Menoufia University
Faculty of Engineering, Shebin El-kom
Department of Electrical Engineering
Final Semester Exam : 2017-2018
Total Mark : 70

Course Code: ELE103
C_Title : Energy Conversion
Time Allowed : 3 hour
Exam Date : 3/6/2018
No of page : 2

Answer the following questions and assume any missing data:

Question 1: [22 Marks]

A. **Illustrate** the main losses that occur in the magnetic core and the different methods to reduce it. [4 Marks]

B. In figure (1) the current in coil 1 and coil 2 shown in figure are 1 Amper,3 Amper respectivily .Assume that the core has a constant relative permeability =4000 . [8 Marks]

- **Calculate** the self inductance of each coil
- **Calculate** the mutual inductance between the two coils
- The total inductance
- The Flux density in the air gap

C. Figure (2) shows the cross-sectional view of a cylindrical iron-clad solenoid magnet. The plunger made of iron is restricted by stops to move through a limited range. The exciting coil has 1200 turns and carries a steady current of 2.25A. he magnetizing curve of the iron portion of the magnetic circuit is given below: [10 Marks]

Flux, Wb	0.0010	0.00175	0.0023	0.0025	0.0026	0.00265
MMF, AT	60	120	210	300	390	510

- **Calculate** the magnetic field energy and co-energy for air-gap g=0.2 cm
- The plunger is now allowed to move very slowly from g = 1 cm to g =0.2 cm. **Find the electrical energy input** to the exciting coil and the mechanical output. When the iron path reluctance is neglected.

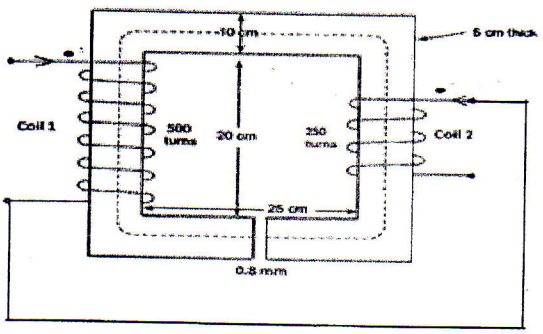

Figure (1)

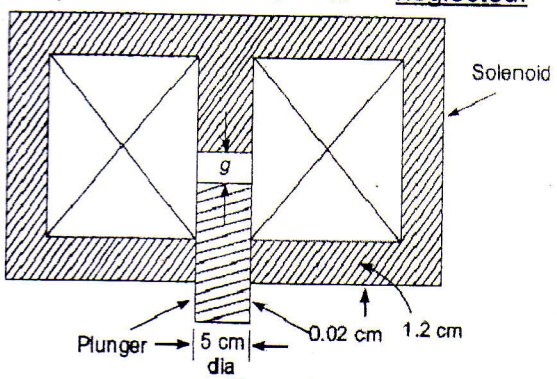

Figure (2)

Question 2: [18 Marks]

A. A cast steel ring has a circular cross-section of 3 cm in diameter and a mean circumference of 80 cm. A 1 mm air-gap is cut out in the ring which is wound with a coil of 600 turns.

- **Estimate** the current required to establish a flux of 0.75 mWb in the air-gap.
- **What is the flux produced in the air-gap** if the exciting current is 2 A .

Magnetization data: [8 Marks]

H(AT/m)	200	400	600	800	1000	1200	1400	1600	1800	2020
B (Tesla)	0.1	0.32	0.6	0.9	1.08	1.18	1.27	1.32	1.36	1.4

B. **Explain with the aiding of digrams** the construction of photovoltaic cell and **Utilization methods of** Photovoltaic systems . [7 Marks]

C. **Classfy** the different catogary sources of energy and mention the types for each catogary. [3 Marks]

PTO

Question 3:[10 Marks]

A. The magnetic circuit of Figure (3) has dimensions: A_c = 4 * 4 cm2, Lg = 0.06 cm, L_c = 40 cm.The number of turns of the coil is 600 ,assume the relative permeablitiy is 6000 for iron. **Calculate the folowing** when the flux density in the core is (1.2 sin 314t) Tesla. [5 Marks]

