Basics of Measurements and Measuring Instruments

The course is introduced for M. Sc. Students of any subject. The student can opt these 6 credits at any of the semesters to understand the basics of measurements. It is of interdisciplinary nature. The course has 4 credits worth 60 lectures and 2 credits for laboratory. It will be run by the Centre of Sensor Studies, University of Pune, which has representation of physical, chemical and biological Sciences

Course to be run by the CSS

Theory **4 credits**

I. Introduction to measurements

Significant figures, units of physical constants, Averages, RMS values, Decibels, Categories of Measurements, Factors in making the measurements-accuracy, precision, resolution, repeatability, reproducibility, hysteresis, sensitivity, range, Errors in Measurements-theoretical, static, dynamic , instrument insertion -12L

II. Test and Measuring instruments

UV-Vis, FTIR Spectrometers, optical Multichannel Analyzer, optical Fiber Receiver- Transmitters, Lock –in –Amplifier, Cyclic Voltmeter, Multimeter, CRO- Principle of Operation, Block Diagram, Specifications, Controls, Making Measurements with the instruments -12L

III. Basic and Advanced Microscopy (Block diagram and working,)

Optical Microscope, SEM, FESEM, TEM, AFM, interpretation of results. -10L

IV. Transducers and Sensor Parameters/ classification

Types, Specifications, Chemical, Physical, Mechanical, Thermal, Optical, Electrical, Magnetic and Bio-Sensors-Two sensors of each type, , Applications of Sensors in clinical diagnosis, environment, Requirements, Basic Science, Design Considerations. -14L

V. Overview of the living world

Introduction to molecules, Basic Ecology.

Prokaryotes and eukaryotic cells and different levels of organization in the living world, overview of Bio-molecules and biochemical machinery of metabolism, Basic ecological concepts, Biotic and abiotic factors influencing ecosystem ecology. -12L

VI. Laboratory Component **2 credits**

Suggested list of Experiment and/ or Experiments of similar nature. -30L

1. Temperature Transducers
   a. Characteristics of IC Temperature Sensor.
   b. Characteristics of Platinum RTD.
   c. Characteristics of NTC Thermistor.

2. Pressure Sensor
   a. Study of strain measurement using strain gauges and cantilever assembly.
   b. To determine linear range of operations of strain measurement.
   c. To determine sensitivity of trainer.

3. Displacement Sensor
   a. Study of Input Output characteristics of LVDT.
   b. To determine linear Range of operation of LVDT.
   c. To determine Sensitivity of LVDT.

d. To measure phase difference between LVDT secondary wiring.

4. Strain / Pressure / Force / Piezo electric sensor
    a. Strain gauge as displacement sensor.
    b. Strain measurement and gauge factor determination.
    c. Test piezo electric transducer.

5. Displacement sensor
    a. Linear displacement measurement using capacitance.
    b. Angular displacement measurement using capacitance.
    c. Displacement measurement using linear potentiometer.

6. Speed measurement sensor
    a. Using magnetic pick up for motor speed sensor.
    b. Photo reflector for speed measurement.
    c. Photo interrupter method for speed measurement.

7. Speed measurement sensor
    a. Stroboscopic method for speed measurement.
    b. Inductance used for speed measurement.
    c. Hall effect used for speed measurement.

8. Ultrasonic sensor
    a. Distance measurement using ultrasonic sensor.
    b. Sound sensitive switch.

9. Optical fiber sensors
    a. Characteristic of optical fibers
    b. Humidity Sensor
    c. Force Sensor
    d. Flow Sensor

10. Temperature sensor
    a. Characteristic of J type thermocouple.
    b. Characteristic of K type thermocouple.
    c. Bimetallic relay as a temperature dependent control device.
    d. Temperature controlled alarm system (INTC)
    e. Temperature controlled alarm system (Bridge NTC)

11. Estimation of Proteins by Biuret Method.

12. Estimation of reducing sugars by DNSA method/ Nelson method.

13. Estimation of Vitamin C

14. Microscopic studies of prokaryotic and eukaryotic cells, plants and animals (including microbes), tissue organization of plants and animals.

15. Familiarization with basic microbiological techniques, study of bacterial growth.

16. Isolation of DNA from Plant/ Animal/ Microbial samples.

17. Biotic components of an (terrestrial / aquatic) ecosystem**.**

Reference Books

Sr. no.	**Book name**	**Author name**	**Publisher**	**Year of Publication**
1	Instant notes in Biochemistry	B. D. Hames, N. M. Hooper, J. D. Houghton	Taylor & Francis	2000, Second Edition
2	Principles of Biochemistry	Albert L. Lehninger, David Lee Nelson, Michael M. Cox	W.H. Freeman,	2005, Fourth Edition
3	Textbook of Biochemistry Lehninger	Mehdix	W. H. Freeman	2002, Fifth Edition
4	Measurement Systems Application and Design	Ernest O. Dobelin	McGraw-Hill Science/Engineering/Math	4th edition (November 1, 1989)
5	Pearson - Elements of Electronic Instrumentation and Measurements	Joseph J. Carr**,**	Prentice Hall	16th October 1995
6	Instrumental Methods of Analysis	Hobarth Willard , Lynne Merritt , John Dean , Frank Settle	Wadsworth Publishing Company	7 Sub edition (February 1988)
7	Sensors and Transducers	D. Patranabis	Prentice-Hall of India Pvt.Ltd	(August 15, 2004
8	T & M instrument catalog and Application		Agilent	2010-2011

9	T & M instrument catalog and Application		Tektronix	2010-2011
10.	Campbell Biology	J. B. Reece, L. A. Ury, M. L. Cain, Wasserman S. A., P. V. Minorsky, R. B. Jackson.	Benjamin Cummings. 9th edition	2010
11	Life : The Science of Biology	D. Sadava, H. C. Heller, D. M. Hillis, M. Berenbaum	W. H. Freeman 9th edition	2009
12	Campbell Biology	J.B.Reece, L.A. Ury, M.L. Cain, Wasserman S.A., P.V. Minorsky, R.B. Jackson	Benjamin Cummings. 9th edition	2010
13.	Life : The Science of Biology	D. Sadava, H.C. Heller, D.M. Hillis, M. Berenbaum	W.H. Freeman 9th edition	2009