

Bachelor of Technology (B. Tech.)
Instrumentation and Control

B. Tech. III Semester – V

Subject Name: Industrial Measurement II

Subject Code: BTIC13501

Type of course: Professional Core Course

Prerequisite (if any): concepts of physical measurements, Basics of sensors and measuring instruments, Industrial measurement I

List of Courses where this course will be prerequisite : Process control, Agriculture and food processing instrumentation, Automotive instrumentation, Process dynamics and control

Rationale: Measurement instruments are used in different setups and applications: For example in industrial process control where the quality of specific production and joining processes is checked. Certain applications of measuring instruments may be characterized as having essentially a monitoring function, e.g., strain measurement, displacement measurement, analytical parameter humidity, temperature measurement, automotive speedometer and fuel gage. These are the one of the most important classes of measurement application

Teaching and Examination Scheme:

| TEACHING SCHEME | | | | Theory Marks | | | Practical Marks | | Total |
|-----------------|---|---|---|--------------|-----|-----|-----------------|-----|-------|
| L | T | P | C | TEE | CA1 | CA2 | TEP | CA3 | |
| 3 | 0 | 2 | 4 | 60 | 25 | 15 | 30 | 20 | 150 |

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

BSC: basic science course /ESC: Engineering Science Course /HSM: Humanities and management /PCC: Professional Core course /PEC: professional Elective course /OEC: Open Elective course/ MD: mandatory non-credit course

Content:

| Sr. No. | Content | Total Hrs | Module Weightage |
|----------------|---|------------------|-------------------------|
| 1 | Displacement Measurement Pneumatic Transducers, Electrical Transducers-Resistive transducer-potentiometer, Inductive transducer-linear and rotary variable differential transducer, Capacitive transducer, Optical Transducers, Ultrasonic Transducers, Magnetostrictive Transducers, Proximity sensors. | 6 | 13% |
| 2 | Analytical Instrumentation Industrial Gas analysis(oxygen and carbon dioxide) -Thermal properties, Magnetic susceptibilities, Adsorption/emission of electromagnetic radiation, chemical reaction. Mass spectrometer, Ionization methods- electron impact, chemical ,matrix assisted laser desorption (MALD). Analyzer-scanning mass analyzer, Time of flight analyzer, Trapped ion mass analyzer Electromagnetic radiation and its interaction with matter -Beer's law, Infrared spectrophotometer, Infrared analyzer- dispersive and non dispersive analyzer, Radiation sources – Monochromators – Filters – Prisms – Diffraction gratings and Detectors. Atomic absorption spectrometry (AAS). Atomic fluorescence spectrometry(AFS). Nuclear magnetic Resonance (NMR) spectroscopy – Basic principles and applications. Chromatography – Basic principles of liquid and gas chromatography – Column details – Detectors for chromatography – Thermal conductivity detector – Flame ionization detector – Flame photometric detector – Electron capture detector – Effect of temperature programming. High pressure liquid chromatography (HPLC). | 10 | 22% |
| 3 | Strain Measurement Introduction, Stress-strain relations, Types, Measurement methods-bridge | 6 | 13 % |

Bachelor of Technology (B. Tech.)
Instrumentation and Control

| | | | |
|----------|--|----------|-------------|
| | circuits, Temperature effect compensation, calibration, Resistance strain gauges, Fiber-optic strain gauges. | | |
| 4 | Acceleration, Force And Torque Measurement Introduction, Measurement, Accelerometers Transducers- Piezoelectric, Piezoresistive, Hall effect, Magneto resistive, Thermal Acceleration measurement, MEMS and Application. Force measurement transducers- Proving Ring, Hydraulic load cell, inductive and reluctance load cell, Magnetoelastic load cell, Piezoelectric load cell, Resonant Wire load cell, Industrial weighing system, Torque measurement, Tachometers. | 9 | 21 % |
| 5 | Miscellaneous Measurements Humidity and Moisture measurement, Density measurement, Viscosity measurement, Turbidity measurement pH measurement – Basic principles – Ion selective electrodes – Glass and reference electrodes. Electrical conductivity measurement – Measuring circuit – Water and steam purity measurement using electrical conductivity. | 8 | 19 % |
| 6 | Application In Water Treatment and Air Pollution Measurement Basic methods of water treatment, General equation for settling or rising of discrete particles, different zones of sedimentation, hindered settling, effect of temperature on coagulation, reduction in efficiency due to various causes, sludge, storage & removal, Importance of air pollution, analytical methods for air pollution studies, Flue gas analysis for pollution control – Measurement of CO, CO ₂ , NO _x and SO _x . | 6 | 12 % |
| | | | |

Suggested Specification table with Marks (Theory):

| Distribution of Theory Marks | | | | | |
|-------------------------------------|-------------|-------------|-------------|-------------|-------------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 10 % | 40 % | 20 % | 10 % | 10 % | 10 % |

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

BSC: basic science course /ESC: Engineering Science Course /HSM: Humanities and management /PCC: Professional Core course /PEC: professional Elective course /OEC: Open Elective course/ MD: mandatory non-credit course

