

ICH581 – Mechanical Measurements and Instrumentation

UNIT I - COMPARATORS

PART A

1. A comparator is mainly used to

- A. Measure absolute size
- B. Compare dimensions
- C. Cut materials
- D. Measure weight

Answer: B

2. Comparator gives

- A. Relative measurement
- B. Direct measurement
- C. Mass
- D. Temperature

Answer: A

3. Mechanical comparator uses

- A. Levers and gears
- B. Air only
- C. Light only
- D. Electric motor

Answer: A

4. Optical comparator works using

- A. Light and optics
- B. Hydraulics
- C. Magnets
- D. Steam

Answer: A

5. Electrical comparator converts displacement into

- A. Electrical signal
- B. Heat
- C. Pressure
- D. Sound

Answer: A

6. Electronic comparator is known for

- A. High sensitivity
- B. Low accuracy
- C. Heavy weight

D. Slow response

Answer: A

7. Pneumatic comparator uses

A. Compressed air

B. Oil

C. Water

D. Vacuum only

Answer: A

8. Solex comparator is a type of

A. Pneumatic comparator

B. Mechanical comparator

C. Optical comparator

D. Electronic comparator

Answer: A

9. Magnification means

A. Increase in pointer movement

B. Weight

C. Pressure

D. Density

Answer: A

10. Mechanical comparator has

A. No external power

B. High air consumption

C. Laser

D. Vacuum pump

Answer: A

11. Optical comparator advantage

A. No friction

B. High noise

C. Low accuracy

D. Heavy

Answer: A

12. Electrical comparator needs

A. Power supply

B. Fuel

C. Steam

D. Oil

Answer: A

13. Electronic comparator output is

- A. Very quick
- B. Very slow
- C. Manual
- D. Mechanical only

Answer: A

14. Air pressure variation indicates

- A. Size variation
- B. Colour
- C. Hardness
- D. Weight

Answer: A

15. Least suitable for dirty air

- A. Pneumatic comparator
- B. Mechanical
- C. Optical
- D. Electrical

Answer: A

16. Comparator checks

- A. Deviation from standard
- B. Length only
- C. Area
- D. Volume

Answer: A

17. Reference size is

- A. Standard size
- B. Unknown size
- C. Random size
- D. Average size

Answer: A

18. Mechanical comparator limitation

- A. Friction error
- B. Needs compressor
- C. Needs light
- D. Needs battery

Answer: A

19. Optical comparator disadvantage

- A. Cost is high
- B. No magnification
- C. No light

D. No lens

Answer: A

20. Electronic comparator advantage

A. Very high accuracy

B. No sensitivity

C. Heavy friction

D. Low reliability

Answer: A

21. Solex comparator is widely used for

A. Precision inspection

B. Welding

C. Casting

D. Forging

Answer: A

True/False

22. Comparators give relative measurements. (True)

23. Mechanical comparators use levers. (True)

24. Optical comparators use light. (True)

25. Electrical comparators need electrical supply. (True)

26. Electronic comparators have high sensitivity. (True)

27. Pneumatic comparators use compressed air. (True)

28. Solex comparator is a pneumatic comparator. (True)

29. Mechanical comparators are free from friction. (False)

30. Electronic comparators are less accurate than mechanical comparators. (False)

PART B

1. Explain the construction and working principle of Dial Gauge.

2. Explain the construction and working principle of Electronic Comparator

3. a) Draw a Pneumatic comparator and label its parts.

b) State the advantages of Pneumatic comparator

4. Explain the construction and working principle of Optical Comparator.

5. MATCH THE FOLLOWING

A) QUESTION 1

Column A	Column B
A. Mechanical Comparator	1. Uses compressed air
B. Optical Comparator	2. Uses levers and gears
C. Electrical Comparator	3. Uses electrical transducer
D. Electronic Comparator	4. Uses electronic amplifier
E. Pneumatic Comparator	5. Uses light and optical system

Answer: A-2, B-5, C-3, D-4, E-1

B) QUESTION 2

Column A	Column B
A. Pointer	1. Amplifies the electrical signal
B. Bellows	2. Indicates size variation
C. Nozzle	3. Control's air flow to the workpiece
D. Amplifier	4. Convert's air pressure into movement
E. Mirror	5. Reflects the light beam

