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<b>NEW SCHEME</b>
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**Fourth Semester B.E. Degree Examination, Dec 06 / Jan 07**  
**ME/IP/IM/MA/AU**

**Metrology and Measurements**

Time: 3 hrs.]

[Max. Marks:100

- Note:** 1. Answer any FIVE full questions choosing at least TWO questions from each part.  
2. Draw neat sketches wherever required.

**PART A – METROLOGY**

- 1 a. Define meter in terms of wavelength standards and list its advantages. (04 Marks)  
b. Four length bars A, B, C and D of basic length 100 mm each are to be calibrated using a calibrated length bar of 400 mm whose actual length is 399.9992 mm. It was also found that lengths of bars B, C and D in comparison to A are +0.0002 mm, +0.0004 mm and -0.0001 mm respectively and the length of all above four bars put together in comparison to standard calibrated bar is +0.0003 mm longer. Determine the actual dimension of all four end bars. (06 Marks)  
c. What is the difference between unilateral tolerance and bilateral tolerance and why unilateral tolerance is preferred over bilateral tolerance? (04 Marks)  
d. The slip gauge set M 38 consists of the following:

Range mm	Steps mm	Pieces
1.005	-	01
1.01 - 1.09	0.01	09
1.1 - 1.9	0.1	09
1.0 - 9.0	1.0	09
10.0 - 100.0	10.0	10

List the slip gauges to be wrung together to produce the following dimensions:

- i) 15.09      ii) 101.345 (06 Marks)

- 2 a. Explain three types of fits with neat sketches. (06 Marks)  
b. Design the general type GO and NOGO gauges for a component having 25 H7 f8 fit. Following details may be used:  
i) 25 mm falls in D/A step 18-30 mm  
ii)  $i = 0.45\sqrt[3]{D} + 0.001D$   
iii) Upper deviation of 'f' shaft =  $-5.5D^{0.41}$   
iv) IT7 = 16i and IT8 = 25i  
v) Wear allowance on gauge = 10% of gauge tolerance. (10 Marks)  
c. What are airy points and their significance? (04 Marks)
- 3 a. Explain Taylor's principle of design of gauges. (04 Marks)  
b. Explain the working of Johansson Mikrokator with a neat sketch. (08 Marks)  
c. Explain the working of Solex gauge with a neat sketch along with its application and limitation. (08 Marks)

- 4 a. With a sketch define the following terms with respect to a screw thread:
- Major DIA
  - Effective DIA
  - Pitch
  - Angle of thread. (04 Marks)
- b. With a sketch, explain how the effective diameter of a metric thread is determined by using 3 wire method. Derive the necessary formulae. (08 Marks)
- c. With a sketch explain the measurement of chordal thickness of a spur gear tooth using gear tooth vernier caliper. Derive the necessary formulae. (08 Marks)

### PART B – MEASUREMENTS

- 5 a. Explain the concept of 'generalized measurement system' with block diagram taking the working of bourdon pressure gauge as an example. (08 Marks)
- b. Define the following terms:
- Hysteresis
  - Error
  - Precision
  - Accuracy
  - Threshold
  - Reproducibility. (06 Marks)
- c. Classify and sub classify errors. Explain briefly each type of error with example and how it can be reduced. (06 Marks)
- 6 a. Explain with sketch the working of following transducer:
- Capacitance transducer by changing area. (08 Marks)
  - Peizo electric transducer. (06 Marks)
- b. With a block diagram of telemetering transmitting and receiving system explain its functioning. (06 Marks)
- c. With block diagram explain working of X-Y plotters. (06 Marks)
- 7 a. With a sketch explain the working of optical pyrometer and its application. (08 Marks)
- b. With a sketch explain the method of measurement of strain by Wheatstone Resistance Bridge. (06 Marks)
- c. With a sketch explain how pressure can be measured. (06 Marks)
- 8 Write short notes on any four:
- Optical flats
  - Sine bar
  - Ballast circuit
  - Proving ring
  - Mounting of strain gauges
  - Thermocouple. (20 Marks)

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**NEW SCHEME**

**Fourth Semester B.E. Degree Examination, July 2006**  
**ME / IP / MA / IM / AU**  
**Metrology and Measurement**

[Max. Marks:100

Time: 3 hrs.]

Note: I. Answer any FIVE questions choosing at least two full questions from each of the parts A and B.

PART - A

- 1 a. Explain the following :
  - i) Line standard (10 Marks)
  - ii) End standard
  - iii) Airy points
- b. Using M-87 slip gauge set, give the slip gauge combination to build the following dimensions :
  - i) 54.2365 mm (05 Marks)
  - ii) 65.3285 mm. (05 Marks)
- c. Write an explanatory note on "Grades of slip gauges".
  
- 2 a. Distinguish between the following :
  - i) Hole basis system and Shaft basis system (10 Marks)
  - ii) Unilateral tolerance and Bilateral tolerance.
- b. Explain briefly the following :
  - i) Applications of interference fits. (10 Marks)
  - ii) Gauge materials.
  
