

Ex/MPE/6531/213/2006

MASTER OF POWER ENGG. EXAMINATION, 2006

(2nd Semester)

POWER TRANSDUCERS TECHNOLOGY

Time: Three hours

Full Marks: 100

Answer any *five* questions.

All questions carry equal marks.

1. (a) Describe the basic principles of a Hall device and explain how it can be used as a magnetic sensor. 6

(b) For a given field condition, on what factors and parameters of the sensor does the Hall voltage output depend? 4

(c) Explain the working of a “Hall effect current transducer”. 6

(d) A Hall effect transducer is used in the measurement of a magnetic field of 0.8 Tesla.

The 2 mm thick slab is made of Bismuth for which the Hall co-efficient is -1×10^{-8} Vm/A and the current is 2.5 A.

Find the corresponding Hall voltage. 4

2. (a) Describe with diagrams, the principle of operation of a co-axial torque sensor. 12

(b) What is an active zone in such a sensor? Why it is provided? Explain. 8

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(2)

3. (a) How does an eddy current proximity sensor operate ?

How is the induced eddy current related to the conductivity and vector potential?

How do the permeability of the material and the supply frequency influence the measurement? 12

(b) Explain the principle of operation of an eddy-current Tachometer. 8

4. (a) Define the term "Telemetry" and explain why it is necessary in an instrumentation systems. 6

(b) Enumerate the different types of Telemetry systems. 4

(c) Explain the voltage Telemetry and motion balance systems. 6

(d) In a PCM (Pulse Code Modulation) system 7-bit encoder is used. Suppose each level represents a voltage of 1 V, what is the range of the encoder. Find the quantization error on account of PCM if a voltage of 1V, what is the range of the encoder. Find the quantization error on account of PCM if a voltage of 125.75 volts is involved. 4

5. (a) Enumerate the stages of a signal conditioning system.

Draw a block diagram of a dc signal conditioning system and explain the functions of each block. 12

(b) What are the desirable characteristics of a d.c. amplifier? What is its greatest disadvantage? 6

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(c) What linear and non-linear processing tasks may be required to be carried out by the signal conditioning equipment? 4

6. (a) What is a transducer ? Give the basis of classification of transducers with examples of respective applications. 14

(b) Explain the advantages of Electrical Transducers. 6

7. (a) Derive a general expression for force developed in a doubly excited transducer. 12

(b) Two coils have the following values of self and mutual inductances (in henrys) as functions of displacement x (in metres).

$$L_{11} = 1+x ; L_{22} = 2(1+x); L_{12} = L_{21} = 1-x.$$

The resistances are negligible.

(i) For constant, $I_1 = 8A$ and $I_2 = -4A$, Compute the mechanical work done in increasing x from Zero to 0.5m.

(ii) During motion how much energy is supplied by source 1 ? By source 2 ? 8
