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| **Syllabus for Comprehensive Test** |
| **Full Marks: 30 marks** |

ME 701: Measurement Systems in Mechanical Engineering

# Experimental Objectives

Monitoring, Control and Research, Systems and Variables Identifications for Mechanical Systems, Planning of Instrumentations

# Measurement Systems

Generalized Description of the Measurement System, Operational Description of the General Measurement System and Elimination Method of Interfering Inputs to the Desired Inputs, Null and Deflection Methods of Measurements, Analog and Digital Measurements, Order of Instruments and Calibration, Performance Characteristics, Frequency Response

# Analysis of Experimental Data

Causes and Types of Experimental Errors, Error Analysis on a Common-Sense Bias, Uncertainty Analysis and Propagation of Uncertainty, Evaluation of Uncertainties for Complicated Data Reduction, Statistical Analysis of Experimental Data, Probability Distributions, The Gaussian or Normal Error Distribution, Method of Least Squares, the Correlation Coefficient, Multivariable Regression, Standard Deviation of the Mean, Graphical Analysis and Curve Fitting, Design of Experiments, Aliasing, Constructing Fractional Design, Taguchi’s Design

# Sensors and Transducers

Data Sampling, Signal Conditioning and Computer Data Acquisition. Error Response Characteristic of Sensors, Measurement Error

# Measurement of Process Variables

*Pressure Measurement:* Dynamic Response, Dead Weight Pressure Tester, Bourdon Gauge; Low Pressure Measurement Techniques-the McLeod Gauge, Pirani Thermal Conductivity Gauge, Knudsen Gauge

*Flow Measurement:* Positive Displacement Methods, Flow Obstruction Methods, the Sonic Nozzle, Hot Wire and Hot Film Anemometer, Magnetic Flow Meter, Flow Visualization Method, LDA

*Temperature Measurement:* Temperature Scales, the Ideal Gas Thermometer, Temperature Measurement by Mechanical Effect, Electrical Effect, Radiation, Effect of Heat Transfer on Radiation, Transient Response of Thermal Systems, Thermocouples, and Temperature Measurement in High-Speed Flow

# Measurement of Force, Torque and Power

*Force Measurement:* Platform Balance, Force to Displacement Conversion, Conversion of Force to Hydraulic Pressure, Piezoelectric Force Transducer

*Measurement of torque and power:* Torque Measurement: Electric Generator as a Dynamometer, Measurement of Rotational Speed

**References**

1. J. P. Holman, “Experimental methods for Engineers”,McGraw-Hill.
2. R. S. Sirohi and H. C. Radha Krishna, “Mechanical Measurements”, Wiley.