- 3 a. With the aid of neat sketches explain the construction and operation of an LVDT. (10 Marks)  
Mention its merits and demerits. (05 Marks)
- b. Sketch and explain Johansson's Mikrokator.
- c. Mention the nominal angles of a standard set of angle gauges and indicate how the following angles can be built using angle gauges i) 32° 15' 33" ii) 54° 30' 42" (05 Marks)
  
- 4 Explain briefly the following ; give sketches wherever necessary :
  - a. Optical flat
  - b. 3-wire method of measuring effective diameter of screw threads.
  - c. Gear-tooth thickness measurement using gear tooth vernier. (20 Marks)
  - d. Applications of autocollimator.

**PART - B**

- 5 a. With the aid of a block diagram explain the three stages of a generalized measurement system. (10 Marks)
- b. Identify the I-stage , II-stage and III-stage elements in the following measuring instruments :
- i) Digital revolution counter.
  - ii) Mercury-in -glass thermometer. (05 Marks)
- c. Distinguish between the following :
- i) Independent linearity and proportional linearity.
  - ii) Precision and accuracy. (05 Marks)
- 6 a. With the aid of a neat sketch explain a capacitance pickup to measure liquid level. (05 Marks)
- b. Distinguish between the following :
- i) Oscilloscope and Oscillograph.
  - ii) Active transducer and passive transducer. (05 Marks)
- c. Sketch and explain a light beam oscillograph. (10 Marks)
- 7 a. With the aid of a neat sketch explain how strain in a machine element subject to tensile load can be measured using electrical resistance strain gauges. Use a compensation gauge also. (10 Marks)
- b. With the aid of a neat sketch, explain a fluid friction type dynamometer for larger capacities. (05 Marks)
- c. Sketch and explain the construction and operation of a pressure measuring device for very high pressure measurement. (05 Marks)
- 8 With neat sketches wherever necessary , explain briefly the following :
- a. Wheat-stone bridge.
  - b. Calibration of electrical resistance strain gauge.
  - c. Proving ring.
  - d. Optical pyrometer. (20 Marks)

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<b>NEW SCHEME</b>
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**Fourth Semester B.E. Degree Examination, July 2006**  
**ME / IP / MA / IM / AU**  
**Metrology and Measurement**

Time: 3 hrs.]

[Max. Marks:100

*Note: 1. Answer any FIVE questions choosing at least two full questions from each of the parts A and B.*

PART - A

- 1 a. Explain the following :
  - i) Line standard
  - ii) End standard
  - iii) Airy points (10 Marks)
- b. Using M-87 slip gauge set, give the slip gauge combination to build the following dimensions :
  - i) 54.2365 mm (05 Marks)
  - ii) 65.3285 mm. (05 Marks)
- c. Write an explanatory note on "Grades of slip gauges". (05 Marks)
  
- 2 a. Distinguish between the following :
  - i) Hole basis system and Shaft basis system
  - ii) Unilateral tolerance and Bilateral tolerance. (10 Marks)
- b. Explain briefly the following :
  - i) Applications of interference fits. (10 Marks)
  - ii) Gauge materials.
  
- 3 a. With the aid of neat sketches explain the construction and operation of an LVDT. Mention its merits and demerits. (10 Marks)
- b. Sketch and explain Johansson's Mikrokator. (05 Marks)
- c. Mention the nominal angles of a standard set of angle gauges and indicate how the following angles can be built using angle gauges i)  $32^{\circ} 15' 33''$  ii)  $54^{\circ} 35' 42''$ . (05 Marks)
  
- 4 Explain briefly the following : give sketches wherever necessary :
  - a. Optical flat
  - b. 3-wire method of measuring effective diameter of screw threads.
  - c. Gear-tooth thickness measurement using gear tooth vernier. (2 Marks)
  - d. Applications of autocollimator.

**PART – B**

- 5 a. With the aid of a block diagram explain the three stages of a generalized measurement system. (10 Marks)
- b. Identify the I-stage , II-stage and III-stage elements in the following measuring instruments :
- i) Digital revolution counter.
  - ii) Mercury-in –glass thermometer. (05 Marks)
- c. Distinguish between the following :
- i) Independent linearity and proportional linearity.
  - ii) Precision and accuracy. (05 Marks)
- 6 a. With the aid of a neat sketch explain a capacitance pickup to measure liquid level. (05 Marks)
- b. Distinguish between the following :
- i) Oscilloscope and Oscillograph.
  - ii) Active transducer and passive transducer. (05 Marks)
- c. Sketch and explain a light beam oscillograph. (10 Marks)
- 7 a. With the aid of a neat sketch explain how strain in a machine element subject to tensile load can be measured using electrical resistance strain gauges. Use a compensation gauge also. (10 Marks)
- b. With the aid of a neat sketch, explain a fluid friction type dynamometer for larger capacities. (05 Marks)
- c. Sketch and explain the construction and operation of a pressure measuring device for very high pressure measurement. (05 Marks)
- 8 With neat sketches wherever necessary , explain briefly the following :
- a. Wheat-stone bridge.
  - b. Calibration of electrical resistance strain gauge.
  - c. Proving ring.
  - d. Optical pyrometer. (20 Marks)

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**NEW SCHEME**

**Fourth Semester B.E. Degree Examination, July 2006  
ME / IP / MA / IM / AU  
Metrology and Measurement**

Time: 3 hrs.]

