14/25

φ	Mark
1	1 /10
2	3 / 8
3	5 / 5
4	8 / 15
5	12 / 12
SUM	29 / 50

University of Jordan

Electrical Eng. Dept

93371 Electrical Machines(1)

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First Exam.

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الاسم: [illegible] رقم التفقد: 53 الرقم الجامعي: 0127430

Q1) Fill in the following blanks: [10]

1/10

1-The quantity that drives flux in magnetic circuit is called:

2-One of the assumptions in calculating Reluctance is:

3-The permeability of a core drops to a low value when:

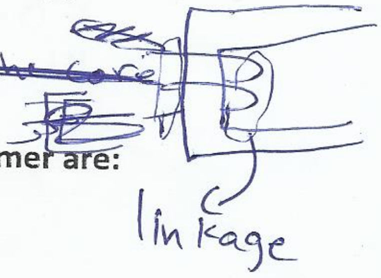
4-The coercive force is defined as:

5-The area of the hysteresis loop is proportional to: magnitude of amplitude of the current and mmf

6-Eddey current losses are reduced by: heat in the core

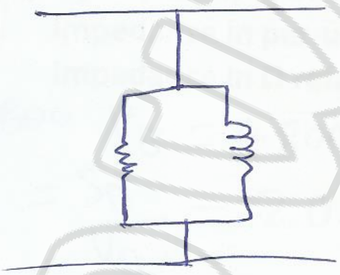
7-The construction of transformer which has the windings wrapped Around the central leg is called:

8-Flux linkage is defined as: ~~That flux can be out the core~~ flux out the core $N\frac{d\phi_L}{dt}$ →



9-The two components of the no-load current of a transformer are: eddy and hysteresis

10-The shape of the transformer excitation current is:



3/8

Q2) The construction shown in Fig. 1 has a depth of 8 cm and the following magnetization curve data:

B(T)	0.15	0.25	0.3	0.4	0.5	0.6
H(A.t/m)	40	50	55	65	70	85

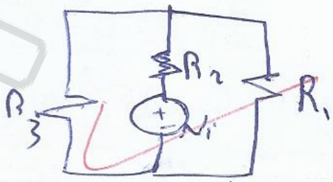
$BA = \phi$ $HL = Ni$ $B = \mu H$

$A = 0.8 \times 0.8 = 0.64\,m^2$

a-Evaluate the current required to produce B=0.25 T in the right leg. Assuming that right and left legs are symmetrical. [6]

$B = \frac{\phi}{A} \rightarrow \mu H$ from the slope $\mu = 0.01$

$B = 0.25 \rightarrow H = 50$



$L_{leg} = 0.56$ $R_1 = R_3 = \frac{0.56}{0.01 \times 0.64}$

3

$R_1 = R_3 = 87.5$

$\phi = 0.25 \times 0.64 = 0.16$

$\phi + \phi_2 = 0.32$

$mmf = \phi \times R = 28 \rightarrow \frac{28}{400} = 0.07$

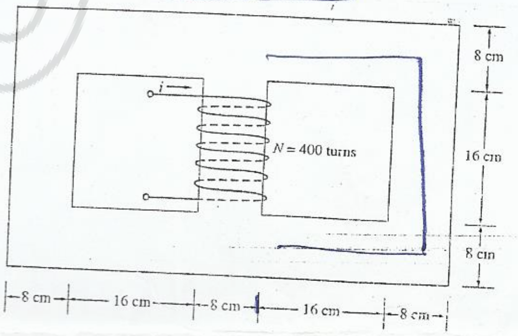


Fig. 1

b-Evaluate μ_r of the core according to the data of central leg. [2]

$\mu = \mu_0 \mu_r = \frac{\Delta B}{\Delta H} = \frac{0.4 - 0.15}{65 - 40} = 0.01$

$\mu_r = \frac{0.01}{4\pi \times 10^{-7}} = 7957.75$

5/5

Q3) A (480/4800) V, 10 kVA transformer has a series equivalent impedance in per-unit as (0.0087+j 0.026).Find the equivalent impedance in Ω referred to HV side. [5]

$V_B = 4800$ $S_B = 10k$

$I_B = \frac{S_B}{V_B} = 2.083$ $Z_B = \frac{V_B^2}{S_B} = 2304.00$

$(0.0087 + j0.026) \times 2304 =$

$(20.0448 + 59.904j)\,\Omega$

Q4) A 20 kVA, (8000/240) V, 60 Hz transformer has the following parameters referred to HV side:

R_C=159 KΩ X_m=38.4 kΩ R_{eq}=38.4 Ω X_{eq}=192 Ω

If an O/C test was performed with the LV as the primary, what would be the READINGS of its measuring instruments. [15]

$V_{oc} = 240\,V$ $Z_c = R_c + X_m$ $Z_c = R_c \parallel X_m$

$|Y_c| = \frac{I_{oc}}{V_{oc}}$ $Z_c = 159000.0 \angle 0.0138$

$Y_c = 6.289 \times 10^{-6} \angle -0.0138$ Also not in LV

6/15

$6.289 \times 10^{-6} \times 240 = I_{oc}$

$I_{oc} = 1.5094 \times 10^{-3}\,A$

$\cos^{-1}\left(\frac{P_{oc}}{V_{oc} I_{oc}}\right) = -0.0138$

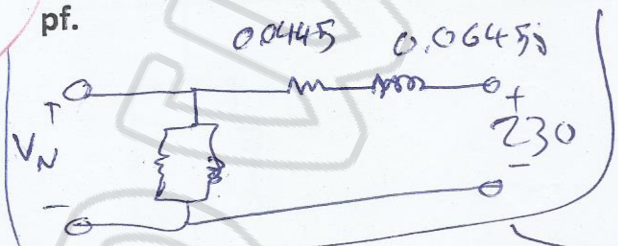
$P_{oc} = 0.99971 \times 240 \times 1.5094 \times 10^{-3}$

$P_o = 362.15 \times 10^{-3}\,W$

Q5) A 15 kVA , 2300/230 V transformer has the following parameters Referred to LV side: R_{eq}=0.0445 Ω X_{eq}=0.0645 Ω

If this transformer is used as step-down, find its PU equivalent circuit and then use it to find the full load voltage regulation at 0.8 lagging pf. [12]

12/12



$V_B = 230$ $S_B = 15 \times 10^3$

$Z_B = 3.5266$

$R_{eq} = 0.012618$

$X_{eq} = 0.01829$

$I = \frac{15 \times 10^3}{2300} \angle -\cos^{-1}(0.8) = 6.5217 \angle -36.869\,A$

$I_B = \frac{S_B}{V_B} = 65.217 \rightarrow I = 1 \angle -36.869$

$V_N = 1 \angle -36.869 \times (0.012618 + 0.01829j) + 1$

$V_N = 0.02222 \angle 18.5298 + 1 = 1.02109 \angle 0.39624$

$VR = \frac{V_N - 1}{1} = 0.02109 = 2.1\%$