BABA BANDA SINGH BAHADUR ENGG COLLEGE

Department of Mechanical Engineering.

MECHANICAL MEASUREMENTS & METROLOGY

QUESTION BANK

Practice Set: 1

1. Distinguish between Measurement and Measurand.
2. How are standards of measurement classified?
3. State the advantages and disadvantages of mechanical, electrical and electronic instruments.
4. Distinguish the following instruments with suitable examples
    a. Null and Deflection type of instruments
    b. Analog and Digital type of instruments
5. "Basic of all engineering is design and basic of all engineering is the making of measurements" Comment on statement with respect to importance of measurement in the field of design.
6. "The measurement of speed of rotating shaft by means of electrical tachometer is a typical example tertiary measurement". Do you agree with this statement, if so why?
7. Draw a block diagram representation of a measurement system. Identify the various elements and point out the function performed by each element.
8. Given below is list of some of the commonly used measuring devices.
   Wrist watch, speedometer, odometer, fuel gauge of an automobile, calibrated balance beam of platform scale and a thermometer.
    a) Which of these devices are null instruments?
    b) Which of these devices have digital and analog outputs?
9. Identify Desired, Interfering and Modifying inputs in the system of pressure measurement by a U tube differential manometer.

Practice Set: 2

1. Enumerate the main static and dynamic characteristics of measurement system.
2. **Explain clearly the following:**
    a. Accuracy and precision
    b. Threshold and Resolution
    c. Drift
    d. Hysteresis
    e. Repeatability and Reproducibility
    f. Bias and Tolerance
    g. Linearity
3. **Define the following terms as related to dynamic characteristics of the instrument with suitable diagram.**
    a. Speed of Response
    b. Fidelity
    c. Overshoot
    d. Measuring Lag
    e. Dynamic error
    f. Dead Zone & Dead Time
4. What is the necessity and importance of dynamic performance of a measurement system?
5. Define sensitivity. Would you prefer sensitivity to be low or high for an instrument?
6. Explain briefly Zero, first and Second order measuring instruments.
7. A wheatstone bridge requires a change of 7ohms in the unknown arm of the bridge to produce a change in deflection of 3mm of the galvanometer. Determine the sensitivity.
8. The calibration range of a certain parameter is 300degree centigrade to 800degree centigrade if the dead zone in it is 0.11% of span. Determine the temp change which might occur before it is detected.
9. A measuring system consist of transducer, an amplifier and a recorder and their individual sensitivity K1=0.25mV/°C, amplifier gain K2=2.5V/mv , recorder sensitivity K3=4mm/V. What would be the overall sensitivity of the instrument?
10.
    a. What is the law of probabilities?
    b. Explain briefly the following terms with the help of Gaussian distribution curve.
        i. Precision Index
        ii. Probable error
    c. State Chauvenet's criterion for the rejection of test data.
    d. What do you mean by curve fitting? State theory of least squares.

Practice Set: 3

1. A simply supported beam carries a concentrated load P at its centre. The maximum values of deflection x corresponding to different values of P are:

P=	100	120	140	160	180	200
X=	0.45	0.55	0.60	0.60	0.80	0.85

   Using the least square technique, find the linear relationship between P & X.

2. Differentiate between Line and End Standards.
3. What is the vernier principle? Explain the vernier principle of 0.02mm vernier.
4. What is the working principle of micrometer? Explain the principle of 0.01mm micrometer.
5. What is sine bar and how we use it for angular measurement?
6. Why sine bar is not suitable for measurement of angle greater than 45°.What are the limitations of sine bar?
7. Define the terms “Primary Texture” (Roughness) and Secondary Texture”.
8. Explain the principle and working of Talysurf surface roughness instrument with neat sketch.
9. What is a comparator? Discuss about the mechanical comparators.
10. Differentiate between the following:
    e. Comparator and Measuring Instrument
    f. Electrical Comparator and Mechanical comparator
    g. Mechanical and optical comparator
11. Describe the construction and working of a “Dead weight Gauge Tester”. State the factor which affects the accuracy of dead weight testers.
12. Write down in short the working principle of following instruments:
    h. Electromagnetic flux meter
    i. Ultrasonic flow meter
    j. Thermal conductivity Gauges