[Max. Marks:100

*Note: 1. Answer any FIVE questions choosing at least two full questions from each of the parts A and B.*

PART - A

- 1 a. Explain the following :
  - i) Line standard
  - ii) End standard
  - iii) Airy points (10 Marks)
- b. Using M-87 slip gauge set, give the slip gauge combination to build the following dimensions :
  - i) 54.2365 mm (05 Marks)
  - ii) 65.3285 mm. (05 Marks)
- c. Write an explanatory note on "Grades of slip gauges". (05 Marks)
  
- 2 a. Distinguish between the following :
  - i) Hole basis system and Shaft basis system
  - ii) Unilateral tolerance and Bilateral tolerance. (10 Marks)
- b. Explain briefly the following :
  - i) Applications of interference fits. (10 Marks)
  - ii) Gauge materials.
  
- 3 a. With the aid of neat sketches explain the construction and operation of an LVDT. (10 Marks)  
Mention its merits and demerits. (05 Marks)
- b. Sketch and explain Johansson's Mikrokator. (05 Marks)
- c. Mention the nominal angles of a standard set of angle gauges and indicate how the following angles can be built using angle gauges
  - i)  $32^{\circ} 15' 33''$
  - ii)  $54^{\circ} 36' 42''$  (05 Marks)
  
- 4 Explain briefly the following ; give sketches wherever necessary :
  - a. Optical flat
  - b. 3-wire method of measuring effective diameter of screw threads.
  - c. Gear-tooth thickness measurement using gear tooth vernier. (20 Marks)
  - d. Applications of autocollimator.

**PART – B**

- 5 a. With the aid of a block diagram explain the three stages of a generalized measurement system. (10 Marks)
- b. Identify the I-stage , II-stage and III-stage elements in the following measuring instruments :
- i) Digital revolution counter.
  - ii) Mercury-in –glass thermometer. (05 Marks)
- c. Distinguish between the following :
- i) Independent linearity and proportional linearity.
  - ii) Precision and accuracy. (05 Marks)
- 6 a. With the aid of a neat sketch explain a capacitance pickup to measure liquid level. (05 Marks)
- b. Distinguish between the following :
- i) Oscilloscope and Oscillograph.
  - ii) Active transducer and passive transducer. (05 Marks)
- c. Sketch and explain a light beam oscillograph. (10 Marks)
- 7 a. With the aid of a neat sketch explain how strain in a machine element subject to tensile load can be measured using electrical resistance strain gauges. Use a compensation gauge also. (10 Marks)
- b. With the aid of a neat sketch, explain a fluid friction type dynamometer for larger capacities. (05 Marks)
- c. Sketch and explain the construction and operation of a pressure measuring device for very high pressure measurement. (05 Marks)
- 8 With neat sketches wherever necessary , explain briefly the following :
- a. Wheat-stone bridge.
  - b. Calibration of electrical resistance strain gauge.
  - c. Proving ring.
  - d. Optical pyrometer. (20 Marks)

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**NEW SCHEME**

**Fourth Semester B.E. Degree Examination, July 2006**  
**ME / IP / MA / IM / AU**  
**Metrology and Measurement**

Time: 3 hrs.]

[Max. Marks:100

Note: I. Answer any FIVE questions choosing at least two full questions from each of the parts A and B.

PART - A

- 1 a. Explain the following :
  - i) Line standard
  - ii) End standard
  - iii) Airy points (10 Marks)
- b. Using M-87 slip gauge set, give the slip gauge combination to build the following dimensions :
  - i) 54.2365 mm (05 Marks)
  - ii) 65.3285 mm. (05 Marks)
- c. Write an explanatory note on "Grades of slip gauges". (05 Marks)
  
- 2 a. Distinguish between the following :
  - i) Hole basis system and Shaft basis system
  - ii) Unilateral tolerance and Bilateral tolerance. (10 Marks)
- b. Explain briefly the following :
  - i) Applications of interference fits.
  - ii) Gauge materials. (10 Marks)
  
- 3 a. With the aid of neat sketches explain the construction and operation of an LVDT. Mention its merits and demerits. (10 Marks)
- b. Sketch and explain Johansson's Mikrokator. (05 Marks)
- c. Mention the nominal angles of a standard set of angle gauges and indicate how the following angles can be built using angle gauges
  - i)  $32^{\circ} 15' 33''$
  - ii)  $54^{\circ} 36' 42''$ . (05 Marks)
  
- 4 Explain briefly the following ; give sketches wherever necessary :
  - a. Optical flat
  - b. 3-wire method of measuring effective diameter of screw threads.
  - c. Gear-tooth thickness measurement using gear tooth vernier.
  - d. Applications of autocollimator. (20 Marks)