Answer: A-2, B-4, C-3, D-1, E-5

UNIT II -Measurement of Velocity and Acceleration

PART A

1. Doppler Effect method is used to measure

- A. Pressure
- B. Linear velocity
- C. Temperature
- D. Force

Answer: B

2. Doppler Effect is based on the change in

- A. Resistance
- B. Frequency
- C. Capacitance
- D. Inductance

Answer: B

3. A Linear Encoder is mainly used to measure

- A. Pressure
- B. Angular displacement
- C. Linear displacement
- D. Temperature

Answer: C

4. The output of a Linear Encoder is generally

- A. Hydraulic
- B. Pneumatic
- C. Electrical
- D. Mechanical

Answer: C

5. Drag Cup Rotor AC Tach generator measures

- A. Linear velocity
- B. Angular velocity
- C. Acceleration
- D. Pressure

Answer: B

6. The output of an AC Tach generator is

- A. DC
- B. AC
- C. Hydraulic
- D. Pneumatic

Answer: B

7. Which instrument measures acceleration?

- A. Tachometer
- B. Accelerometer
- C. Manometer
- D. Barometer

Answer: B

8. Seismic Accelerometer consists of

- A. Seismic mass and spring
- B. Lens
- C. Bellows
- D. Rotor

Answer: A

9. Piezoelectric Accelerometer works on

- A. Thermal
- B. Magnetic
- C. Piezoelectric
- D. Hall

Answer: C

10. Linear Encoder is widely used in

- A. CNC Machines
- B. Boilers
- C. Compressors
- D. Refrigerators

Answer: A

11. Strain Gauge Accelerometer works on

- A. Resistance change
- B. Pressure
- C. Capacitance
- D. Temperature

Answer: A

12. LVDT Accelerometer works on

- A. Piezoelectric
- B. Electromagnetic induction
- C. Hall
- D. Photoelectric

Answer: B

13. Piezoelectric Accelerometer measures

- A. Static
- B. Dynamic
- C. Pressure

D. Temperature

Answer: B

14. Sensing element is

A. Piezo crystal

B. Bellows

C. Bourdon

D. Float

Answer: A

15. Movable part of LVDT

A. Rotor

B. Core

C. Pointer

D. Nozzle

Answer: B

16. Static acceleration measured by

A. Strain Gauge

B. Piezo

C. Optical

D. Doppler

Answer: A

17. Advantage of drag cup rotor

A. Low inertia

B. High friction

C. Heavy

D. Slow

Answer: A

18. Disadvantage of piezo accelerometer

A. Cannot measure static

B. Low accuracy

C. Needs air

D. Heavy

Answer: A

19. Advantage of LVDT accelerometer

A. High accuracy

B. Low sensitivity

C. High friction

D. Heavy

Answer: A

20. Doppler used for

- A. Moving vehicles
- B. Water level
- C. Pressure
- D. Boilers

Answer: A

21. Linear encoder used in

- A. CNC machines
- B. Boilers
- C. Pumps
- D. Fans

Answer: A

True/False

22. Doppler Effect method measures the linear velocity of a moving object. (True)

23. The reflected frequency changes due to Doppler Effect. (True)

24. Linear Encoder converts displacement into electrical signal. (True)

25. Drag Cup Rotor AC Tach generator measures linear velocity. (False)

26. Seismic Accelerometer contains seismic mass and spring. (True)

27. Piezoelectric Accelerometer measures static acceleration. (False)

28. Resistance of strain gauge changes under strain. (True)

29. LVDT Accelerometer works on electromagnetic induction. (True)

30. Piezoelectric Accelerometer requires compressed air. (False)

PART B

1. Explain the construction and working principle of Drag cup rotor AC Tacho generator.

2. Explain any one method of linear velocity measurement.

3. a) Draw a Piezo electric accelerometer and name its parts.

b) State the advantages of Piezo electric accelerometer.