Practice Set: 4

1. What is the principle of Piezo-electric transducer? What are their advantages, disadvantages and applications? Why it is desirable that it should be used for dynamic quantities?
2. Explain briefly bonded and unbounded strain gauges. Which out of these two is finding wide industrial applications?
3. What are the relative advantages and limitations of unbounded strain gauges over bonded strain gauges?
4. How will you provide temperature compensation in strain gauge measurement?
5. What is the purpose of proving ring? Draw a neat sketch of the ring. Explain its working.
6. What is load cell? Explain with the help of neat sketch the principle and working of
    a. Hydraulic load cell b. Pneumatic load cell
7. How will you determine the speed of hermetically sealed compressor installed in a refrigerator?
8. Explain how speed is measured with stroboscope. Mention the various applications of stroboscope.
9. Distinguish between transmission and absorption type dynamometers.
10. Explain clearly with the help of neat sketches, the laws of thermocouples. Mention the commonly used industrial names of thermocouples mentioning the materials and temperature range of each.

PRACTICE SET: 5 (MCQ Type)

Q 1. The instrument with null output is:	
a) light meter of a camera	b) Bourdon pressure gauge
c) a platform type weighing machine	d) a mercury manometer
Correct answer:	C
Q 2. The function of transducer element is to:	
a)amplify the input signal	b) average of fluctuating type of input signals
c)convert the input signal to a form which can be easily processed	d) regulate th signal for a suitable control application
Correct answer:	C
Q 3. The smallest change in the value of input variable being measured, that will cause a change in the output signal of the instrument is termed as:	
a) hysteresis	b) drift
c) resolution	d) threshold
Correct answer:	C
Q 4. The error which is repetitive in nature is:	
a) observational error	b) environmental error
c) random error	d) systematic error
Correct answer:	D
Q 5. Zero error of a micrometer is:	
a) random error	b) interference error
c) systematic error	d) loading error
Correct answer:	C
Q 6. The gradual departure of the instrument output caused by certain interfering input and component instabilities is termed as:	
a) hysteresis	b) dead zone
c) threshold	d) drift
Correct answer:	D
Q 7. Repeatability of the instrument with respect to given fixed input is:	
a) accuracy	b) precision

c) resolution	d) sensitivity
Correct answer:	B
Q 8. Which of the following is not a self-generating type of transducer	
a) thermocouple	b) LVDT
c) photo voltaic cell	d) Bourdon tube of pressure gauge
Correct answer:	B
Q 9. The elastic type of transducer element in the Bourdon pressure gauge is of	
a) circular cross section	b) square cross section
c) rectangular cross section	d) elliptical cross section
Correct answer:	D
Q 10.Error caused by the act of measurement on the physical system being tested is	
a) hysteresis error	b) random error
c) systematic error	d) loading error
Correct answer:	D
Q 11. Threshold of the instrument is defined as	
a) ratio of the output of the instrument to the corresponding input signal	b) drift of the output of the instrument due to ageing of components
c) smallest input measureable change (non-zero value)	d) smallest measureable input signal which can be detected
Correct answer:	D
Q 12. The value of gauge factor for a semiconductor strain gauge used in practice can be approximately	
a) 0.48	b) 2.05
c) 3.5	d) 150
Correct answer:	D
Q 13. The most common transducer for shock and vibration measurement is	
a) dial gauge	b) ring type of load cell
c) LVDT	d) piezoelectric pick up
Correct answer:	D
Q 14. The most usual value of resistance, suitable for the wire resistance strain gauge is:	
a) 12 Ω	b) 50 Ω

