Engineering Measurement MDP 141

Assignment 3

Characteristics of Measuring System

Q1: With the aid of neat sketch, explain the following static characteristic:

Scale interval	Scale division	Measuring capacity
Scale range	Equipment capacity	Span
Sensitivity	Resolution	Deflection factor
drift	precision	accuracy
readability	hysteresis	Percentage accuracy

Q2: For the shown scale, if the primary scale pointer length is 40 mm and the secondary scale pointer length is 10 mm, determine the following for both scales:

Scale Value

Scale division

Scale range

Span

Sensitivity

Deflection factor

Q3: For a three pointer wall clock of outer diameter equals 30 cm, determine its scale value, scale division, measuring range and its span.

Q4: A milli ammeter has 100 divisions, and its range is 1 mA. What is the scale value of the ammeter?

Q5: A force sensor measures a range of 0 to 150 N with a limiting error of ± 0.1 FS. Find the smallest change in force that can be measured.

Q6: A flow meter having a range of 500 m^3/sec and a limiting error of ± 2% of its FS. If the measured flow was 300 m^3/sec. What is the percentage error in this reading.

Q7: A 0-150 voltmeter has an accuracy of ± 1% of its full scale. The measured voltage by this voltmeter is 83 V. Calculate the percentage error in this measured value.

Q8: A temperature transducer has a range of 20° to 250 ^OC. A measurement results in a value of 55^OC. Compare the errors if the accuracy is :

± 0.5 % FS

± 0.75 % of span

What is the possible temperature in each case?

Q9: A dial gauge as shown in Fig. is fitted on the stand shown on left The diameters of the dial gauge graduation scales are 70 and 20 mm respectively.
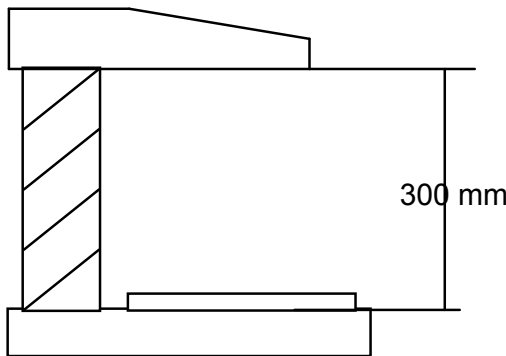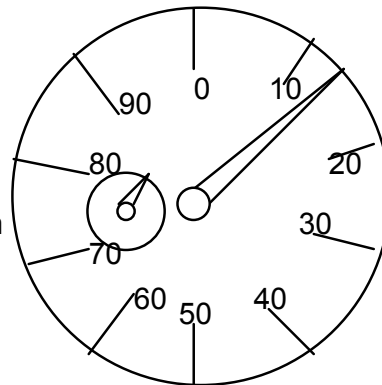

Figure a   Figure b

The dial was calibrated, the readings taken were as given in the table:

Slip gauge mm	10.00	10.05	10.15	10.25	10.35	10.45
Dial Reading mm	0.000	0.053	0.148	0.235	0.356	0.453
Slip gauge mm	10.55	10.65	10.75	10.85	10.95	11.00
Dial Reading mm	0.552	0.646	0.735	0.809	0.850	0.875

* Find out the required no of divisions so that the scale value becomes 0.001 mm.
* If the minimum acceptable scale division is 1.1 mm, find the minimum scale value which can be obtained using the same diameter of the dial graduation scale.

∗   If the minimum acceptable scale division is 6.6 mm, find out the required diameter of the scale graduation to obtain the same scale value.

∗   What can be done to :

      1. Extend the measuring capacity of the dial gauge.

Increase the Diameter of graduation- Decrease the Scale Division.

      2. Minimize the scale value of the dial gauge.

Increase the No. of division- Decrease the measuring capacity.

      3. Maximize the scale division.

Increase the Diameter of graduation- Decrease the Scale Division.

10: An instrument has been used to measure the length of a part. the result was 2.638 inches. An error of measurement study was made on the instrument with the following results:

Accuracy   +0.001 inch (on the average, the instrument reads 0.001 inch high)

Precision: 0.0004 inch (1 standard deviation)

Make a statement concerning the true value of the part just measured

a) ue is applied to it repeatedly under the same condition.
b) The smallest change in input signal which can be detected by the sensor.
c) The ease with which observations can be made
d) error caused by when the measured property reverses direction
e) the smallest change it can detect in the quantity that it is measuring
f) The ability of a measuring device to reproduce output readings when the same measured value is applied to it repeatedly under the same condition.
g) The smallest change in input signal which can be detected by the sensor.