4. Compare Linear velocity measurement vs Angular velocity measurement.

5. Match the Following

A) Question 1

Column A	Column B
A. Doppler Effect Method	1. Measures angular velocity
B. Linear Encoder	2. Measures linear velocity
C. Drag Cup Rotor AC Tach generator	3. Measures linear displacement
D. Piezoelectric Accelerometer	4. Measures dynamic acceleration
E. LVDT Accelerometer	5. Measures static and low-frequency acceleration

Answer: A-2, B-3, C-1, D-4, E-5

B) Question 2

Column A	Column B
A. Doppler Effect Method	1. Electromagnetic induction
B. Linear Encoder	2. Frequency shift
C. Piezoelectric Accelerometer	3. Digital position measurement
D. Strain Gauge Accelerometer	4. Change in resistance
E. LVDT Accelerometer	5. Piezoelectric effect

Answer: A-2, B-3, C-5, D-4, E-1

UNIT III - Measurement of Force, Torque and Shaft Power

PART A

1. Which instrument is used to measure force?

A. Thermometer

- B. Pendulum Scale
- C. Tachometer
- D. Barometer

Answer: B

2. A load cell is mainly used to measure

- A. Pressure
- B. Temperature
- C. Force
- D. Velocity

Answer: C

3. Hydraulic Load Cell works on

- A. Hydraulic pressure
- B. Air pressure
- C. Magnetic effect
- D. Optical effect

Answer: A

4. Pneumatic Load Cell uses

- A. Water
- B. Compressed air
- C. Steam
- D. Oil

Answer: B

5. Strain Gauge Load Cell works on

- A. Change in resistance
- B. Change in capacitance
- C. Change in inductance
- D. Piezoelectric effect

Answer: A

6. Which Load Cell gives an electrical output?

- A. Hydraulic
- B. Pneumatic
- C. Strain Gauge
- D. Pendulum

Answer: C

7. SI unit of force is

- A. Joule
- B. Newton
- C. Watt
- D. Pascal

Answer: B

8. Pendulum Scale measures

- A. Force
- B. Torque
- C. Speed
- D. Temperature

Answer: A

9. Hydraulic Load Cell does not require

- A. Electrical power
- B. Liquid
- C. Pressure
- D. Oil

Answer: A

10. Advantage of Pneumatic Load Cell

- A. High sensitivity
- B. Heavy
- C. High friction
- D. Low accuracy

Answer: A

11. Optical Torsion Meter measures

- A. Force
- B. Torque
- C. Pressure
- D. Temperature

Answer: B

12. Optical Torsion Meter works on

- A. Reflection of light
- B. Air pressure
- C. Hydraulic pressure
- D. Resistance

Answer: A

13. Electrical Torsion Meter converts shaft twist into

- A. Hydraulic pressure
- B. Pneumatic pressure
- C. Electrical signal
- D. Mechanical force

Answer: C

14. Strain Gauge Torsion Meter works on

- A. Change in resistance
- B. Capacitance
- C. Induction

D. Piezo effect

Answer: A

15. SI unit of torque

A. Newton

B. Newton-meter

C. Watt

D. Joule

Answer: B

16. Instrument used to measure shaft power

A. Comparator

B. Dynamometer

C. Accelerometer

D. Encoder

Answer: B

17. Prony Brake Dynamometer is

A. Transmission

B. Absorption

C. Electrical

D. Hydraulic

Answer: B

18. Rope Brake Dynamometer measures

A. Pressure

B. Temperature

C. Shaft Power

D. Force

Answer: C

19. Advantage of Prony Brake

A. Simple construction

B. High maintenance

C. Complex

D. High friction

Answer: A

20. Disadvantage of Rope Brake

A. Not suitable for high power

B. Electrical output

C. No friction

D. Cannot measure power

Answer: A

21. Shaft power depends on

- A. Torque and Speed
- B. Force and Pressure
- C. Pressure and Temp
- D. Speed and Temp

Answer: A

True/False

22. A Pendulum Scale is used to measure force. (True)

23. A Hydraulic Load Cell works on liquid pressure. (True)

24. A Pneumatic Load Cell uses compressed air. (True)

25. A Strain Gauge Load Cell works on change in resistance. (True)

26. An Optical Torsion Meter measures torque. (True)

27. A Strain Gauge Torsion Meter uses strain gauges. (True)

28. A Prony Brake Dynamometer is an absorption type dynamometer. (True)

29. A Rope Brake Dynamometer measures shaft power. (True)

30. The SI unit of torque is Newton (N). (False)

PART B

1. Explain the construction and operation of Pendulum scale with a neat diagram.

2. a) Draw Pneumatic load cell and name its parts.