c) 120 Ω	d) 2400 Ω
Correct answer:	C
Q 15. LVDT works on the principle of	
a) variable resistance	b) variable self-induction
c) variable mutual induction	d) variable capacitance
Correct answer:	C
Q 16. The following is not a type of comparator	
a) Electrical	b) Pneumatic
c) Optical	d) Hydraulic
Correct answer:	D
Q 17. The following is not used to measure angles	
a) Bevel protectors	b) Optical flats
c) Calibrated levels	d) Clinometers
Correct answer:	B
Q 18. The effective diameter (E) in three wire method is given by	
a) E = M – C	b)E = M + C
c)E = M / C	d)E = M x C
Correct answer:	A
Q 19. A strain gauge material should have low	
a) Gauge factor	b) Sensitivity
c) Resistance temperature coefficient	d) All of the above
Correct answer:	C
Q 20. For measuring the temperature of a boiler furnace which one of the following is the appropriate thermometer?	
a) Bimetal strip thermometer	b) Thermocouple
c) Vapour pressure thermometer	d) Optical pyrometer
Correct answer:	D
Q 21. McLeod gauge is used to measure	
a) Pressure	b) Vacuum
c) Flow rate	d) pH value
Correct answer:	B

Q 22. Ionisation gauge is used to measure pressures	
a) Below 3 microns	b) Between 100 and 200 microns
c) Above 100 microns	d) Above 200 microns
Correct answer:	A
Q. 23. Which of the following can be used as sensing element for an instrument?	
a) Diaphragm	b) Proving ring
c) Bourdon tube	d) Any of the above
Correct answer:	D
Q 24. A Pirani gauge works on the principle of change of	
a) Thermal conductivity of medium	b) Electrical resistivity
c) Conductance	d) Capacitance
Correct answer:	A
Q 25. Which of the following Bourdon tube material can be used for very high pressures?	
a) Phosphor bronze	b) Stainless steel
c) Alloy steel	d) K-monel
Correct answer:	C
Q 26. Which of the following is an indirect pressure measuring device?	
a) Ionisation gauge	b) Bourdon tube
c) Flat diaphragm	d) Manometer
Correct answer:	A
Q 27. Which of the following can be used as thermal detector?	
a) Pyrometer	b) Thermistor
c) Thermocouple	d) Any of the above
Correct answer:	D
Q 28. A hot wire anemometer is used to measure	
a) Pressure of gases	b) Liquid discharges
c) Very low pressures	d) Gas velocities
Correct answer:	D
Q 29. A load cell cannot be used to measure	
a) Weight	b) Temperature
c) Level	d) All of above

Correct answer:	B
Q 30. Which of the following is an indirect method of pressure measurement?	
a)McLeod gauge	b) Thermal conductivity gauge
c) Ionisation gauge	d) All of the above
Correct answer:	D
Q 31. Which of the following material is used for photoconductive cells	
a) Selenium	b) Mica
c) Thorium	d) Barium sulphate
Correct answer:	A
Q 32. Which of the following is generally not used as a thermocouple material?	
a) Platinum - Rhodium	b)Chromel – Alumel
c) Gold - Silver	d)Chromel – Copper
Correct answer:	C
Q 33. Thermistors have	
a) Low and positive temperature coefficient	b) Low and negative temperature coefficient
c) High and negative temperature coefficient	d) Zero temperature coefficient
Correct answer:	C
Q 34. A rotameter can be used to measure	
a) Specific gravity	b) Flow
c) Viscosity	d) Pressure of wind
Correct answer:	B
Q 35. Which of the following is not a piezoelectric material?	
a) Quartz	b) Sodium chloride
c) Ammonium dihydrogen phosphate	d) All of the above
Correct answer:	B
Q 36. Thermocouples are generally used for temperature measurements upto	
a) 250C	b) 500C
c) 1000C	d) 1600C
Correct answer:	D
Q 37. Which of the following device can be used to measure blow of air around an	

