THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
LEVEL 4
FINAL EXAMINATION 2008/2009
MEX4271 – SENSORS AND ACTUATORS
DATE : 8th MARCH 2009
TIME : 0930HRS TO 1230HRS
DURATION : THREE HOURS [3 hrs]

036

READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING THE QUESTION PAPER

- This question paper has eight questions.
- Answer five questions only.

Question 01:

i. Briefly discus advantage and disadvantages of photo electric effect?
ii. Define terms mechanical loading and electrical loading, in the context of motion sensing. Explain how these loading effects can be reduced in the process of motion sensing.
iii. Explain the principle of operation of a Linear Differential Variable Transducer (LVDT).

Question 02:

i. State Faraday's and Ampere's Laws.
ii. Consider toroidal coil shown in Figure Q2 drive an expression for the magnetic field density B on the center line of the core in terms of the number of coil turns N, the current I, the permeability μ of the core and the physical dimensions.

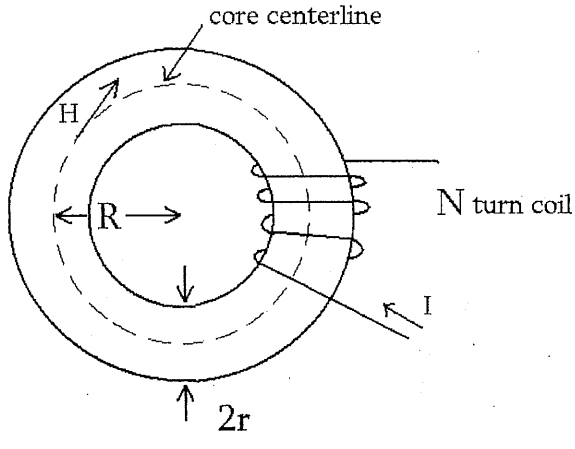


Figure Q2

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iii. Assuming that the flux density is constant throughout the core, find expressions for the ***total flux*** and the ***flux linkages.***

Question 03:

i. Briefly explain ***core loss*** in a coil having an iron core.
ii. In motors, generators and transformers, the conversion of energy into heat in undesirable. Therefore what factors should consider when selecting alloy and permanent magnet.
iii. What is ***eddy-current loss*** in the core material?
iv. Briefly explain what are the action you can take to minimize the eddy current in the core material

Question 04:

A 3-phase induction motor having a synchronous speed of 1200rpm draws 80kW from a 3-phase feeder. The copper losses and iron losses in the stator amount to 5kW. If the motor runs at 1152rpm, calculate the following:

i. The active power transmitted to the rotor.
ii. The rotor I^2R losses.
iii. The mechanical power delivered.
iv. The mechanical power delivered to the load, knowing that the windage and friction losses are equal to 2kW.
v. The efficiency of the motor.

Question 05:

i. What is the difference between a reluctance and a permanent magnet stepper motor?
ii. Describe the construction of a hybrid stepper motor.
iii. A15°per step stepper motor is given 64 step clockwise and 12 step anti clockwise. Assuming it started at 0°, find the final position.

Question 06:

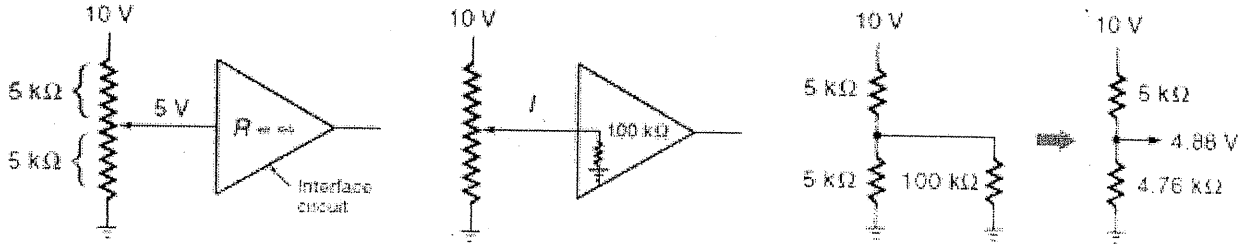
i. What are the factors taken into account while selecting pneumatic pipes?
ii. Briefly explain the function of following Compressors.

a. Rotary Vane compressor
b. Twin lobe compressor
c. Screw compressor

Question 07:

i. A 10-KΩ pot is used as a position sensor shown in Figure Q7. Assume that the wiper is in middle of its range. Find the loading error when

   a. The interface circuit presents an infinite resistance.
   b. The interface circuit presents a resistance of 100kΩ.



(a) Pot is unloaded: no error

(b) 100kΩ resistance cause loading error

(c) Equivalent circuit of Figure Q7(b)

Figure Q7

ii. The resistive element of a wire-wound pot is made from 10mm of 100Ωmm^{-1} resistance wire and is wound as a coil 200 loops. The range of the pot is 350°. What is the resolution of this pot?

Question 08:

i. Describe the basic details of
   a. a popet valve
   b. a shunttle valve
ii. Explain how sequential valve can be used to initiate an operation only when another operation has been completed.
iii. Design a pneumatic valve circuit to give the sequence A+, followed by B+ and then simultaneously followed by A- and B-.

-End-