

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2023

M.Tech-I Semester (CSE/IT/ECE/CE/BT/BI)

COURSE CODE (CREDITS): 21M11EC111 (3)

MAX. MARKS: 35

COURSE NAME: SENSOR AND SMART INSTRUMENTATION

COURSE INSTRUCTORS: Dr. HARSH SOHAL

MAX. TIME: 2 Hours

Note: (a) All questions are compulsory.

(b) Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Q1. [CO1+CO2] Explain the following with references to sensors/instrumentation systems while giving suitable numerical examples and/or applications. [2x4=8]

- (a) Gross Errors
- (b) limiting errors or guarantee errors.
- (c) 'self heat condition' with reference to thermister
- (d) Radiation Pyrometers

Q2. [CO2, CO3] [6]

(a) Explain the basic principle of operation of capacitive transducers. What are the uses or applications of Capacitive Transducers? [2]

(b) A capacitive transducer uses two quartz diaphragms of area 1000 mm^2 separated by a distance of 3.0 mm. A pressure of 800 kN/m^2 when applied to the top diaphragm produces a deflection of 0.4 mm. The capacitance is 350 pF when no pressure is applied to the diaphragms. Find the value of capacitance after the application of a pressure of 800 kN/m^2 . [4]

Q3. [CO4, CO5] [7]

(a) What is piezo-resistive effect? Explain. How does it form the basis of working of a strain gauge? [3]

(b) A resistance, wire strain gauge with a gauge factor of 2 is bonded to a steel structural member subjected to a stress of 100 MN/m^2 . The modulus of elasticity of steel is 200 GN/m^2 .

Calculate the percentage change in the value of the gauge resistance due to the applied stress.
Comment upon the results. [4]

Q4.[CO4, CO5] [6]

(a) What is a Wheatstone bridge? Explain its principle of working. What are the areas where it finds applications? [3]

(c) A highly sensitive galvanometer can detect a current as low as 0.1 nA. This galvanometer is used in a Wheatstone bridge as a detector. The resistance of galvanometer is negligible. Each arm of the bridge has a resistance of $1\text{ k}\Omega$. The input voltage applied to the bridge is 20 V. Calculate the smallest change in resistance which can be detected. The resistance of the galvanometer can be neglected as compared with the internal resistance of bridge. [3]

Q5. [CO3, CO4, CO5] [8]

(a) What is an LVDT? Explain the working and construction of an LVDT. Also discuss the range of applications in which an LVDT may be employed. [4]

(b). The output of an LVDT is connected to a 5 V voltmeter through an amplifier whose amplification factor is 250. An output of 2 mV appears across the terminals of LVDT when the core moves through a distance of 0.5 mm. Calculate the sensitivity of the LVDT and that of the whole set up. The milli-voltmeter scale has 100 divisions. The scale can be read to $1/5$ of a division. Calculate the resolution of the instrument in mm. [2+2].