**PART – B**

- 5 a. With the aid of a block diagram explain the three stages of a generalized measurement system. (10 Marks)
- b. Identify the I-stage , II-stage and III-stage elements in the following measuring instruments :
- i) Digital revolution counter.
  - ii) Mercury-in –glass thermometer. (05 Marks)
- c. Distinguish between the following :
- i) Independent linearity and proportional linearity.
  - ii) Precision and accuracy. (05 Marks)
- 6 a. With the aid of a neat sketch explain a capacitance pickup to measure liquid level. (05 Marks)
- b. Distinguish between the following :
- i) Oscilloscope and Oscillograph.
  - ii) Active transducer and passive transducer. (05 Marks)
- c. Sketch and explain a light beam oscillograph. (10 Marks)
- 7 a. With the aid of a neat sketch explain how strain in a machine element subject to tensile load can be measured using electrical resistance strain gauges. Use a compensation gauge also. (10 Marks)
- b. With the aid of a neat sketch, explain a fluid friction type dynamometer for larger capacities. (05 Marks)
- c. Sketch and explain the construction and operation of a pressure measuring device for very high pressure measurement. (05 Marks)
- 8 With neat sketches wherever necessary , explain briefly the following :
- a. Wheat-stone bridge.
  - b. Calibration of electrical resistance strain gauge.
  - c. Proving ring.
  - d. Optical pyrometer. (20 Marks)

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USN

Fourth Semester B.E. Degree Examination, January/February 2005

Common to ME/P/MMA/MAU

**Metrology and Measurements**

[Max. Marks : 100]

Time: 3 hrs.]

Note: 1. Answer any FIVE questions choosing atleast TWO questions from each part.

2. Answer must be short and to the point only.
3. Write sketch wherever necessary.
4. Use of Data book, Chart, Table in any form is not permitted.

**PART A**

1. (a) Define Metre in terms of wave length standards and discuss the important features of wave length standards. (4 Marks)
- (b) Give details of M87 and M42 set of slip gauges. (4 Marks)
- (c) Using M112 set of slip gauges, build the following dimensions. (4 Marks)
  - i) 49.3115 ii) 68.208 iii) 52.496.
- (d) Four length bars A, B, C, D of approximately 250mm each are to be calibrated with standard calibrated metre bar which is actually 0.0008 mm less than a metre. It is also found that, bar B is 0.0002 mm longer than bar A, bar C is 0.0004 mm longer than bar A and Bar D is 0.0001mm shorter than bar A. The length of all four bars put together is 0.0003mm longer than calibrated standard metre. Determine the actual dimensions of each bar. (6 Marks)

2. (a) With neat sketch explain the following :

- i) Accumulation of tolerance ii) Compound tolerance. (6 Marks)
- (b) State and explain Taylor's principle of gauge design. (4 Marks)
- (c) For the assembly 28 H7/f8, calculate all the relevant dimensions. Dimension 28 falls in the range of 18 to 30. Fundamental elevation for  $f$  shaft is  $-5.5D^{0.41}$ .  $IT_7 = 16J$ ,  $IT_8 = 25J$  (10 Marks)

3. (a) What is comparator? What is the basis for classification of comparators? Give the detailed classification of comparators. (8 Marks)

(b) Sketch and explain the working of sigma comparator. (12 Marks)

(5 Marks)

4. (a) Explain the working of sine bar. (15 Marks)

(b) Give the details of angle gauge: set and build the following angles.

(15 Marks)

- i)  $49^\circ 36' 48''$  ii)  $35^\circ 32' 36''$

(c) Derive an expression for best wire size for 2 wire / 3 wire method of screw thread measurement. (8 Marks)

(d) Explain the gear tooth measurement using gear tooth vernier caliper. (15 Marks)

**PART - B**

(5 Marks)

5. (a) Explain the generalised measurement system. Give examples.

(b) Explain the following with respect to instrument

- i) Sensitivity ii) threshold
- iii) hysteresis iv) loading effect

(2x4=8 Marks)

(c) Give the detail classification of errors in measurement & also state the factors responsible for the above errors. (7 Marks)

6. (a) Differentiate between active and passive transducers with examples. (4 Marks)

(b) State the advantages of electrical transducers over other transducers. (4 Marks)

(c) State the advantages of electrical transducers over other transducers. (6 Marks)

(6 Marks)

(d) Write a note on telemetry. (8 Marks)

7. (a) Explain the working principle of CRO & give its application. (6 Marks)

(b) Where Pirani gauge is used and give the working principle with sketch. (6 Marks)

(c) Explain in detail the working principle of hydraulic dynamometers which is used for torque measurement. (6 Marks)

(6 Marks)

(6 Marks)

(6 Marks)

(6 Marks)

8. (a) Explain the laws of thermocouple. (6 Marks)

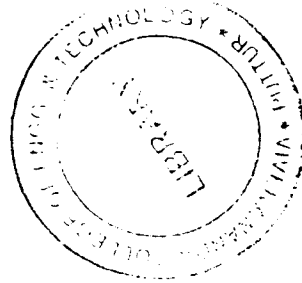
(b) What is pyrometer. Explain the working principle of optical pyrometer. (6 Marks)

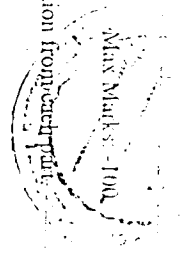
(c) Derive the expression for the gauge factor of the strain gauges in terms of poisson's ratio. (6 Marks)

(2 Marks)

(d) State different types of strain gauges.

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Note: - 1) Answer any five questions choosing at least two questions from each part.  
2) Draw neat sketches with pencils wherever required.

