

MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

THIRD SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.) **END SEMESTER EXAMINATIONS, NOV/DEC 2016**

SUBJECT: SENSORS AND TRANSDUCERS [ICE 2105]

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitably assumed.
- 4 What is Self-Heating mode of a sensor? Which sensors may be used in this mode? 1A. State any one application where a sensor is used in self heating mode?
- **1B.** Define Calibration, Repeatability, Reproducibility, Traceability and Robustness with 6 the help of suitable examples.
- 2A. From an application perspective, what is the significance of the law of homogenous 2 metals?
- **2B.** Derive an expression for sensitivity of a metallic strain gauge connected in half 3 bridge configuration as shown in Fig Q2B. Assume that the gauges are identical with the same gauge factor, an input voltage of V is applied and all resistances in their relaxed state are R ohms each.
- **2C.** Identify the type of the load cell depicted in Fig.Q2C and explain its signal 2 conditioning circuit.
- **2D** In order to measure strain in a cantilever beam, a single strain gauge of resistance 1 k 3 and gauge factor 2 is mounted on the beam and connected in one arm of a bridge circuit. The other three arms of the bridge have a resistance of 1000 ohm each. The bridge detector resistance is 100 ohm and its sensitivity is 10mm/µA and an input voltage of 10V. Calculate detector deflection for 0.1 % strain.
- How is a photodiode different from a phototransistor in terms of sensitivity and 1 3A. bandwidth?
- **3B**. A micro-strain-gauge of dimensions 100x50 microns as shown in the Fig. Q3B is to 5 be fabricated. Write down the steps and provide a brief explanation for each step.
- **3C.** With a neat schematic explain the concept of Mass Spectroscopy.
- Explain with a neat schematic how a variable area capacitive sensor may be used for 4A. 4 the measurement of displacement and velocity? For use in audio microphones, what should be the minimum excitation frequency? Explain
- **4B**. Compare hall effect sensor and eddy current sensor for measuring speed of a rotating 3 shaft?
- With the help of suitable diagrams illustrate the working of RVDT? State any one **4C**. 3 practical application of the same.

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- 5A. Prove that current transmitters are more efficient than voltage transmitters 3 mathematically.
- 5B. How can current be measured without actually establishing a physical contact. State 2 the principle. Explain with a schematic.
- 5C. Derive a mathematical expression for the piezoelectric effect? How does a QCM 3 work as a biosensor?
- **5D.** With neat diagrams, illustrate the operation of a resolver.



Fig. Q2B

Fig.Q2C

Fig.Q3B

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