Kafrelsheikh University
Faculty of Engineering
Department: Electrical Engineering
Year : 2nd year (2007) 2016-2017
Subject: Energy Conversion
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Date: 22 -5-2017.
Time Allowed: 3 hrs.
Full Mark: 90 Marks.
Final 2nd Term Exam: 2 pages
Academic Code: EPM 2204.

Answer All The Following Questions:

Question (1): (20 Marks)

a) ***Define*** magnetic flux density and intensity

b) Fig. 1 shows a magnetic circuit of a synchronous machine. Assume that stator and rotor iron have infinite permeability, two air gaps each of length g = 0.5 cm, area A_g= 2000cm^2, N=1000 turns and the rotor current I= 8 A.

i. ***Determine*** the value of the air gap flux density, B_g.

ii. If the rotor is replaced by a permanent magnet (PM) with length l_m, cross-section area A_m, and the point of maximum energy product is 40 kJ/m^3, ***Determine*** the minimum volume of PM required to establish the same air gap flux density found in the case of rotor wound coil.

Question (2): (25 Marks)

a) ***Discuss*** briefly the magnetic hysteresis and saturation

b) ***Derive*** the relationship between mutual inductance and self inductances of magnetically coupled two coils of N_1 and N_2 turns.

c) A three-legged ferromagnetic circuit is shown in Fig. 2.The coil, wound on the center limb, has 250 turns and the coil on right leg has 500 turns. The magnetic circuit has uniform cross-section area of 10 cm^2 .The assumption is made that the relative permeability of the iron part of the circuit is infinitely high . ***Find***:

i. Self and mutual inductances in terms of excitation currents.
ii. The voltages induced in coils 1and 2 by i_1= 5 cos ωt A , i_2 = 2 A
iii. The energy stored in the magnetic field

Question (3): (20 Marks)

a) ***Draw*** the flow of energy for the motor mode in conservative electromechanical energy conversion system and ***explain*** the sources of losses.

b) For a linear translational electromechanical energy system, ***derive*** an expression for current, flux linkage and force in terms of stored energy and coenergy.

c) As shown in Fig. 3, an N-turn electromagnet is used to lift a slab of iron of mass M. The surface roughness of the iron is such that when the iron and the electromagnet are in contact, there is a minimum air gap of g_{min}=0.18 mm in each leg. The electromagnet cross-sectional area