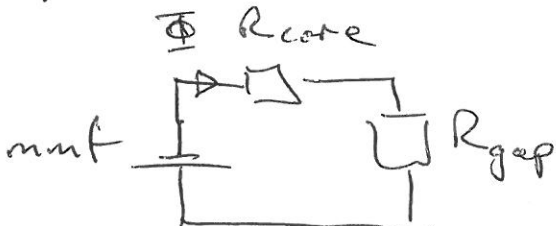


School of Logistics and Mechanical Engineering

EXAMINATION SOLUTIONS: SESSION 2015

Programme:		Level:	L6 - RESIT
Module/Unit:	Electrical Machines - M6X00373		
Author:	f Char Hon	Page:	1 of 5

Question No	Question	Marks
①	Description of basic DC motor	①0
②	Description of working principles of a simple DC generator.	①0
③	4 pole alternator - 2 pole pairs $\therefore$ O/P frequency is twice the rotation speed. $\therefore$ for 50 Hz, required speed must be $\frac{50}{2} = 25 \text{ Hz}$. $\therefore$ Rotation speed = $25 \times 60 = 1500 \text{ rpm}$	②
④	Equivalent Elec. Circuit  Use Ampere's Law $NI = \int \vec{H} \cdot d\vec{l}$	

Continuation Sheet

Module/Unit: <u>Materials</u>	Page: <u>2 of 5</u>
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Question No	Question	Marks
4 cont	$NI = mmf_{core} + mmf_{gap}$ $I = \frac{\sum mmf_s}{N}$ $B_{core} = \frac{\Phi}{A} = \frac{0.6 \times 10^{-3}}{(20 \times 30) \times 10^{-6}} = 1 \text{ T.}$ from the nickel-iron alloy BH curve $H_{core} = 50 \text{ A.t/m}$ $mmf_{core} = \cancel{50} H_{core} \times L_c$ $= 50 \times 260 \times 10^{-3}$ $= \underline{13 \text{ A.t}}$ $H_{gap} = \frac{B_{gap}}{\mu_0}; \text{ Assuming no leakage or fringing}$ $B_{gap} = B_{core}$ $\therefore H_{gap} = \frac{1}{4\pi \times 10^{-7}} = 795.45 \times 10^3 \text{ A.t/m}$ $mmf_{gap} = H_{gap} \times L_{gap} = 795.45 \times 10^3 \times 20 \times 10^{-3}$ $= \underline{15909 \text{ A.t.}}$	

Continuation Sheet

Module/Unit: <u>Materials</u>	Page: <u>3</u> of <u>5</u>
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Question No	Question	Marks
<u>4 cont.</u>	$I = \frac{15909 + 13}{400} = \underline{\underline{39.805 \text{ A.}}}$	(10)
(5)	Given that the energy in a magnetic field is given by $U_p = \frac{B^2 \times \text{vol}}{2\mu_0}$ $W = F \times \text{distance}$ $\therefore F \times \text{length} = \frac{B^2 \times \text{vol}}{2\mu_0} = \frac{B^2 \times A \times \text{length}}{2\mu_0}$ $\div$ thro' by length of gap $F = \frac{B^2 A}{2\mu_0}$	(3)
(6)	$U_p = \frac{B^2 \times \text{vol}}{2\mu_0}; \quad B = \frac{0.6 \times 10^{-3}}{(20 \times 30) \times 10^{-6}} = \underline{\underline{1 \text{ T}}}$ $U_p = \frac{1 \times (20 \times 20 \times 30) \times 10^{-9}}{2\mu_0} = \underline{\underline{4.77 \text{ J}}} \quad (1)$ $F = \frac{1 \times (20 \times 30) \times 10^{-6}}{2\mu_0} = \underline{\underline{238.64 \text{ N.}}} \quad (1)$	(2)

Continuation Sheet

Module/Unit:	Materials	Page:	4 of 5
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Question No	Question	Marks
7	Using $F = BIl$ where $I = \frac{V}{R} = \frac{1.5}{0.125}$ $= 12A.$ $F = 1.2 \times 12 \times 350 \times 10^{-3}$ $= 5.04N.$	2
8	(a) $E_{max} = NBA\omega$ $A = (25 \times 180) \times 10^{-6} m^2$ $\omega = 2\pi f$ $= 0.0045 m^2$ $= 2\pi \times \frac{2000}{60}$ $= 209.524.$ $E_{max} = 50 \times 0.68 \times 0.0045 \times 209.524$ $= 32.1v.$ (b) When coil is @ 90° to Φ $\Phi = BA = 0.68 \times 0.0045$ $= 3.06 mWb.$	3
9	(a) $F_{per\ conductor} = BIl = 0.5 \times 65.4 \times 10^{-3}$ $\times 50 \times 10^{-3}$ $= 1.635mN$ For each side of coil $= 250 \times 1.635 \times 10^{-3}$ $= 408.75mN$	2

Continuation Sheet

Module/Unit:	Materials	Page:	5 of 5
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Question No	Question	Marks
9 cont.	Ⓐ Max Torque on coil $\tau = f \times w$ $= 408.75 \times 10^{-3} \times 35 \times 10^{-3}$ $= \underline{14.31 \text{ mN.m}}$	2
	Ⓑ Max. Torque when coil area at 90° to B and minimum when coil area at 0° to B.	2
Total 50 marks		