b) Draw Hydraulic load cell and name its parts

3. Explain Electrical Torsion Meter with a diagram

4. Explain Prony Brake Dynamometer with diagram.

5. Match the Following

A) Question 1

Column A	Column B
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A. Pendulum Scale	1. Measures Torque
B. Hydraulic Load Cell	2. Measures Force
C. Optical Torsion Meter	3. Uses Liquid Pressure
D. Prony Brake Dynamometer	4. Uses Rope Arrangement
E. Rope Brake Dynamometer	5. Measures Shaft Power

Answer: A-2, B-3, C-1, D-5, E-4

B) Question 2

Column A	Column B
A. Strain Gauge Load Cell	1. Absorption Dynamometer
B. Pneumatic Load Cell	2. Change in Resistance
C. Electrical Torsion Meter	3. Electrical Output
D. Prony Brake Dynamometer	4. Depends on Torque and Speed
E. Shaft Power	5. Uses Compressed Air

Answer: A-2, B-5, C-3, D-1, E-4

UNIT IV – MEASUREMENT OF PH AND GAS ANALYSIS

PART - A

1. pH is a measure of
A. Temperature

- B. Pressure
- C. Acidity or alkalinity of a solution
- D. Density

Answer: C. Acidity or alkalinity of a solution

2. The pH value of pure water at room temperature is
- A. 1
 - B. 7
 - C. 10
 - D. 14

Answer: B. 7

3. Which electrode is used as a primary reference electrode?
- A. Glass Electrode
 - B. Hydrogen Electrode
 - C. Oxygen Electrode
 - D. Platinum Electrode

Answer: B. Hydrogen Electrode

4. Which electrode is commonly used as a reference electrode in pH measurement?
- A. Glass Electrode
 - B. Hydrogen Electrode
 - C. Calomel Electrode
 - D. Carbon Electrode

Answer: C. Calomel Electrode

5. Which electrode is most widely used for pH measurement in industries?
- A. Hydrogen Electrode
 - B. Glass Electrode
 - C. Copper Electrode
 - D. Zinc Electrode

Answer: B. Glass Electrode

6. The sensing element of a Glass Electrode is
- A. Thin glass membrane
 - B. Copper wire
 - C. Platinum plate
 - D. Steel diaphragm

Answer: A. Thin glass membrane

7. The Hydrogen Electrode uses _____ gas.
- A. Oxygen
 - B. Nitrogen
 - C. Hydrogen

D. Carbon dioxide

Answer: C. Hydrogen

8. Calomel Electrode contains

- A. Mercury and mercurous chloride
- B. Copper sulphate
- C. Zinc chloride
- D. Silver nitrate

Answer: A. Mercury and mercurous chloride

9. Which electrode is easy to use and requires less maintenance?

- A. Hydrogen Electrode
- B. Glass Electrode
- C. Platinum Electrode
- D. Copper Electrode

Answer: B. Glass Electrode

10. One advantage of the Glass Electrode is

- A. Simple construction and fast response
- B. Requires hydrogen gas
- C. Very difficult to maintain
- D. Cannot measure pH accurately

Answer: A. Simple construction and fast response

11. An Oxygen Analyzer is used to measure the concentration of

- A. Carbon Monoxide
- B. Sulphur Dioxide
- C. Oxygen
- D. Hydrogen

Answer: C. Oxygen

12. A Paramagnetic Oxygen Analyzer works on the property of

- A. Electrical Conductivity
- B. Para magnetism of Oxygen
- C. Thermal Expansion
- D. Piezoelectric Effect

Answer: B. Para magnetism of Oxygen

13. Oxygen gas is

- A. Diamagnetic
- B. Paramagnetic
- C. Non-magnetic
- D. Ferromagnetic

Answer: B. Paramagnetic

14. A CO Analyzer is used to measure

- A. Oxygen
- B. Carbon Monoxide
- C. Carbon Dioxide
- D. Sulphur Dioxide

Answer: B. Carbon Monoxide

15. A CO Analyzer is mainly used in

- A. Boiler flue gas analysis
- B. Water level measurement
- C. Temperature measurement
- D. Pressure measurement