aeroplane?	
a) Anemometer	b)Rotameter
c) Manometer	d)None of above
Correct answer:	A
Q 38. A load cell is essentially a	
a) Thermocouple	b) Thermistor
c) Photoconductive device	d) Strain gauge
Correct answer:	D
Q 39. A LVDT has	
a) One primary coil and two secondary coils	b)Two primary coils and one secondary coil
c) One primary coil and one secondary coil	d) Two primary coils and two secondary coils
Correct answer:	C
Q 40. Instruments used for angular measurements	
a) Micrometer	b) Sine bar
c) vernier calliper	d) None of above
Correct answer:	B
Q 41. Which of the following transducer is used to translate linear motion into electrical signals?	
a) LVDT	b) Strain gauge
c) Bellows	d)Thermistor
Correct answer:	A
Q 42. What does a hall effect sensor sense?	
a) temperature	b) moisture
c) magnetic fields	d) pressure
Correct answer:	C
Q 43. What causes the piezoelectric effect?	
a) heat or dissimilar metals	b) pressure on a crystal
c) water running on iron	d)a magnetic field
Correct answer:	B
Q 44. A transducer's function is to	

a)transmit electrical energy	b)convert energy
c)produce mechanical energy	d)prevent current flow
Correct answer:	B
Q 45. Self generating type transducers are _____ transducers	
a) Active	b) passive
c) Secondary	d) Inverse
Correct answer:	A
Q 46. A transducer that converts measurand into the form of pulse is called	
a) Active transducer	b) Analog Transducer
c)Digital Transducer	d) Pulse Transducer
Correct answer:	D
Q 47. Which of the following is a digital transducer	
a) Strain Guage	b) Encoder
c) Thermistor	d) LVDT
Correct answer:	B
Q 48. An inverse transducer is a device that converts	
a) an electrical quantity into a non electrical quantity	b) electrical quantity into mechanical quantity
c) electrical energy into thermal energy	d) Electrical energy into light energy
Correct answer:	A
Q 49. A strain guage is a passive transducer and is employed for converting	
a) mechanical displacement into a change in resistance	b) pressure into a change in resistance
c)force into displacement	d) pressure into displacement
Correct answer:	A
Q 50. . The ratio of output signal or response of the instrument'" to a change in input or measured variable is called	
a) sensitivity	b) precision
c) resolution	d) threshold
Correct answer:	A
Q 51. Resolution of a transducer depends on	

a) Material of wire	b) Length of wire
c)Diameter of wire	d) Excitation voltage
Correct answer:	C
Q 52. Bonded wire strain gauges are	
a) exclusively used for construction of transducers	b) exclusively used for stress analysis
c) used for both stress analysis and construction of transducer	d) pressure measurement
Correct answer:	C
Q 53. Quartz and Rochelle salt belongs to _____ of piezo electric materials	
a) Natural group	b) Synthetic group
c) Natural or synthetic group	d) Fiber Group
Correct answer:	A
Q 54. LVDT windings are wound on	
a) steel sheets	b) aluminium
c) ferrite	d) copper
Correct answer:	C
Q 55. Which of the following can be measured with the help of piezo electric crystal	
a) Force	b) Velocity
c) Sound	d) Pressure
Correct answer:	A
Q 56. Capacitive transducers are normally employed for _____ measurement	
a) Static	b) Dynamic
c) Transient	d) Both static and dynamic
Correct answer:	B
Q 57. Photo conductive cell consists of a thin film of	
a) quartz	b) lithium sulphate
c) barium titanate	d) selenium
Correct answer:	D
Q 58. ._____ is an example of photo emissive cell	

a) LDR	b) Photo diode
c) Photo transistor	d) Photo multiplier
Correct answer:	A
Q 59. Fibreoptics sensor can be used to sense _____	
a) Displacement	b)Power
c)Current	d) Resistance
Correct answer:	A
Q 60. Photo multiplier consists of	
a)1 photo emissive cathode and 2 dynodes	b)2 photo emissive cathode and 2 dynodes
c) 2photo emissive cathode and 1 dynodes	d) 1photo emissive cathode and 1 dynodes
Correct answer:	A