Part A

- Q1. a. Explain an "International Prototype meter" with a sketch. 04
- b. Distinguish between "Line standards" and "end Standards". 06
- c. Build up a dimension of 69.2375mm using M112 set slip gauges. 05
- d. Explain the concept of "Interchangeability". 05
- Q2. a. Explain three type of fits with sketches. 09
- b. Design "Go" and "No Go" gauges to control the production of a hole-shaft pair designated as  $100H_{7}e_8$ . 11  
Following details may be used.  
(i) 100mm shaft lies in a step of 80-120mm.  
(ii) Std. tolerance unit  $i$  is determined using a formula  $i = 0.45 \sqrt[3]{D} + 0.001D$  ( $D$  in mm,  $i$  in microns)  
(iii) The fundamental deviation for an 'e' grade shaft is obtained by a formula -  $11D^{0.14}$  microns.  
(iv) IT7 = 16i, IT8 = 25i.

- Q3. a. Explain the working of a "Sigma Comparator" with a neat sketch. 10
- b. Explain the working of a "Solex Gauge" with a neat sketch. 10
- a. Explain the working of a vernier bevel protractor with a neat sketch. 08
- b. Derive an expression for the "best size" of a wire used in measurement of thread. 05
- c. Explain the working of a "Gear tooth vernier" with a sketch. 07

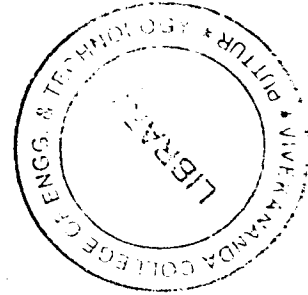
Part B

- Q5. a. Explain the concept of a "generalized measurement system" with block diagrams taking the working of a Bourdon Pressure gauge as an example. 08
- b. Define the following terms. 04
  - i. Accuracy
  - ii. Precision
  - iii. Sensitivity
  - iv. Threshold

## PART B

5. (a) What are the causes of errors in measurement? Give the detailed classification of errors. (10 Marks)
- (b) Elaborate the significance of the following terms used with reference to measurement  
 i) Accuracy ii) Precision  
 iii) Linearity iv) Repeatability  
 v) Resolution (10 Marks)
6. (a) With reference to transducers discuss the significance of following terms :  
 i) Transfer efficiency ii) Sensitivity. (6 Marks)
- (b) Explain the working of LVDT. (6 Marks)
- (c) Write a detail note on ballast circuit. (8 Marks)
7. (a) State any four terminating devices and explain any one. (6 Marks)
- (b) Sketch and explain the working of proving ring. (6 Marks)
- (c) Name the instruments used for pressure measurement. Explain the working of McLeod gauge. (8 Marks)
8. Write notes on the following :  
 i) Resistance thermometer (6 Marks)  
 ii) Thermo couples. (4 Marks)  
 iii) Mounting of strain gauges. (6 Marks)  
 iv) Strain measurement. (4 Marks)

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## NEW SCHEME

USN

Fourth Semester B.E. Degree Examination, July/August 2004

Common to ME/PI/MMA/AU

## Metrology and Measurements

[Max.Marks : 100]

Time: 3 hrs.

- Note: 1. Answer FIVE full questions choosing at least two questions from each part.  
 2. Draw neat sketches with pencil whenever required.

## PART - A

1. (a) Distinguish between line standard and end standards. Give examples of these two types of standard. (6 Marks)
- (b) Discuss the need of having light wave as standard of measurement. (4 Marks)
- (c) Write a brief note on the manufacture of slip gauges. (5 Marks)
- (d) Build up a dimension of 78.3667 mm using M112 set slip gauges. (5 Marks)
2. (a) Explain briefly the difference between the interchangeable manufacture and selective assembly. (4 Marks)
- (b) Determine the tolerances on the hole and the shaft for a precision running fit designated by 50H7/96. You may use the following aid for solving the problem.  
 i) 50 mm lies between 30-50mm (10 Marks)  
 ii)  $i = 0.46(D)^{1/3} + 0.001D$  (microns) (4 Marks)  
 iii) Fundamental deviation for 4 hole = 0  
 iv) Fundamental deviation for g shaft =  $-2.5D^{0.34}$  microns. (10 Marks)  
 v) IT7 = 16i (4 Marks)  
 vi) IT6 = 10i. (4 Marks)
- (c) Give the detailed classification of plain gauges. (10 Marks)
3. (a) Mention a few basic requirements of a comparison for general workshop work. (4 Marks)
- (b) Describe any one of the available mechanical comparators. How will you distinguish between mechanical and optical-mechanical comparators. (10 Marks)
- (c) Explain the working principle of solex pneumatic gauge with sketch. (6 Marks)
4. (a) Explain with neat diagram the working principle of N.P.L flatness interferometer. (10 Marks)
- (b) Describe the working of a vernier bevel protractor with a neat sketch. (6 Marks)
- (c) How effective diameter of screw thread is measured using 3-wire method. Give set up for the above one. (6 Marks)

NEW SCHEME

USN

Fourth Semester B.E. Degree Examination, July/August 2005

Common to ME/PI/M/MA/VAU

Metrology and Measurements

(Max. Marks) - 100

Time: 3 hrs.]