Answer: A. Boiler flue gas analysis

16. An SO₂ Analyzer is used to measure

- A. Nitrogen
- B. Oxygen
- C. Sulphur Dioxide
- D. Hydrogen

Answer: C. Sulphur Dioxide

17. One advantage of a Paramagnetic Oxygen Analyzer is

- A. High accuracy
- B. High maintenance
- C. Low sensitivity
- D. Heavy moving parts

Answer: A. High accuracy

18. One disadvantage of a Paramagnetic Oxygen Analyzer is

- A. Higher cost
- B. Low accuracy
- C. Cannot measure oxygen
- D. No electrical output

Answer: A. Higher cost

19. Gas analyzers are mainly used to

- A. Measure gas composition
- B. Measure liquid level
- C. Measure force
- D. Measure speed

Answer: A. Measure gas composition

20. Gas analyzers are widely used in

- A. Process industries
- B. Textile weaving only
- C. Building construction
- D. Agriculture only

Answer: A. Process industries

21. Which instrument is commonly used for continuous oxygen monitoring in industrial processes?

- A. Paramagnetic Oxygen Analyzer
- B. Glass Electrode
- C. Calomel Electrode
- D. Pendulum Scale

Answer: A. Paramagnetic Oxygen Analyzer

True or False

22. pH is a measure of the acidity or alkalinity of a solution. (True)

23. The pH value of pure water is 7. (True)

24. The Hydrogen Electrode is used as a primary reference electrode. (True)

25. The Glass Electrode is the most commonly used electrode for industrial pH measurement. (True)

26. The Calomel Electrode is used as a reference electrode in pH measurement. (True)

27. A Paramagnetic Oxygen Analyzer works on the paramagnetic property of oxygen. (True)

28. A CO Analyzer is used to measure the concentration of carbon monoxide gas. (True)

29. An SO₂ Analyzer is used to measure Sulphur dioxide gas. (True)

30. The Glass Electrode requires hydrogen gas for its operation.
False

PART B

1. Draw and explain the operation of Hydrogen Electrode.
2. Explain with neat diagram the operation of Glass electrode.
3. Explain with diagram the operation of Para magnetic analyzer.
4. Explain with diagram the SO₂ analyzer.
5. Match the Following

a) Question 1

Column A	Column B
A. Hydrogen Electrode	1. Measures carbon monoxide
B. Calomel Electrode	2. Reference electrode
C. Glass Electrode	3. Measures oxygen
D. Oxygen Analyzer	4. Industrial pH measurement
E. CO Analyzer	5. Primary reference electrode

Answer: A-5, B-2, C-4, D-3, E-1

b) Question 2

Column A	Column B
A. Paramagnetic Oxygen Analyzer	1. Hydrogen gas
B. SO ₂ Analyzer	2. Sulphur dioxide measurement
C. Glass Electrode	3. Paramagnetic property
D. Hydrogen Electrode	4. Thin glass membrane
E. Calomel Electrode	5. Mercury and mercurous chloride

Answer: A-3, B-2, C-4, D-1, E-5

UNIT – V Chromatography and Spectral Method of Analysis

Part - A

1. Chromatography is a method used to
- a) Heat a sample
 - b) Separate the components of a mixture
 - c) Measure temperature
 - d) Measure pressure

Answer: b

2. In chromatography, the sample is separated based on
- a) Colour only
 - b) Size only
 - c) Difference in movement through the stationary phase
 - d) Weight only

Answer: c

3. Which is a type of chromatography?
- a) Gas Chromatography
 - b) Liquid Chromatography
 - c) Paper Chromatography
 - d) All the above

Answer: d

4. In Gas Chromatography (GC), the mobile phase is
- a) Liquid
 - b) Gas
 - c) Solid
 - d) Steam

Answer: b

5. In Liquid Chromatography (LC), the mobile phase is
- a) Gas
 - b) Liquid
 - c) Solid
 - d) Air

Answer: b

6. The stationary phase in chromatography is usually
- a) Fixed in the column
 - b) Moving continuously
 - c) A gas only
 - d) Water only