Q11: A voltage of nominal <u>24 volt</u>s has been measured. The following data is obtained:

25.15	25.18	25.11	25.29	25.16

25.22	25.23	25.19	25.20	25.18

calculate the accuracy and the precision of the instrument using one Ϭ (standard deviation)? Make a statement concerning the true value of the measured value

Q12: A pressure gauge with a range between 0-10 bar is found to have an error of +/- 0.15 bar when calibrated by the manufacturrere., calculate

The error percentage of the gauge.

The error percentage when the reading obtaibed is 2.0 bar.

Q13: Using the following data, determine the linearity and the coefficient of correlation.
The reading are

1	2	3	4	5	6	7	8	9	10
6.36	6.40	6.36	6.65	6.39	6.40	6.43	6.37	6.46	6.42

11	12	13	14	15	16	17	18	19	20
6.39	6.38	6.40	6.41	6.45	6.34	6.36	6.42	6.38	6.51

Q14: In a calibration test, 10 measurement using a digital voltmeter have been made of the voltage of a battery that is known to have a true voltage of 6.11 V. The readings are: 5.98, 6.05, 6.10, 6.06, 5.99, 5.96, 6.02, 6.09, 6.03 and 5.99. Estimate the linearity of the instrument.

Q15: A technician checks the resistance value of 5 coils and records the values in ohms: 3.35, 3.37, 3.28, 3.34, and 3.3. Determine the precision

Q16: A pressure gauge with a range between 0-1 bar with an accuracy of ± 5% FS (full scale). Calculate the maximum error.

Q17: mA pressure gauge with a range between 0-10 bar is found to have an error of ± 0.15 bar when calibrated by the manufacturer.

Calculate:

The error percentage of the gauge

The error percentage when the reading obtained is 2.0 bar

Q18: Two pressure gauges A and B have a full scale accuracy of ± 5%. Sensor A has a range of 0 – 1 bar and sensor B 0- 10 bar. Which gauge is more suitable to be used if the reading is 0.9 bar?

Q19: Using the data about mileage versus speed, determine the linearity. The reading are

1	2	3	4	5	6	7	8
30	30	34	35	40	40	45	45

9	10	11	12	13	14	15	16
50	50	55	55	60	60	65	65

Q20: Using the following data, determine the linearity. The reading are

1	2	3	4	5	6	7	8	9	10
6.36	6.40	6.36	6.65	6.39	6.40	6.43	6.37	6.46	6.42

11	12	13	14	15	16	17	18	19	20
6.39	6.38	6.40	6.41	6.45	6.34	6.36	6.42	6.38	6.51

21	22	23	24	25	26	27	28	29	30
6.40	6.39	6.39	6.38	6.41	6.36	6.40	6.46	6.56	6.20

Q21: Put a check mark(√) against The correct answer, and cross mark(×) against the wrong answer.

( ) Resolution is always specified in mm.

( ) As larger is the scale division, the readability gets better.

( ) Precision express how far the result is close to the true value.

( ) Deflection factor is the reciprocal of the sensitivity.

( ) Resolution is the smallest measurable input.

Q22: Give one or more word to express the following

	1	The smallest measurable input change
	2	The distance between two adjacent scale marks in mm
	3	The variation in the reading of an instrument caused by no change in the measurand
	4	The smallest measurable input
	5	The phenomenon which depicts different readings when loading and unloading
	6	The instrument does not read zero when the input is zero
	7	The output deviates from the calibrated linear relationship between the input and the output.
	8	The instrument gives a different output, when the input returns to the same value.
	9	If the observer's eye is not squarely aligned with the pointer and scale
	10	If the measurement is made in temperature different than the standard temperature
	11	The instrument does not read zero when the input is zero
	12	The instrument does not read zero when the input is zero.
	13	The output is different, depending on whether the input is

		increasing or decreasing at the time of measurement
	14	The smallest change it can detect in the quantity that it is measuring
	15	The smallest change in input signal which can be detected by the sensor
	16	The output deviates from the calibrated linear relationship between the input and the output
	17	The instrument gives a different output, when the input returns to the same value
	18	The instrument does not read zero when the input is zero
	19	The ability of a measuring device to reproduce output readings when the same measured value is applied to it repeatedly under the same condition
	20	The variation in the reading of an instrument caused by no change in the measurand
	21	The distance between two adjacent scale marks in mm
	22	The smallest change in input signal which can be detected by the sensor.
	23	The smallest measurable input change
	24	The ease with which observations can be made