 18/05/18	
Q. No.	Bit	Description	Marks	CO's

Q2 a Fault on Power system with Z_f — 3 — 02-3



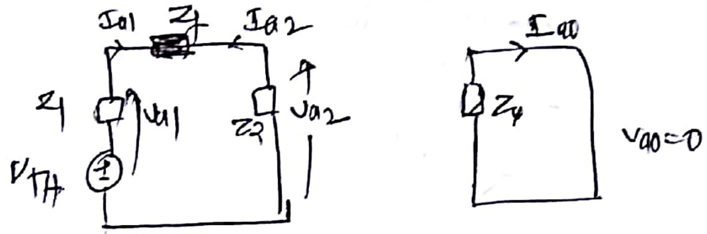
$I_a = 0$

$I_c = -I_b$

$V_b = V_c + I_b Z_f$

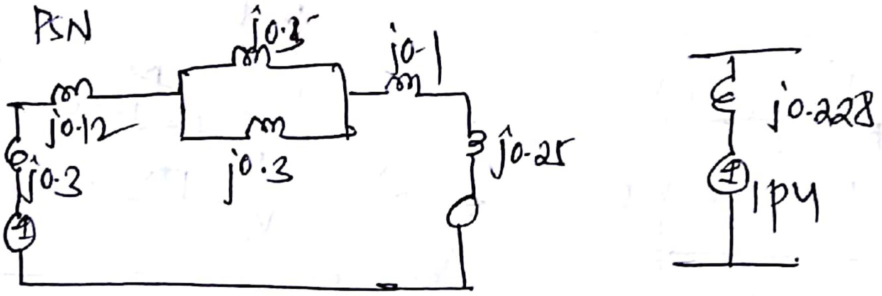
$I_{a1} = -I_{a2}$

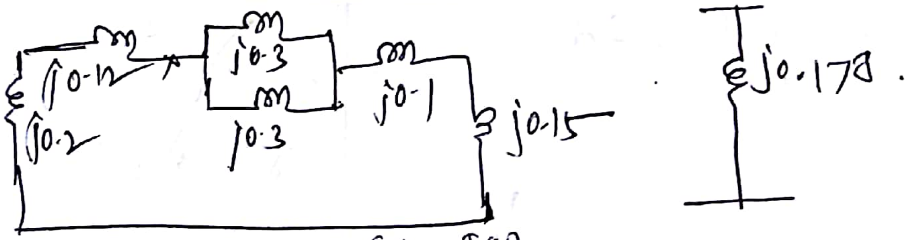
$V_{a1} = V_{a2} + I_{a1} Z_f$

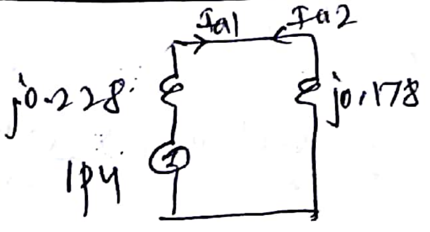


$$I_f = I_b = -j\sqrt{3}\, I_{a1} = \sqrt{3} \cdot I_{a1} = \sqrt{3}\, \frac{V_{TH}}{Z_1 + Z_2 + Z_f}$$

Q2 b PSN — 302-3







$$I_f = -j\sqrt{3}\, I_{a1} = -j\sqrt{3}(-j2.463) = 4.266\ pu$$

S J P N Trust's

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IA Scheme
2017-18 Even Sem

Page. No.: 104

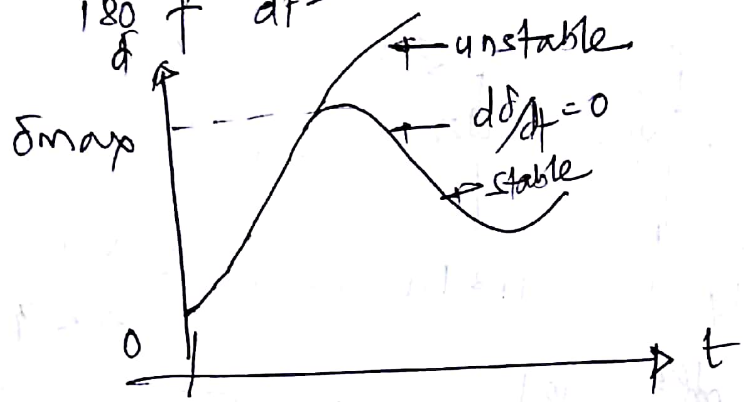
SCHEME OF EVALUATION

Sem: 6 Subject: PSA-II Sub Code: 15EE62 Date: 18/05/18

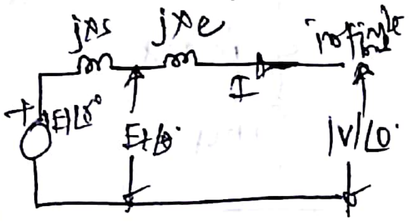
Q. No.	Bit	Description	Marks	CO's
Q3	a	Derivation swing equation.		302.4

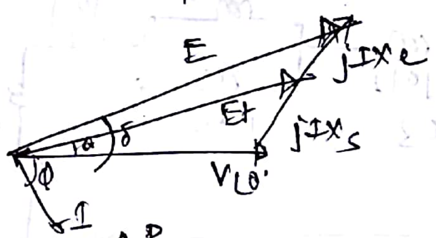
$$\frac{GH}{180 f}\frac{d^2\delta}{dt^2} = P_a = P_s - P_e$$

$$\frac{H}{180 f}\frac{d^2\delta}{dt^2} = P_a = P_s - P_e$$

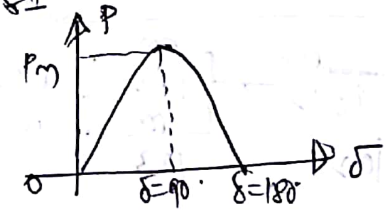


Q. No.	Bit	Description	Marks	CO's
Q3	b			302.4

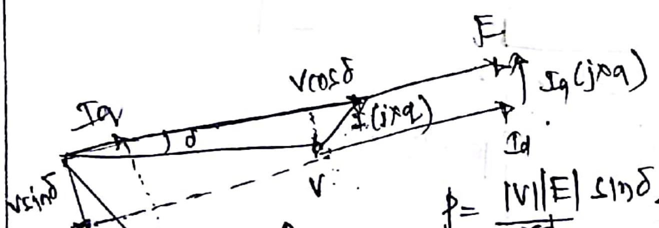




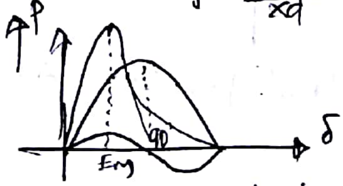
$$P = \frac{|V||E|}{(X_s + X_e)}\sin\delta$$



Q. No.	Bit	Description	Marks	CO's
Q4	a			302.4



$$P = \frac{|V||E|}{X_d}\sin\delta + \frac{|V|^2 (X_d - X_q)}{2X_dX_q}\sin 2\delta$$



Q. No.	Bit	Description	Marks	CO's
Q4	b	Definition steady state stability, transient stability, SSSL, TSL	2+2+1+1 = 6m	302.4

Course Coordinator Module Coordinator HOD