

III B.Tech I Semester Regular Examinations, November 2006

INDUSTRIAL INSTRUMENTATION

(Electronics & Instrumentation Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions

All Questions carry equal marks

1. (a) What are mechanical comparators? Why is it used ? Give its classification. Explain each in detail .
(b) Describe the construction and working principle of mechanical optical comparators. [9+7]
2. (a) Draw the response curves of Accelerometers.
(b) Discuss the relative characteristics of commonly used Accelerometers.
(c) Describe in detail about Seismic type velocity transducer (moving coil). [5+5+6]
3. (a) A variable reluctance type tachometer has 60 rotor teeth. The counter records 3600 counts per second. Determine the speed in rpm.
(b) An Inductive pick up operating from a 60 tooth wheel is used with a digital frequency meter to determine the speed of rotation of a shaft on which the wheel is mounted the gating period is set to $10^4 \mu s$ and a reading of 0.024 is obtained on 4 digital display. What shaft speed does this represent in r.p.s ? if the available gating periods are $10^2, 10^3, 10^4, 10^5, 10^6, 10^7$ and $10 \mu s$ respectively, which would be the optimum setting of gating period for making this measurement.
(c) While measuring speed of a steam turbine with Stroboscope single line images were observed for Stroboscope setting of 3000, 4000 and 5230 rpm. Calculate the speed of the turbine. [5+6+5]
4. (a) With the help of a circuit diagram, explain how temperature compensation is done in load cell circuits for the variations of Young's modulus with temperature. Derive the necessary equation.
(b) Considering idealized model of an elastic force transducer determine its dynamic Response. [9+7]
5. (a) Distinguish between the terms vibration and shock
(b) Using working of bonded strain gauge accelerometer. [8+8]
6. What is a strain gauge? Explain the strain gauge load cell method of measuring density. [16]
7. What are the industrial needs which make viscosity determination desirable? Classify the viscosity measuring instruments according to their principle of operation.

[16]

8. (a) Explain how resistive transducers can be used for measurement and control of relative humidity. Describe its advantages and disadvantages.
- (b) Describe the theory and working of a sling psychrometer used for the measurement of relative humidity. What are its limitations? [8+8]

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1. (a) Write in detail about fluid displacement comparators
(b) Discuss the construction and working principle of differential comparators.
[8+8]
2. (a) Describe in detail about the principle of rotational velocity measurement.
(b) How will you measure relative velocity ? Discuss briefly about the basic Principle of any one method of relative velocity measurement. [8+8]
3. (a) A variable reluctance type tachometer has 60 rotor teeth. The counter records 3600 counts per second. Determine the speed in rpm.
(b) An Inductive pick up operating from a 60 tooth wheel is used with a digital frequency meter to determine the speed of rotation of a shaft on which the wheel is mounted the gating period is set to $10^4 \mu s$ and a reading of 0.024 is obtained on 4 digital display. What shaft speed does this represent in r.p.s ? if the available gating periods are $10^2, 10^3, 10^4, 10^5, 10^6, 10^7$ and $10^8 \mu s$ respectively, which would be the optimum setting of gating period for making this measurement.
(c) While measuring speed of a steam turbine with Stroboscope single line images were observed for Stroboscope setting of 3000, 4000 and 5230 rpm. Calculate the speed of the turbine. [5+6+5]
4. With the help of neat sketch explain the operation of strain gage load cell. Derive the expression for output voltage. [16]
5. (a) How mechanical shocks are measured. Explain the principle and working.
(b) Give the system characteristics of the complete measuring system for vibration and shock. [8+8]
6. Briefly explain Buoyancy method of density measurement and give its advantages, disadvantages and applications. [16]
7. What are the industrial needs which make viscosity determination desirable? Classify the viscosity measuring instruments according to their principle of operation.
[16]
8. (a) How the moisture content in leather can be measured?

Code No: RR311003

Set No. 2

(b) Explain briefly about crystal hygrometer.

[8+8]

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1. (a) What is protection comparator? Show a sketch to illustrate the principle and give the type of works for which this instrument is specially suitable .
(b) Why parallel light must be used when projecting cylindrical objects in a project ? [8+8]
2. (a) Describe the basic principle of Seismic Accelerometer.
(b) Explain the basic principle of Inductive Accelerometer [8+8]
3. (a) A variable reluctance type tachometer has 60 rotor teeth. The counter records 3600 counts per second. Determine the speed in rpm.
(b) An Inductive pick up operating from a 60 tooth wheel is used with a digital frequency meter to determine the speed of rotation of a shaft on which the wheel is mounted the gating period is set to $10^4 \mu\text{s}$ and a reading of 0.024 is obtained on 4 digital display. What shaft speed does this represent in r.p.s ? if the available gating periods are $10^2, 10^3, 10^4, 10^5, 10^6, 10^7$ and $10 \mu\text{s}$ respectively, which would be the optimum setting of gating period for making this measurement.
(c) While measuring speed of a steam turbine with Stroboscope single line images were observed for Stroboscope setting of 3000, 4000 and 5230 rpm. Calculate the speed of the turbine. [5+6+5]
4. A torsion bar is made of mild steel and has a diameter of 25mm. The shear modulus of mild steel is 80 GN/m^2 . Calculate the value of shear sensitivity. Suppose a torque of 10^4 N-m is applied to the bar, calculate the value of shear strain angle. If the bar is notched to 15 mm diameter, what is the value of shear sensitivity and the shear angle for the above torque. [16]
5. With the help of neat sketches and mathematical relations explain the measurement of vibration using Piezo Electric Pick up. [16]
6. (a) Explain with a neat diagram the radiation type of measuring density.
(b) Explain briefly about specific gravity scales generally used in the petroleum industries. [8+8]
7. Explain the different methods of measuring consistency along with their usage. [16]
8. (a) Explain specific humidity, DBT, WBT.

Code No: RR311003

Set No. 3

(b) Explain about Galvanometric Hygrometer.

[8+8]

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(b) Describe the construction and working principle of mechanical optical comparators. [9+7]
2. Explain the basic principle of
(a) strain gauge Accelerometers
(b) piezo electric Accelerometers [8+8]
3. (a) Suggest one method to measure the rotational speeds upto 5000 r/min at an accuracy of $\pm 1/2$.
(b) Discuss the principle of tachogenerators. [8+8]
4. Explain the measurement of force using gyroscopic transducer. Derive its transfer function. [16]
5. A seismic motion transducer has a mass of 50 g. Its undamped natural frequency is 10 Hz and damping ratio is 0.6. The relative motion of the seismic mass with respect to the frame of the transducer is converted to voltage by a first order transducer which has a static voltage sensitivity of 2 V/mm and time constant of 0.01s. Find the output voltage for an input motion of 0.5 mm at a frequency of 30 Hz. Derive the formula used. [16]
6. (a) Explain with a neat diagram the radiation type of measuring density.
(b) Explain briefly about specific gravity scales generally used in the petroleum industries. [8+8]
7. What are the industrial needs which make viscosity determination desirable? Classify the viscosity measuring instruments according to their principle of operation. [16]
8. (a) Explain how resistive transducers can be used for measurement and control of relative humidity. Describe its advantages and disadvantages.
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