Note: 1. Answer any FIVE full questions choosing atleast TWO questions from each part.

2. All questions carry equal marks.

PART - A METROLOGY

1. (a) What do you understand by "line" and "end" standards. Discuss their respective characteristics. (6 Marks)

(b) Four length bars A, B, C and D are to be calibrated using a calibrated length bar of 400mm whose actual length is 399.9998mm. The basic length of each of the four length bars is 100mm. If the lengths of bars B, C and D in comparison to A are +0.0004mm, +0.0003mm and -0.0001mm respectively, and also the lengths of all the four bars put together is +0.0002mm longer than the calibrated length bar, determine the actual length of all the four end bars. (7 Marks)

(c) How do you classify comparators? With a neat sketch explain the working and construction of a flow or velocity type comparator. (7 Marks)

2. (a) With neat sketches, explain the different types of fits. (6 Marks)

(b) Determine the actual dimensions to be provided for a shaft and hole of 90mm size for H<sub>8</sub>/d<sub>9</sub> type clearance fit. Size 90 mm falls in diameter steps of 80 and 100. Value of tolerance unit  $i = 0.45(\sqrt[3]{D}) + 0.001D$ . Value of tolerance for IT8 and IT9 grades are 25i and 40i respectively. Value of fundamental derivation for 'd' type shaft is -60D<sup>0.44</sup>. (7 Marks)

(c) What are GO and NOGO gauges? Explain briefly how Taylor's principle is applied in designing them. (7 Marks)

3. (a) Explain with neat sketches the use of sine bar for measuring known and unknown angles. (6 Marks)

(b) Illustrate the principle of interferometry with neat sketches. (7 Marks)

(c) With a neat sketch explain the principle of autocollimator. (7 Marks)

4. (a) What do you understand by "best size wire". Explain. Derive an expression for the same. (6 Marks)

(b) With neat sketches, explain how you would measure the major and minor diameters of internal screw threads. (7 Marks)

(c) Write notes on any TWO:

i) Wringing phenomenon

ii) Wear allowances on gauges

iii) Positional tolerances.

PART - B MEASUREMENTS

5. (a) What is measurement? Explain the requirements and significance of measurement systems. (9 Marks)

(b) Explain what is meant by i) Amplitude response ii) frequency response and iii) phase response. (6 Marks)

(c) Distinguish between systematic and random errors. (4 Marks)

6. (a) Explain the basic principle of capacitive transducers. With neat sketches, explain the different types of capacitive transducers. (8 Marks)

(b) With a neat sketch, explain the working of an electrokinetic transducer. (6 Marks)

(c) What are electronic amplifiers? List the general principles of an ideal electronic amplifier. (6 Marks)

7. (a) With a neat sketch, explain the working of a light-beam Oscillograph. (6 Marks)

(b) With a neat sketch, explain the working of a Prony-brake dynamometer. (6 Marks)

(c) With a neat sketch explain the working of a Pirani Thermal-conductivity pressure gauge. (6 Marks)

8. (a) What are the principles that govern the use of radiation pyrometers? With a neat sketch explain the working of any one type of radiation pyrometer. (3 Marks)

(b) With a neat sketch explain the working of a semiconductor or piezoresistive strain gauge. (6 Marks)

(c) Write shortnotes on any TWO: i) Law of thermocouples ii) Strain gauge mounting iii) Telemetry. (6 Marks)

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**Fourth Semester B.E. Degree Examination, June / July 08**  
**Mechanical Measurements and Metrology**

Time: 3 hrs.

Max. Marks:100

**Note :** Answer any FIVE full questions out of EIGHT questions choosing at least TWO questions from PART A and TWO questions from PART B.

**PART - A**

- 1 a. What is Metrology? State and explain the objectives of metrology. (06 Marks)  
b. What are Airy points? Where are the Airy points located on 600mm bar? (06 Marks)  
c. Compute the slip gauge block combination necessary to check 'GO' and 'NOT GO' dimensions of a limit gauge  $38^{-0.025}_{-0.064}$  using M – 87 special set. (08 Marks)
- 2 a. Explain what is meant by : i) Universal Interchangeability ii) Selective Assembly. (04 Marks)  
b. Explain the following terms : i) Deviation ii) Upper deviation iii) Lower deviation iv) Fundamental deviation. (04 Marks)  
c. Determine the actual dimensions to be provided for a shaft and hole of 90mm size for H<sub>8</sub> e<sub>8</sub> type clearance fit. Size 90mm falls in diameter steps of 80 – 100.  
Value of tolerance unit  $i = 0.45 \sqrt[3]{D} + 0.001D$ .  
Value of tolerance for IT8 and IT9 grades are 25i and 40i. Value of fundamental deviation for 'e' type shaft is  $-11 D^{0.41}$ . Also design the 'GO' and 'NO GO' gauges as percent British system, in which the same workshop and inspection gauges are used. (12 Marks)
- 3 a. How comparators are classified? (03 Marks)  
b. Describe with a neat sketch, the construction and working of LVDT. (10 Marks)  
c. Explain with a neat sketch the working of 'Solex' pneumatic comparator. (07 Marks)
- 4 a. How do you measure the tooth thickness of a spur gear using a gear tooth vernier caliper? (10 Marks)  
b. Explain the principle of operation of optical flat. (05 Marks)  
c. Derive an expression for 'best wire size'. (05 Marks)