Answer: a

7. The main purpose of Gas Chromatography is
- a) Mixing chemicals

- b) Separating volatile compounds
- c) Measuring weight
- d) Measuring pressure

Answer: b

8. Retention time means

- a) Time taken by a component to come out of the column
- b) Time taken to heat the sample
- c) Time taken to cool the sample
- d) Time taken to clean the instrument

Answer: a

9. Dead time is

- a) Time taken by an unretained substance to pass through the column
- b) Time taken to prepare the sample
- c) Time taken to heat the detector
- d) Time taken to switch on the instrument

Answer: a

10. Which detector measures changes in thermal conductivity?

- a) Electron Capture Detector
- b) Flame Photometric Detector
- c) Thermal Conductivity Detector
- d) UV Detector

Answer: c

11. Thermal Conductivity Detector is commonly called

- a) TCD
- b) ECD
- c) FPD
- d) UVD

Answer: a

12. Flame Photometric Detector is mainly used to detect

- a) Sulphur and phosphorus compounds
- b) Oxygen only
- c) Nitrogen only
- d) Water

Answer: a

13. Flame Photometric Detector is abbreviated as

- a) TCD
- b) FPD

- c) ECD
- d) IRD

Answer: b

14. Electron Capture Detector is abbreviated as

- a) ECD
- b) FPD
- c) TCD
- d) LCD

Answer: a

15. Electron Capture Detector is highly sensitive to

- a) Halogen compounds
- b) Sugar
- c) Water
- d) Salt

Answer: a

16. Beer's Law relates

- a) Pressure and volume
- b) Absorbance and concentration
- c) Speed and time
- d) Density and mass

Answer: b

17. UV spectrophotometer uses

- a) Ultraviolet light
- b) X-rays
- c) Gamma rays
- d) Radio waves

Answer: a

18. IR spectrophotometer uses

- a) Infrared radiation
- b) Ultraviolet radiation
- c) Visible light only
- d) Gamma rays

Answer: a

19. Which instrument is used to measure absorbance?

- a) Spectrophotometer
- b) Thermometer

- c) Barometer
- d) Ammeter

Answer: a

20. UV spectrophotometer is mainly used for

- a) Quantitative analysis
- b) Cutting metals
- c) Measuring pressure
- d) Cooling samples

Answer: a

21. IR spectroscopy is mainly used for

- a) Identifying functional groups in compounds
- b) Measuring temperature
- c) Measuring weight
- d) Measuring speed

Answer: a

True or False

22. Chromatography is used to separate the components of a mixture. (True)

23. Gas Chromatography uses a liquid as the mobile phase. (False)

24. Liquid Chromatography uses a liquid mobile phase. (True)

25. Retention time is the time taken by a component to come out of the column. (True)

26. Thermal Conductivity Detector is called TCD. (True)

27. Flame Photometric Detector is mainly used for sulphur and phosphorus compounds. (True)

28. Electron Capture Detector is sensitive to halogen compounds. (True)

29. According to Beer's Law, absorbance decreases when concentration increases. (False)

30. IR spectroscopy uses infrared radiation. (True)

PART B

1. With a neat sketch explain the operation of Liquid Chromatography.
2. Explain with neat diagram the operation of Thermal conductivity detector.
3. Explain with diagram the operation of Electron capture detector.
4. Explain with diagram the IR/UV spectrophotometry.
5. Match the Following

(a) Question 1

Column A	Column B
A. Gas Chromatography	4. Uses gas as mobile phase
B. Liquid Chromatography	2. Uses liquid as mobile phase
C. Retention Time	1. Time taken by sample to reach detector
D. Dead Time	3. Time taken by carrier gas only
E. Chromatography	5. Method used to separate mixtures

Answer Key: A-4, B-2, C-1, D-3, E-5

(b) Question 2

Column A	Column B
A. Thermal Conductivity Detector (TCD)	2. Measures change in thermal conductivity
B. Flame Photometric Detector (FPD)	3. Used for sulphur and phosphorus compounds
C. Electron Capture Detector (ECD)	1. Detects compounds containing halogens
D. Beer's Law	4. Absorbance is proportional to concentration
E. UV Spectrophotometer	5. Used to measure UV light absorption

Answer Key: A-2, B-3, C-1, D-4, E-5