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University of Jordan	Faculty of Engineering & Technology	Electrical Engineering Department	
EE371: Electric Machines I	First Exam	1st Semester 2014-2015	22/10/2014 Time: 1 Hour

Student Name [redacted]

$\mu_o = 4\pi\times10^{-7}$ H/m

Question	1	2	3	4	5	6	7	8
Answer	c	a	b	c	d	b	b	d
Question	9	10	11	12	13	14	15	
Answer	b	d	c	a	b	d	d	

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SHOW YOUR CALCULATIONS

Question # 1 (15 points)

Select the correct answer for each of the following statements and fill it in the table.

1.1 A transformer transforms:

a. the frequency.
b. the power at constant frequency.
c. the voltage at constant power.
d. both the power and the voltage.

1.2 When conducting the no-load and short circuit tests for single-phase transformers, it is not recommended to:

a. Apply the rated voltage during SC test.
b. Apply the rated voltage during OC test.
c. Apply the rated current during SC test.
d. None of the above.

1.3 In single phase transformers, what type of losses always exist regardless of the load:

a. *Copper losses.* b. *Core losses.* c. (a) and (b) d. *None of the above.*

1.4 Eddy current losses can be reduced by ..... .

a. using high quality magnetic material.
b. using light weigh magnetic material.
c. using thin magnetic material.
d. using heavy weigh magnetic material.

1.5 Short circuit test is conducted in transformers to find:

a. winding resistance b. winding leakage reactance c. core resistance d.

1.6 The rated primary and secondary currents of a 20 kVA, 1200/120 V single-phase transform... this transformer delivers a load of 12 kW at PF = 0.8 lagging are ..... A and ..... A.

a. $I_{1(rated)} = 10$, $I_{2(rated)} = 100$
b. $I_{1(rated)} = 12.5$, $I_{2(rated)} = 125$
c. $I_{1(rated)} = 16.7$, $I_{2(rated)} = 167$
d. $I_{1(rated)} = 13.4$, $I_{2(rated)} = 134$

1.7 A magnetic circuit has eddy-current loss P_e = 1000 W and hysteresis loss P_h = 800 W at rated voltage and rated frequency. If the frequency is reduced by 20% while the flux density remains constant, the eddy-current loss P_e and hysteresis loss P_h become .... W and .... W.

a. $P_e = 640$, $P_h = 640$
b. $P_e = 200$, $P_h = 160$
c. $P_e = 400$, $P_h = 160$
d. $P_e = 800$, $P_h = 640$

1.11 A single-phase transformer has 400 primary turns and 800 secondary turns. The net iron cross sectional area of the core is 40 cm². If the primary winding is connected to a 60 Hz supply at 600 V. The maximum value of the core flux density, B_m is … T.

a. $B_m = 2.8$ b. $B_m = 0.7$ c. $B_m = 1.4$ d. $B_m = 5.6$

$V_1 = N_1 \frac{d\phi}{dt}$

$\phi = \frac{1}{N} \int V_1(t)\, dt$

$\phi = \frac{600}{400 \times 2\pi \times 60}$

1.12 How many turns must the primary and the secondary windings of a 220/110-V, 50-Hz ideal transformer have if the core flux is not allowed to exceed 5 mWb?

a. $N_p = 198$, $N_s = 99$ b. $N_p = 220$, $N_s = 110$ c. $N_p = 40$, $N_s = 20$ d. $N_p = 2$, $N_s = 1$

$V_p = N \frac{d\phi}{dt}$

$5 \times 10^{-3} = \frac{220}{2\pi \times 50 \times N_P}$

1.13 A 1.2-kVA, 240/120-V, 400 Hz transformer is desired to be used at a frequency of 50 Hz. The kVA rating of the transformer under reduced frequency would be:

a. 9.6 kVA b. 0.15 kVA c. 76.8 kVA d. 1.92 kVA

$\frac{S_2}{S_1} = \frac{f_2}{f_1}$

$N_P = 180$ $N_S = 45$

1.14 A single-phase transformer has 180 and 45 turns, respectively, on its primary and secondary windings. The corresponding resistances are $R_1 = 0.242\Omega$ and $R_2 = 0.076\Omega$, respectively. The equivalent resistance R'_{eq} referred to the primary is …. Ω.