**PART - B**

- 5 a. Explain three stages of measurement with suitable examples. (08 Marks)  
b. What are the sources of errors in instruments? Explain. (06 Marks)  
c. What are the advantages of electrical transducer elements over mechanical transducer element? (06 Marks)
- 6 a. What are X – Y plotters? With a block diagram, explain its working. (07 Marks)  
b. Explain with a block diagram, telemetering receiving system. (07 Marks)  
c. Explain with a neat sketch stylus type Oscilloscope. (06 Marks)
- 7 a. Explain with a neat sketch, the analytical balance (equal arm balance). (08 Marks)  
b. With a neat sketch, explain the working of hydraulic dynamometer. (08 Marks)  
c. Explain the working of proving ring with a neat sketch. (04 Marks)
- 8 a. Explain the working of a device used to measure high temperature. (07 Marks)  
b. Explain i) Cross – sensitivity and ii) Temperature compensation. (06 Marks)  
c. How do you calibrate the given strain gauge? (07 Marks)

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**Fourth Semester B.E. Degree Examination, Dec 08 / Jan 09**  
**Mechanical Measurements and Metrology**

Time: 3 hrs.

Max. Marks:100

- Note : 1. Answer FIVE full questions, selecting atleast TWO questions from each part.**  
**2. Draw neat sketches, wherever necessary.**

**PART – A**

- 1 a. Explain with sketch “Wringing Phenomenon” with respect to slip gauges. (10 Marks)  
b. A calibrated meter bar (end bar) has an actual length  $L = 1000.0003\text{mm}$ . It is to be used in the calibration of two bars A and B, each having a basic length of 500mm. When compared with the meter bar,  $L_A + L_B$  was found shorter by 0.0002mm. When A and B are compared, it was found that the bar A was 0.0004m longer than bar B. Find the actual length of bar A and bar B. (10 Marks)
- 2 a. Explain the following : i) Tolerance build – up ii) Compound Tolerances. (10 Marks)  
b. Explain the Taylor’s principle of Gauge design. (10 Marks)
- 3 a. What is Comparator? Explain any one type of mechanical comparator. (07 Marks)  
b. Explain the uses of Angle gauges. (03 Marks)  
c. Explain with sketch, how sine bar can be used to measure a taper angle. (10 Marks)
- 4 a. What is Auto Collimator? Explain with sketch the principle and working of an Auto Collimator. (10 Marks)  
b. Explain 2 – wire and 3 – wire method of measuring pitch and effective diameter of screw threads. (10 Marks)

**PART – B**

- 5 a. Explain with block diagram, the generalized concept of a measuring system. (10 Marks)  
b. Explain the terms with sketches : i) Linearity ii) Hysteresis. (10 Marks)
- 6 a. What are the inherent problems of the mechanical intermediate modifying devices? (04 Marks)  
b. State the advantages of electrical signal conditioning elements. (06 Marks)  
c. What is CRO? Explain with sketch the principle and working of Cathode Ray Oscilloscope. (10 Marks)
- 7 a. Explain with sketch any one device used for force measurement. (10 Marks)  
b. Explain with sketch, the Bridgeman gauge used for pressure measurement. (10 Marks)
- 8 a. What is Thermo couple? State the law of thermocouple. (04 Marks)  
b. Explain Resistance Thermometer. (06 Marks)  
c. Explain with sketch the “Grid Technique” used for strain measurement. (10 Marks)

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**Fourth Semester B.E. Degree Examination, June-July 2009**  
**Mechanical Measurements and Metrology**

Time: 3 hrs.

Max. Marks:100

**Note : Answer any FIVE full questions, selecting atleast  
TWO questions form each Part – A and Part - B**

**PART - A**

- 1
  - a. Define metrology and state its objectives. (06 Marks)
  - b. Explain how end standards are derived from line standards. (06 Marks)
  - c. Three 100mm end bars are measured by first wringing them together and comparing it with a 300mm bar and then intercomparing them. The 300mm bar has a known error of +42 $\mu$ m and the bars together measure 64 $\mu$ m less than the 300mm bar. Bar A is 18 $\mu$ m longer than bar B and 23 $\mu$ m longer than bar C. Find the actual length of each bar. (08 Marks)
- 2
  - a. Differentiate between interchangeability and selective assembly. (06 Marks)
  - b. Explain geometrical tolerance and sketch a minimum of six symbols used to represent geometrical characteristics. (06 Marks)
  - c. Determine the tolerances to be provided for a shaft and hole of 90mm size for H<sub>8</sub> e<sub>9</sub> type clearance fit. Size 90mm falls in diameter steps of 80 and 100. Value of tolerance unit  $i = 0.45 \sqrt[3]{D} + 0.001D$ . Multipliers for IT<sub>8</sub> and IT<sub>9</sub> grades are 25 and 40 respectively. Value of fundamental deviation for 'e' type of shaft is  $-11D^{0.41}$ . (08 Marks)
- 3
  - a. With a neat sketch, explain any type of optical comparator. Enumerate its advantages over other types of comparators. (08 Marks)
  - b. Explain with a neat sketch, the working of a 'solex pneumatic comparator'. (06 Marks)
  - c. Explain why it is preferred not to use a sine bar for generating angles larger than 45°, if high accuracy is required. (06 Marks)
- 4
  - a. With a neat sketch, explain the working principle of an auto collimator. (06 Marks)
  - b. With a neat sketch, explain the measurement of minor diameter of internal threads. (06 Marks)
  - c. Define "effective diameter" and "best size wire". Derive an expression to determine the best size wire diameter. (08 Marks)