Bachelor of Technology (B. Tech.)
Instrumentation and Control

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

| Sr no | Title of book /article | Author(s) | Publisher and details like ISBN | Year of publication | Publication Edition |
|-------|---|---------------------------------------|--|---------------------|-------------------------|
| 1 | Process Measurement and Analysis | B. G. Liptak | CRC Press ISBN-978-0849310836 | 2003 | 4 th Edition |
| 2 | Handbook of Applied Instrumentation | D. M. Considine and Sidney David Ross | McGraw Hill Publicaiton, ISBN-978-0070124264 | 1964 | 3 rd Edition |
| 3 | Encyclopedia of Instrumentation and Control | D. M. Considine | McGraw-Hill Inc., US | 1971 | 1 st Edition |
| 4 | Instrumentation Reference Book | Walt Boyes | Butterworth Heinemann Publisher ISBN-978-0750683081 | 2009 | 4 th Edition |
| 5 | Introduction to Instrumentation and Control | A. K. Ghosh, | Prentice Hall India Learning Private Limited ISBN-978-8120346253 | 2012 | 4 th Edition |
| 6 | Industrial Instrumentation | K. Krishnaswamy and S. Vijayachitra | New Age International Publication. ISBN-978-8122427509 | 2010 | 2 nd Edition |
| 7 | Measurement Systems: Application and Design | E. O. Doebelin, | McGraw Hill Publication ISBN-007-017338-9 | 1990 | 4 th Edition |
| 8 | Air pollution control technology | Wark & Warner | Pearson ISBN-978-0673994165 | 1998 | 3 rd Edition |
| 9 | Environmental instrumentation and analysis handbook | Randy D. Down & Jay H. Lehr | A John Wiley & Sons, Inc. ISBN 978-0471463542 | 2004 | 1 st Edition |

Course Outcomes:

After learning the course the students should be able to:

Page 4 of 6

BSC: basic science course /ESC: Engineering Science Course /HSM: Humanities and management /PCC: Professional Core course /PEC: professional Elective course /OEC: Open Elective course/ MD: mandatory non-credit course



SARVAJANIK
UNIVERSITY

INCLUSIVE | INTEGRATED | INNOVATIVE

SARVAJANIK UNIVERSITY
Sarvajani College of Engineering and Technology

Bachelor of Technology (B. Tech.)
Instrumentation and Control



| Sr. No. | CO statement | Marks % weightage |
|---------|---|-------------------|
| CO-1 | use basic instruments for measurement of displacement, strain, acceleration, force, torque. | 30% |
| CO-2 | determine the physical properties of samples using PH, viscosity, density, Conductivity and other analytical parameters and Identify the type of sensor and their relevant specification. | 20% |
| CO-3 | operate chemical and analytical instruments and identify the basic components of spectroscopic, chromatographic instrumentation. | 20% |
| CO-4 | quantitatively measure the composition of dissolved oxygen, carbon dioxide elements present in the given samples | 15% |
| CO-5 | identify various instruments for environmental health monitoring and quality control applications. | 15% |

Mapping with POs:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO-1 | 3 | 2 | | 1 | | | 3 | | 1 | | 3 | 1 | 2 | | |
| CO-2 | 2 | 2 | | | | | 1 | | 1 | | 3 | 1 | 3 | | 1 |
| CO-3 | 2 | 3 | | 1 | 2 | | | | 1 | | 3 | | 3 | | 2 |
| CO-4 | 2 | 2 | | | 1 | | | | 3 | | 2 | 1 | 3 | | 2 |
| CO-5 | 3 | 2 | 2 | | 1 | | 2 | | 1 | | 1 | 1 | 3 | | 1 |

List of Open Source Software/learning website:

<http://www.nptel.ac.in/courses/105102089/9>

<http://nptel.ac.in/video.php>

<https://www.vlab.co.in>

BSC: basic science course /ESC: Engineering Science Course /HSM: Humanities and management /PCC: Professional Core course /PEC: professional Elective course /OEC: Open Elective course/ MD: mandatory non-credit course

List of Open Source Software: Not applicable
FOR LAB SESSIONS:

List of Experiments:

1. Characterization and calibration of potentiometer based displacement sensor
2. Characterization and calibration of LVDT as displacement sensor
3. Measurement of strain on a beam using strain gauge.
4. Determine the effect of temperature and electromagnetic interference on Strain Gauge and LVDT respectively.
5. Characterization and calibration of speed measurement system. (Tachometer, Photoelectric and magnetic Pick-up).
6. Characterization and calibration of vibration measurement system. (Piezo-resistive vibration pick-up)
7. Characterize the Proximity sensors (inductive) and study its behavior under environment under study.
8. Identify the absolute position of the shaft using encoders.
9. Study of the detectors (leak detectors, flame detectors, smoke detectors)
10. To calibrate pH measurement system and to measure pH of given sample.
11. Qualitative and quantitative analysis using UV-Visible spectrophotometer.
12. To analyze a given water sample using turbidity meter, conductivity, hygrometer, etc.
13. Study of measurement for air polluting parameters like SO₂, NO_x, etc.
14. Study of Gas Chromatograph
15. Study of HPLC system

Major Equipment Needed: Universal calibrator, Temperature bath, Voltage/ current Simulator, Measurement set up for different parameters. Analytical instruments, Ambient condition monitoring system, etc