Course 36. Industrial Instrumentation (Web Course)

Faculty Coordinator(s) :

1. **Prof. V. Jayashankar**

   Department of Electrical Engineering

   Indian Institute of Technology Madras

   Chennai 600036.

   Email : vjkumar@ee.iitm.ernet.in

   Telephone : (91-44) Off : 2257 8367

   Res : 2243 4878

Detailed Syllabus :

1. **Measurement of force torque, velocity** **7**
   Electric balance – different types of load cells – magnets – elastics load cell-strain gauge load cell-different methods of torque measurement, strain gauge, relative regular twist-speed measurement-revaluation counter- capacitive tacho-drag up type tacho D.C and A.C tacho generators – stroboscope.

2. **Measurement of acceleration, vibration and density** **8**
   Accelerometers – LVDT, piezo-electric, strain gauge and variable reluctance type accelerometers – mechanical type vibration instruments – seismic instrument as an accelerometer and vibrometer – calibration of vibration pick ups – units of density, specific gravity and viscosity used in industries – Baume scale API scale – pressure head type densitometer – float type densitometer – ultrasonic densitometer Bridge type gas densitometer.

3. **Pressure measurement** **12**
   Units of pressure – manometers – different types – elastic type pressure gauges – Bourde type bellows – diaphragms – Electrical methods – elastic elements with LVDT and strain gauges – capacitive type pressure gauge – piezo resistive pressure sensor – resonator pressure sensor – measurement of vacuum – McLeod gauge – thermal conductivity gauges – Ionization gauge cold cathode and hot cathode types – testing and calibration of pressure gauges – dead weight tester.

4. **Temperature measurement** **9**
   Definitions and standards – primary and secondary fixed points – calibration of thermometers different types of filled in system thermometer – sources of errors in filled in systems and their compensation – Bimetallic thermometers – Electrical methods of temperature measurement – signal conditioning of industrial RTDs and their characteristics –3 lead and 4 lead RTDs.

5. **Thermocouples and pyrometers** **9**
   Thermocouples – law of thermocouple – fabrication of industrial thermocouples – signal conditioning of thermocouple output – thermal block references functions – commercial circuits for cold junction compensation – response of thermocouple – special techniques for measuring high temperature using thermocouples – Radiation methods of temperature measurement – radiation fundamentals – total radiation and selective radiation pyrometers – optical pyrometer – two colour radiation pyrometer.

Text books

1. Ernest O.Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw Hill Book Company, 1998.

2. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.

References

1. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
2. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation – Dhanpat Raj and Sons, New Delhi, 1999.
3. P.Holman, Experimental Methods for Engineers International Student Edition, McGraw Hill Book Company, 1971.
4. B.C.Nakra and K.K.Chaudary, Instrumentation Measurement and Analysis, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1985.

INDUSTRIAL INSTRUMENTATION-II

1. Measurement of viscosity, humidity and moisture **9**

Viscosity terms – say bolt viscometer – rotameter type viscometer – industrial consistency meters – humidity terms – dry and wet bulb psychrometers – hot wire electrode type hygrometer – dew cell – electrolysis type hygrometer – commercial type dew point meter – moisture terms – different methods of moisture measurement – moisture measurement in granular materials, solid penetrable materials like wood, web type material.

2. Mechanical type flowmeters **8**

Theory of fixed restriction variable head type flow meters – orifice plate – venturi tube – flow nozzle – dall tube – installation of head flow meters – piping arrangement for different fluids – pilot tube.

3. Quantity meters, area flow meters and mass flow meters **10**

Positive displacement flow meters – constructional details and theory of operation of mutating disc, reciprocation piston, oval gear and helix type flow meters – inferential meter – turbine flow meter – rota meter – theory and installation – angular momentum mass flow meter – coriolis mass flow meters – thermal mass flow meter – volume flow meter plus density measurement – calibration of flow meters – dynamic weighing method.

4. Electrical type flow meter **9**

Principle and constructional details of electromagnetic flow meter – different types of excitation – schemes used – different types of ultrasonic flow meters – laser doppler anemometer systems – rortex shedding flow meter – target flow meter – solid flow rate measurement – guidelines for selection of flow meter.

5. Level measurement **9**

Gauge glass technique coupled with photo electric readout system – float type level indication – different schemes – level switches level measurement using displacer and torque tube – bubbler system. Boiler drum level measurement – differential pressure method – hydra step systems – electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors

Text books

1. D.Patranabis, Principles of Industrial Instrumentation Tata McGraw Hill Publishing Co., New Delhi, 1999
2. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi 1999.

References

1. Ernest O.Doebelin, Measurement systems application and design international student Edition, Tata McGraw Hill Publishing Co., New Delhi, 1999.
2. Patranabis, Principles of Industrial Instrumentation Tata McGraw Hill Publishing Co., New Delhi, 1999
3. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi 1999.
4. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation – Dhanpat Rai and Sons, New Delhi, 1999.

5. Eckman D.P.Industrial Instrumentation – Wiley Eastern Limited, 1990.
6. Liptak B.G. Instrument Engineers Handbook (Measurement), Chilton Book Co., 1994.