BITS, PILANI – DUBAI CAMPUS
Knowledge Village, Dubai

Semester I   2006 – 2007
III Year (EIE)

Comprehensive Examination (Closed Book)

Course No.: INSTR UC 381   **Course Title:** Transducers & Meas. Systems

Date: 25.12.2006   **Time: 03 Hours   M.M. = 40 (40 %)**

- *Attempt all question in serial order.*
- *Assume suitable data/assumptions, if needed.*

1.
[A]   Discuss the classification of types of Measurement Applications, with the help of examples.   [4]

[B]   Discuss the Input –Output Configuration of Instruments and Measurement systems.   [4]

2.
[A]   Draw the Time Domain specifications of an under damped Second Order System and thus define the various parameters.   [4]

[B]   A linear Second order system with single degree of freedom has a mass of 8×10^{-3} Kg and stiffness of 1000 N/m. calculate the natural frequency of the system and determine the damping constant necessary to just prevent overshoot in response to a step input of force.   [4]

3.
[A]   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 applied stress. Comment on the result.   [4]

[B]   With the help of a simple series circuit arrangement, show how will you measure the temperature using Thermistors.   [4]

4.
[A]   Write down the various advantages and Disadvantages of LVDT. The output voltage of a LVDT is 1.5 V at maximum displacement. At a load of 0.5 MΩ, the deviation from linearity is maximum and it is 0.003 V and -0.003 V from a straight line through origin. Find the linearity at the given load.   [2+2]

[B]   The lens of an optical pyrometer is clouded so that the transmission factor is 0.8. The instrument indicates a temperature of 1480 ^{0}C. Calculate the True Temperature.   [4]

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5.

[A]   Voltage E1 is applied to the horizontal input and voltage E2 is applied to the vertical input of CRO. E1 and E2 have the same frequency. The trace is an ellipse. The slope of major axis is positive. The maximum vertical value is 5.0 divisions and the point where the ellipse crosses the vertical axis is 2.5 divisions. The ellipse is symmetrical about the horizontal and vertical axis. Determine the possible phase angles of E2 with respect to E1.   [4]

[B]   Write technical notes on the following: [2+2]
(i)   Modulation and demodulation
(ii)   Telemetry

Course No.: INSTR UC 381   **Course Title:** Transducers & Meas. Systems

Date: 26.11.2006   **Time: 50Minutes   M.M. = 20 (20 %)**

- *Attempt all questions.*
- *Assume suitable assumptions, if needed.*

Q1. A U type manometer (Hg) is used for measurement of pressure of water in a pipe line. The right limb of the manometer is open to atmosphere while the left limb is connected to the pipe. In the right limb, the upper surface of Hg column is in exact level with the centre of the pipe and the difference of Hg levels in two limbs is 130 mm. calculate the pressure in the pipe in terms head of water and in Kn/m^2. The densities of water and Hg are 1000 Kg/m^3 and 13560 Kg/m^3.   [5]

Q2. A Pitot tube is used to measure flow velocity of water of density 1000 Kg/m^3. Determine the flow velocity at the head of the Pitot tube if it produces a differential pressure of 10 Kg/m^2 between its two outlets. Also if the same differential pressure is obtained in air at an altitude where the density of air is 0.65 Kg/m^3, determine the actual air velocity.   [5]
Take correction factor as 0.97.

Q3. Write a technical note on Rotameters, describing its advantages and disadvantages.   [4]

Q4. The lens of an optical pyrometer is clouded so that the transmission factor is 0.8. The instrument indicates a temperature of 1480 ^{0}C. Calculate the True Temperature.   [3]

Q5. Write a technical note on Thermistors.   [3]

Course No.: INSTR UC 381   **Course Title:** Transducers & Meas. Systems

Date: 15.10.2006   Time: 50Minutes   **M.M.** = 20 (20 %)

- *Attempt all questions.*
- *Assume suitable assumptions, if needed.*

Q1. Measurements on a human nerve cell indicate an open circuit voltage of 80 mV, and a current of 5 nA through a 6 M-ohm load. What is a maximum power available from the cell? [3]

Q.2. A thermometer has a time constant of 3.5 sec. It is quickly taken from a temperature 0 degree C to a water bath having a temperature 100 degree C. What temperature will be indicated after 1.5 sec? [2]

Q.3. A 2nd order instrument has a natural frequency of 4 Hz and a damping ratio of 0.66. If the excitation frequency of the system is 6 Hz, determine the error due to the proximity of excitation frequency with the natural frequency of the system. [3]

Q.4. Prove that for the liquid level system, the liquid head rises exponentially with time, when the liquid in flow rate is increased suddenly. [5]

Q.5. A pulse is applied to a piezo electric transducer for a time T. Prove that in order to keep the undershoot to a value within 5%, the value of time constant should be approx. 20 T. [4]

Q.6. Draw the time domain specification diagram for an under damped second order system, showing all specifications. [3]

Name:_____   Id:_____

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QUIZ (Closed Book)

Course No.: INSTR UC381   **Course Title: Transducers & Meas. Systems**

Date: 28.09.2006   **Time: 30 Minutes**   **M.M. = 20 (10 %)**

Q1. While generalizing the classification of Measurement Systems, they can be classified in to _____ major categories.

Q.2. Monitoring of processes and operations refers to situations where the _____ is being used to keep track of some quantity.

Q.3. Experimental Engineering Analysis is that part of engineering design, development and research that relies on lab testing of one kind or another to answer questions.   **(True / False)**

Q.4. Control of processes and operations usually refers to an automatic feedback control systems.   **(True / False)**

Q.5. The primary sensing element
a) deliver energy from measured medium
b) receives energy from measured medium
c) both a and b
d) none

Q.6. A component whose output energy is supplied entirely or almost entirely by its input signal is commonly called a _____.

Q.7. An active Transducer has an auxiliary source of power which supplies a minor output power while the input signal supplies major portion.   **(True / False)**

Q.8. For Analog Signals, The precise value of the quantity carrying the information is insignificant.   **(True / False)**

Q.9. Desired Inputs represent the _____ that the instrument is specifically intended to measure.

Q.10. Modifying inputs are the quantities that cause a change in the input-output relations for the desired and interfering inputs.

(True / False)

Q.11. Static calibration refers to a situation in which all inputs except one are kept at some constant value.

(True / False)

Q.12. A null type of instrument as compared to a deflection type instrument has
a) A higher accuracy
b) a lower sensitivity
c) a faster response
d) all of the above

Q.13. A meter reads 127.50 V and the true value of the voltage is 127.43. The static error is _____.

Q.14. A quantity whose magnitude has a definite repeating time cycle is called a
a) transient
b) steady state periodic
c) both a & b

Q.15. Dynamic response consists of _____ parts.

Q.16. The analogous of velocity in rotational system is _____ and in Electrical system is _____. (Force –Voltage Analogy)

Q.17. Linear Potentiometer is _____ order system.

Q.18. Liquid level system is _____ order system.

Q.19. Rise time is defined as time required for a system to rise from 100 to 200 percent of its final value.

(True / False)

Q.20. A set of readings has a wide range and therefore it has
a) Low Precision
b) High Precision
c) Low accuracy
d) High accuracy