

II B.Tech. I Semester Supplementary Examinations, May -2005
TRANSDUCERS AND INSTRUMENTATION COMPONENTS
(Instrumentation & Control Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Define the following static characteristics with necessary examples and graphs:
 - i. Accuracy
 - ii. sensitivity
 - iii. static error
 - iv. Dead space
 - v. Drift.
- (b) A voltage has a true value of 1.50 volts. An Analog indicating instrument with a scale range of 0-2.50 volts shows a voltage of 1.46 volts. What are the values of absolute error and correction. Express the error as a fraction of the true value and the full-scale deflection.
2. (a) What are the precautions to be taken care while fastening strain gauges on to the specimen explain.
- (b) A strain gauge is bonded to a beam 0.1 m long and has a cross sectional area 4cm^2 . Young's modulus for steel is 206GN/m^2 . The strain gauge has an unstrained resistance of gauge changes by 0.013Ω . Calculate the change in length of the steel beam and the amount of force applied to the beam.
3. Explain clearly the concept of loading effects and frequency response of piezo electric transducer.
4. (a) Write short notes on resistance thermometers.
- (b) What are the possible sources of errors in filled in thermometers and how are they minimized.
5. (a) What is velocity rates as applied to belt drives.
- (b) Derive the expression for velocity rate of belt drive.
- (c) Explain the effect of slip on the performance of the belt drive.
6. (a) What do you understand the term pneumatic amplification?
- (b) Explain the operation of pneumatic amplifier with required sketches?
- (c) Mention a few applications of pneumatic amplifier.
7. (a) Express a relationship between various voltages of a synchro transmitter.
- (b) How are synchros useful in error detection and correction in a servo control system.

8. (a) With a neat diagram explain the working of $3 - \theta$ stepper motor.
(b) A three- phase variable stepper motor has the following parameters.

Average Phase winding Resistance = 1 ohm

Average phase winding Inductance = 30mH

Rated winding current = 3A.

Design a simple uni polar drive circuit, such that the electrical time constant is 2 mSec at phase turn-on and 1 mSec. At turn-off. The stepping rate is 300 steps per second.

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2. (a) With a neat diagram explain the working of LVDT. Indicate the phase sensitive detection system for an LVDT.
- (b) In digital systems how synchro can be used. Explain.
3. (a) A displacement capacitive transducer uses a differential arrangement with two outer plates which are fixed and a central plate which is movable. The distance between fixed and movable plates is 5mm when no displacement is applied. A voltage of 1000v rms is applied across the fixed plates. Find the differential output voltage of a displacement of 0.01mm is applied to the central plate. Find also the sensitivity of the transducer.
- (b) Write a detailed a note on capacitive transducer signal conditioning.
4. (a) What are peltier and seebeck effects? How are they responsible in thermo-emf generation?
- (b) A copper-constantan thermocouple was found to have a linear relationship between $0^{\circ}C$ to $400^{\circ}C$ with emf at maximum temperature (Reference junction temperature $0^{\circ}C$) equal to 20.68 mV
 - i. Determine the correction which must be made to the indicated emf if the cold junction the temperature is $25^{\circ}C$.
 - ii. If the indicated emf is 8.92 mV, in the thermocouple circuit determine the temperature of the hot junction.
5. (a) Compare the performance of cycloidal and involute tooth gear.
- (b) Explain the basic principle and operation of intermeshers.

6. (a) Explain with a diagram the operation of pilot operated safety relief valve.
(b) What are the merits and demerits of pilot operated by safety relief valve?
7. Explain how d.c potentiometers are used for error detection and give the transfer characteristic of potentiometers.
8. (a) What is a multistock stepper moter?
(b) Describe the working of a multistock stepper motor with neat diagram.
(c) Mention two uses of stepper motor.

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1. (a) Explain with a block diagram an instrumentation system and explain the function of various blocks.
(b) The dead-zone of a certain pyrometer is 0.125 percent of the span. The calibration is $800^{\circ}C$ to $1800^{\circ}C$ what temperature change must occur before it is detected?
2. (a) Derive a relationship for incremental sensitivity and time constant of hot wire anemometer when operated under
 - i. Constant temperature mode
 - ii. The constant current mode.(b) Explain the techniques adopted for increasing the bandwidth of the basic hot wire anemometers.
3. (a) Describe the moving coil microphone system and identify the primary and secondary transducers of the arrangement.
(b) Explain the basic principles of operation of variable permeability transducers and show how the phenomenon of permeability enables measurement of certain physical quantities.
4. (a) Explain how the variation of ambient temperature causes error in filled-in-system thermometers.
(b) Explain the method adopted to minimize them.
5. (a) Classify different types of bearings.
(b) Where are ball and roller bearings are used in preference to one another in special applications.
6. (a) What is meant by pneumatic value actuator. Explain.
(b) What factors are to be considered in the selection of pneumatic valve actuator.
7. (a) What are the essential characteristics required of a switch.
(b) Mention different types of switches based on the number of circuits they can switch and the number of outlets for each circuit.
(c) Can active elements like diode and transistor be used as switch Explain.
8. (a) With a neat diagram explain the working of $3 - \theta$ stepper motor.

(b) A three- phase variable stepper motor has the following parameters.

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2. (a) Describe the constructional features of a linear variable differential transformer and comments on its merit in comparison to a push pull self inductive transducer.
- (b) Discuss the factors limiting the bandwidth and sensitivity of a linear variable differential transformer.
3. (a) In a variable capacitance transducer the diaphragms are 20mm in diameter and 4mm apart. If a pressure produces an average deflection of 0.25mm, calculate the value of capacitance after the application of force. The capacitance before application of force is 400pf.
- (b) Discuss the scheme of a variable permittivity of thickness dielectric type sensor.
4. (a) Describe the construction, theory and working of thermocouples.
- (b) Show how a thermocouple can be used as temperature Transducers.
5. (a) What is the coupling mechanism with operation of a clutch in an automotive?
- (b) In what way are they different from chain and belt drives?
- (c) Enumerate the applications of friction drives.
6. (a) How does a force balance controller differ from the motion balance controller.
- (b) Explain the essential difference between the hydraulic and pneumatic controllers. Enumerate the advantages and limitations of each controller?
7. (a) With neat diagrams explain the working of a synchro transmit receive system.
- (b) Mention major applications of synchro system.

8. (a) With diagram explain the operation of a permanent magnet stepper motor.
- (b) How are stepper motors superior to ordinary motors under specific requirements.

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