I. Induced emf.
II. Magnetic field energy .
III. The root mean square value of the exciting current.

B. For the mechanical configuration shown in figure (4) . **Calculate** the magnitude of torque when the maximum flux density in the air gap is limited to 2.2 T the radius of the rotor is 50 mm ,the air gap length g is 2mm and axial length h =10 mm. [5 Marks]

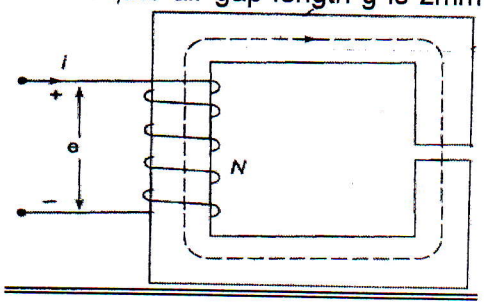

FIGURE (3)

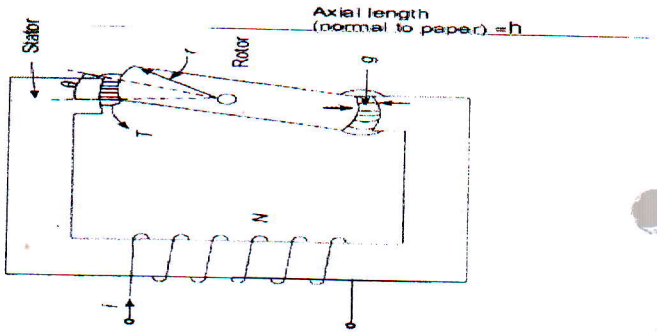

FIGURE (4)

Question 4:[20 Marks]

A. Two coils have self- and mutual-inductances of the configuration shown in figure (5)

$$L11 = L22 = 2/(1+2x) \quad \text{and} \quad L12 = 1/(1+2x)$$

I. The current I1 is maintained constant at 5 A and I2 at –2 A. **Find** the mechanical work done when x increases from 0 to 0.5 m. **What is the direction** of the force developed.
II. During the movement in part(I), **calculate** the energy supplied by sources supplying I1and I2
III. **Calculate the average force** and **coil currents** for the two coils are connected in series across a voltage source of 100 cos314t . [10 Marks]

B. Figure (6) shows the cross-sectional view of a cylindrical plunger magnet. The position of the plunger when the coil is unexcited is indicated by the linear dimension D. Assume the iron to be infinitely permeable. **Derive an expression for** : [10 Marks]

I. The force in terms of the data shown on the figure.
II. The coil voltage

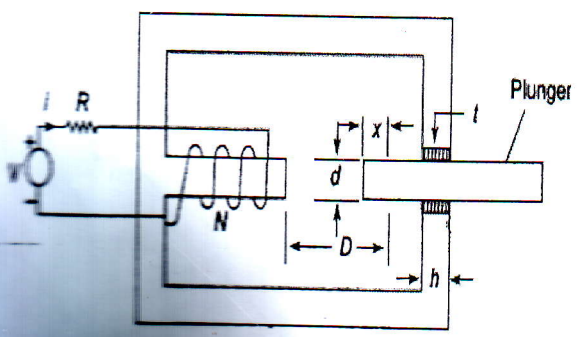

FIGURE (5)

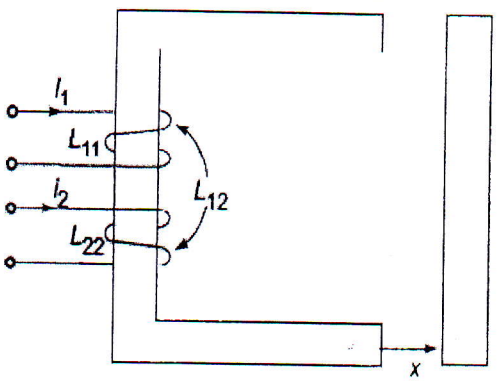

FIGURE (6)

This exam measures the following ILOs			
	Knowledge &Understanding Skills	Intellectual Skills	Professional Skills
	Q1A , Q2B,Q2C,Q3A,Q3B	Q3B,Q4A,Q1C,Q1B	Q2A , Q4B

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