**PART - B**

- 5
  - a. Define measurement. Explain the requirements and significance of measurement systems. (06 Marks)
  - b. Explain the terms amplitude response, phase response and frequency response. (06 Marks)
  - c. Explain the basic principle of capacitive transducers. With neat sketches, explain the different types of capacitive transducers. (08 Marks)
- 6
  - a. Explain the inherent problem present in mechanical intermediate modifying systems. (06 Marks)
  - b. What are electronic amplifiers? With a neat sketch, explain chopper amplifier. (06 Marks)
  - c. With a neat sketch, explain the working of a light beam type oscillograph. (08 Marks)
- 7
  - a. Sketch and explain the platform balance method of measuring force. (06 Marks)
  - b. With a neat sketch, explain the working of a hydraulic dynamometer. (06 Marks)
  - c. Explain with a neat sketch, the principle of a Pirani thermal conductivity gauge. (08 Marks)
- 8
  - a. State and explain the laws of thermo couple. (06 Marks)
  - b. Explain the principle and working of unbonded and bonded electrical strain gauges. (06 Marks)
  - c. Write notes on any two of the following :
    - i) Gauge factor and cross sensitivity.
    - ii) Temperature compensation in resistance type strain gauges.
    - iii) Calibration of strain gauges.
    - iv) Wheat stone bridge arrangement for strain measurement. (08 Marks)



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**Fourth Semester BE Degree Examination, Dec.09-Jan.10**  
**Mechanical Measurements and Metrology**

Time: 3 hrs.

Max. Marks:100

**Note: 1. Missing data can be suitably assumed.**

**2. Solve any FIVE questions choosing at least 2 from each part.**

**PART - A**

- 1 a. A calibrated metre and bar has an actual length 1000.0006 mm. It is to be used in the calibration of two bars A and B each having a length of 500 mm. When compared with metre bar  $\alpha A + \alpha B$  was found to be shorter by 0.0003 mm. In comparing A with B it was found that A was 0.0005 mm longer than B. Find the actual length of A and B. (06 Marks)
- b. Explain "International prototype meter" with sketch. (05 Marks)
- c. Build up a dimension of 69.2875 mm using M112 set slip gauges. (05 Marks)
- d. Distinguish between "Line standards and end standards". (04 Marks)
- 2 a. Explain types of fits with sketches. (06 Marks)
- b. Design 'Go' and 'NOGO' gauges to control the production of 90H<sub>6</sub>e<sub>7</sub>. 90 mm lies in a step of 80 – 120 mm  
FD for shaft e = -11D<sup>0.14</sup>  
 $IT_6 = 10i$   $IT_7 = 16i$   $i = 0.45\sqrt[3]{D} + 0.001D$ . (14 Marks)
- 3 a. List the important design principles of a comparator. (06 Marks)
- b. With a neat sketch explain the working of Reed type comparator. (08 Marks)
- c. Explain with a neat sketch induction type electrical comparator. (06 Marks)
- 4 a. Explain the two wire method to find the effective diameter of screw thread. (06 Marks)
- b. With a neat sketch explain the gear pitch checking instrument. (06 Marks)
- c. With neat sketches explain how would you measure the major and minor diameters of internal screw threads. (08 Marks)

**PART - B**

- 5 a. Explain the working "generalised measurement system" with block diagram taking the example of LVDT. (06 Marks)
- b. Define the following terms  
i) Accuracy ; ii) Sensitivity ; iii) Precision ; iv) Threshold. (08 Marks)
- c. Classify the errors. Explain each type of error. (06 Marks)
- 6 a. Explain the working of "Cathode Ray Oscilloscope". (06 Marks)
- b. List the various functions associated with intermediate modifying stage and briefly explain them. (06 Marks)
- c. Explain with a neat sketch / circuit diagram.  
i) Ballast circuit ii) Ionization transducer. (08 Marks)
- 7 a. Give the classification of dynamometers with brief working principle of each class. (04 Marks)
- b. Explain with a neat sketch, the measurement of torque using proney brake dynamometer. (08 Marks)
- c. Explain with a neat sketch McLeod gauge used for pressure measurement. (08 Marks)
- 8 a. Explain the working of a resistance thermometer. (06 Marks)
- b. State the laws of thermocouple. (04 Marks)
- c. Define i) Gauge factor ii) Cross Sensitivity. (06 Marks)
- d. Sketch the arrangement and explain the method of mounting strain gauges to measure the bending strain. (04 Marks)

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Important Note: 1. On completing your answers compulsorily draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8, will be treated as malpractice.





