**Dr. Mahalingam College of Engineering and Technology, Pollachi.**

(An Autonomous Institution affiliated to Anna University of Technology, Coimbatore)

**Mid Semester Examination**

**ME Structural Engineering**

**11ST102 EXPERIMENTAL METHODS AND MODEL ANALYSIS**

Semester: 1st Semester Date : 06.11.2012

Duration: 3 hours Maximum Marks: 100

**Section – A (10x2=20 Marks)**

1. What are the basic requirements for measurement?
* The standard used for comparison purpose must be accurately defined and should be commonly accepted.
* The apparatus used and the method adopted must be provable.
1. Differentiate between range and accuracy.

Range is the amount or extent a value can be measured where as Accuracy is the ability of a measurement to match the actual value of the quantity being measured.

1. What do you understand by stress and strain invariants?

Invariants are quantities which remain unchanged upon rotation of the coordinate system. The stresses and strains can be expressed in any arbitrary rectangular orthogonal coordinate system, and the same principal stresses and principal strains must result irrespective of the coordinate system used. Thus, in the equations, for finding the principal stresses or principal strains, the coefficients are called stress invariants because their values do not vary under rotation of coordinates.

1. List the limitations of the mechanical strain gauge.
* Useful when strain gradient is small
* When adequate space is available for fix the gauge
* When the effect mass of the gauge is insignificant compared to the mass of the structure/test specimen
1. Name the materials used for resistance type electrical strain gauges.

Constantan(Copper, Nickel),

Iso-Elastic(Elinvar),

Nichrome, Manganin,

Chromel-C.

1. What do you understand by STC gauges?

The change in temperature will affect the strain measurement readings due to the thermal expansion. Several methods are available to compensate for the temperature effect. In one of the approach is to manufacture the gauge itself as the self-temperature compensated (STC) strain gauge. STC gauges made up of two parts: one with positive response to the temperature and the other having negative response, and are so proportioned to cancel each other over a change in the temperature.

1. What is the function of the fourth gauge in the T-Delta rosette?

The Fourth gauge in the T-Delta is used to validate and refine the results of the three primary gauges.

1. What are the advantages of strain rosette?

To find general state of strain, the strain gauge elements are necessary. Advantage of strain rosettes over 3 individual strain gauges are as follows:

Installation is very easy

Can be installed in a small area

Angle between the gauges will not change

1. What is a dummy gauge?

Dummy gauge is the gauge which used in the circuit but not fixed on the test specimen. The purpose of this gauge is to compensate the error induced in the active gauge due to temperature change and other causes.

1. What is the necessity of calibration?

The calibration of all instruments is important since it affords the opportunity to check the instrument against a known standard and subsequently to errors in accuracy.

**Section – B (5x16=80 Marks)**

11.(a) Explain each of the basic characteristics of a strain gauge? Discuss the factors that are to be considered while selection a strain gauge?

(**OR**)

11.(b) Write notes on the follwing

 i) Linear Variable Differential Transformer (4)

 ii) Electronic Load cell (4)

 iii) Cathode Ray Oscilloscope (4)

 iv) Seismograph (4)

12.(a) What are the various types of mechanical strain gauges? Explain the construction and working principle of Huggenberger tensometer in detail with neat sketch.

 (**OR**)

12.(b) Explain the construction and working principle of the following strain gauges in detail with neat sketch:

 i). Acoustical Strain gauge (8)

 ii) Optical strain gauge (8)

13.(a) What are the different types of resistance strain gauges? What are their advandages of over other types of gauges? Explain the processes, steps and precautions involved in installation of foil type strain gauge.

 (**OR**)

13.(b) i) Determine the percentage error introduced by neglecting transverse sensitivity if a strain gauge having Sg = 2.10, S║=2.12, S┴ = 0.0191, K=0.9% is used to determine the longitudinal strain in a steel beam having ν = 0.30. (8)

 ii) A cylindrical steel tank 125cm diameter has a wall thickness of 6mm and is subjected to an internal pressure of 2.5N/mm2. Calculate the expected strain reading from a gauge used as a maximum principal stress gauge. (8)

14.(a) A delta rosette yields the following strain indications, εA= -845 m/m, εB= 1220 m/m, εC= 710 μm/m. Calculate the angle from the axis of gauge ‘A’ to the maximum principal strain, principal stress, the maximum principal stress and maximum shear stress. E=200GPa and ν = 0.285.

 **(OR)**

14.(b) Derive expression for the output voltage of an unbalanced Wheatstone bridge. Show how this expression can be used for measuring strain.

15.(a) A four arm strain gauge wheatstone bridge is mounted on a steel shaft (E=200GPa, ν = 0.30) so that two strain gauges sense maximum tensile strain and the other two sense maximum compressive strain. The gauges are arranged to yield maximum strain output due to torque. If the strain indicator reading is 1500 μm/m strain, determine the maximum stresses in the shaft.

(**OR**)

15.(b) Write short notes on the following with sketches:

 i) Displacement and Force transducers (5)

 ii) Velocity and Acceleration transducers (5)

 iii) Digital data Acquisition system (6)

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