Alexandria Higher Institute of Engineering & Technology (AIET)			
Comunications & Mechatronic Departements	2011/2012	Second Year	
EME 231 & EME 233	Electromechanical Energy Conversion Transformers & Machines	Mid of-Semester Exam 2, Date 18 / 12 / 2011	
Examiners:	Prof. Dr. Kamel Mohamed Soliman		Time: 1 hour

Question one: (1 mark)

State briefly one application for one – to – one ratio transformer.

Question two: (1 mark)

For transformer of primary side P and secondary side S , what is wrong in this equation? Why ?

V1 \ V2 = I2 \ I1 = P1 \ P2 = transformation ratio

Question three: (2 marks)

Why constant current transformer must operate at saturation region .

Question four: (6 marks)

Tests are performed on a single phase 10 KVA , 2200 / 220 volt, 60 Hz transformer, and the following results are obtained :

	Open circuit test	Short circuit test
V	220V	150V
I	2.5A	4.55A
P	100watt	215watt

1-Derive the parameters for the approximate equivalent circuit referred to the high voltage side
2-Determine the Power Factor for the no-load and short circuit tests
3-Determine the voltage regulation in percent for the case of 0.75 full load , 0.6 power factor lagging

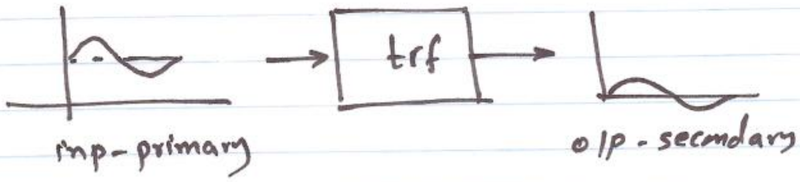
"الإجابة المختصرة والمدعمة بالرسم أفضل "
" الإجابة بأي لغة "
(جزء من الدرجة على صحة أرقام الجواب النهائي)

Good Luck

Second Mid-Term-Solution

1 a- application of one-to-one ratio trf.:

-Separating AC from suppercomposed DC component

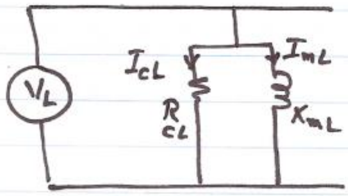


b- $\frac{P_1}{P_2} \neq a$ because $P_1 \equiv P_2$

c- Constant current trf. depends mainly on the repulsion and attraction forces produced from the variable leakage flux linking from one coil to the other one.

This leakage is changed mainly due to saturation

2 ⓐ O.C.T



$$P_{oc} = \frac{V_l^2}{R_{cl}}$$

$$\therefore R_{cl} = \frac{V_l^2}{P_{oc}}$$

$$= \frac{(220)^2}{100} = \boxed{484\,\Omega = R_{cL}}$$

$$I_{cl} = \frac{V_l}{R_{cl}} = \frac{220}{484} = \underline{0.45\text{ A}}$$

$$I_{ml} = \sqrt{I_l^2 - I_{cl}^2} = \sqrt{(7.5)^2 - (0.45)^2} = \underline{2.46}$$

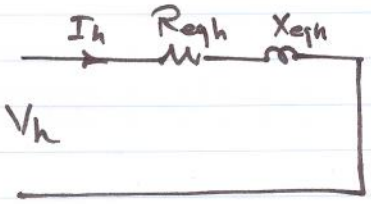
$$\therefore X_{mL} = \frac{V_L}{I_{mL}} = \frac{220}{2.46} = \boxed{89.4 = X_{mL}}$$

$$a = \frac{2200}{220} = 10$$

$$\therefore R_{ch} = a^2 R_L = 100 \times 484 = \boxed{48400\,\Omega = R_{ch}}$$

$$X_{mh} = a^2 X_{mL} = 100 \times 89.4 = \boxed{8940 = X_{mh}}$$

S.C.T



$$P_{sc} = I_h^2 R_{eqh}$$

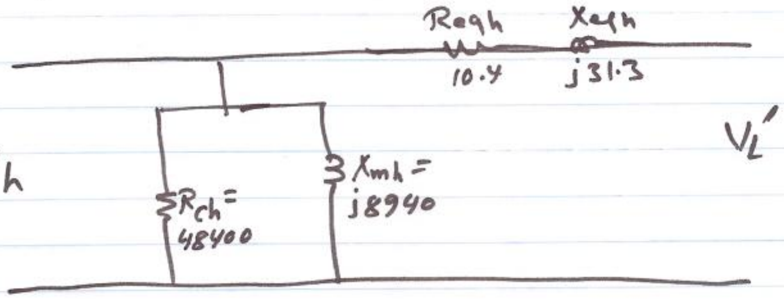
$$\therefore R_{eqh} = \frac{215}{(4.55)^2} = \boxed{10.4\ \Omega = R_{eqh}}$$

$$Z_{eqh} = \frac{V_h}{I_h} = \frac{150}{4.55} = \underline{\underline{32.97\ \Omega}}$$

$$X_{eqh} = \sqrt{Z_{eqh}^2 - R_{eqh}^2} = \sqrt{(32.97)^2 - (10.4)^2}$$

$$= \boxed{31.3\ \Omega = X_{eqh}}$$

$\therefore$ eq^t circuit refered to high. v. side is



(b) op. ct. power factor :

$$P = V I \cos \phi$$

$$\cos \phi_{oc} = \frac{100}{220 \times 2.5} = \boxed{0.182}$$

S.C. p.f. :

$$\cos \phi_{sh.c.} = \frac{215}{150 \times 4.55} = \boxed{0.315}$$

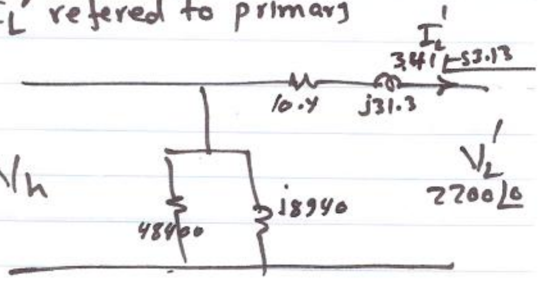
(c) at 75% f.L ; 0.6 Lagging P.f :

$$V_{fLh} = \left(\frac{VA}{I}\right)_h = \frac{10\,000}{2200} = \underline{4.55\ A}$$

$$\therefore I_h = .75\, I_{fLh} = .75 \times 4.55$$

$$\boxed{I_h = 3.41\ A \angle -53.13} \quad (\text{P.f } 0.6 \text{ Lag})$$

$= I_L'$ refered to primary



$$V_h = V_L' + I_L' Z_{eqh}$$

$$= 2200\angle 0 + 3.41 \angle -53.13 \times (10.4 + j31.3)$$

$$\boxed{V_h = 2306.94 \angle 0.9}$$

$$VR\% = \frac{V_h - V_L'}{V_L'} \times 100 = \frac{2306.94 - 2200}{2200} \times 100$$

$$\boxed{VR\% = 4.86\ \%}$$