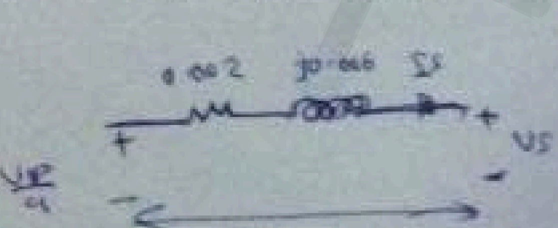
a. $R'_{eq} = 0.55$ b. $R'_{eq} = 0.32$ c. $R'_{eq} = 0.14$ d. $R'_{eq} = 1.46$

$a = \frac{180}{45} = 4$

1.15 A 500-kVA, 2300/230-V transformer has a series impedance referred to the secondary $Z''_{eq} = 0.002 + j0.006\Omega$. The percentage voltage regulation when the transformer is delivering its rated load at 0.8 PF lagging is:

a. %VR = 2.05% b. %VR = 4.97% c. %VR = -3.26% d. Non of these

a = 10



$S = VI$

$P = VI\ PF$

$I_S = \frac{500 \times 10^3 \times 0.8}{230}$

2341.2

234.1

$VR = \frac{234.1 - 230}{230}$

1.11 A single-phase transformer has 400 primary turns and 800 secondary turns. The net iron cross sectional area of the core is 40 cm^2. If the primary winding is connected to a 60 Hz supply at 600 V. The maximum value of the core flux density, B_m is … T.

a. $B_m = 2.8$ b. $B_m = 0.7$ c. $B_m = 1.4$ d. $B_m = 5.6$

1.12 How many turns must the primary and the secondary windings of a 220/110-V, 50-Hz ideal transformer have if the core flux is not allowed to exceed 5 mWb?

a. $N_p = 198$, $N_s = 99$. b. $N_p = 220$, $N_s = 110$. c. $N_p = 40$, $N_s = 20$. d. $N_p = 2$, $N_s = 1$.

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a. 9.6 kVA. b. 0.15 kVA. c. 76.8 kVA. d. 1.92 kVA.

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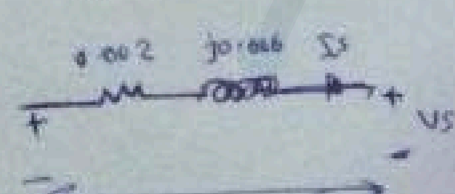

$S = VI$

$P = VI\ PF$

$I_s = \frac{500 \times 10^3 \times 0.8}{230}$

$VR = \frac{239.1 - 230}{230}$

1.8 A ferromagnetic ring with a mean circumference L_m=36 cm and a cross-sectional area A_c= 3 cm^2 is wound with 400 turns of wire as shown in Fig. 1. When the excitation current is 1.4 A, the flux is found to be ϕ= 1.4 mWb. The relative permeability of the iron μ_r is .... .

a. μ_r = 238732   b. μ_r = 238.7   c. μ_r = 0.2387   d. μ_r = 2387

1.9 The solenoid shown in the Fig. 2 consists of a 500 turn coil on a uniformly sized core. The core has a cross-sectional area A_c = 4 cm^2. The length of the air gap is l_g =5 mm long. If the reluctance of the core is negligible and the coil exciting current I = 10 A, the total magnetic flux ϕ that circulates in the core is ..... mWb.

a. ϕ = 1.25   b. ϕ = 0.50   b. ϕ = 5   d. ϕ = 12.5

1.10 A cast steel ring, as shown in Fig. 3 with B-H data as shown in Table 1, has a mean length of L_m = 30 cm and an air gap of L_g = 2 mm length. The number of ampere-turns (NI) required to produce a flux density B = 0.6 T in the air gap is ... At.

a. NI = 1084   c. NI = 129
b. NI = 955   d. NI = 0.86

Table 1: B-H data for Cast Steel

B (T)	0.4	0.6	0.8
H (At/m)	130	430	720

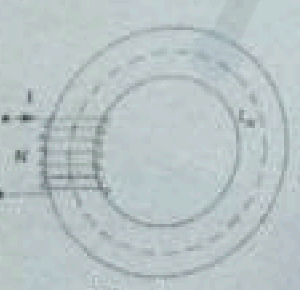
Fig. 1

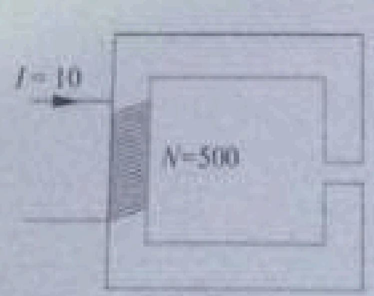

Fig.2

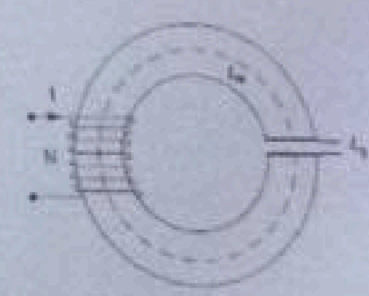
Fig.3