Indian Institute of Technology, Kanpur

Proposal for a New Course

1. Course No: PHY692

2. Course Title: Measurement Techniques

3. Per Week Lectures: 2 (L), Tutorial: 0 (T), Laboratory: _ 6 (P), Additional Hours[0-2]: 0 (A),
   Credits (3*L+2*T+P+A): 12_ Duration of Course: Full Semester

4. Proposing Department/IDP : Physics
   Other Departments/IDPs which may be interested in the proposed course:
   Other faculty members interested in teaching the proposed course: Krishnacharya, Chanchal Sow

5. Proposing Instructor(s): Aditya H. Kelkar, Venkata Jayasurya Yellapragada

6. Course Description:

A) Objectives: This course is to discuss basic concepts of experimental measurements, and the introduction of experimental and data analysis techniques used in various domains of experimental research. The course will comprise of lectures on selected topics as well as laboratory sessions and hands-on instrumentation.

B) Contents (*preferably in the form of 5 to 10 broad titles)*:

S. No	Broad Title	Topics	No. of Lectures
1.	Theory of Error Analysis	Uncertainties in measurement, Probability distribution, Error analysis, Mean and expectation value, counting statistics, Least square fit.	4
2.	Data analysis and Numerical techniques	χ^2 fit, Linear correlation, Polynomial interpolation, numerical differentiation, integration, roots of non-linear equation	4
3.	Vacuum Technology	Kinetic theory of gases, Gas flow, Vacuum pumps, Vacuum gauges, leak testing, degassing	4
4.	Electronics and Instrumentation	Basics of diodes and transistors, analog circuits using opamp, digital electronics, interfacing with microcontroller (Arduino/esp32)	5
5.	Radiation Detection and measurement	Radiation sources, interaction of radiation with matter, Scintillator detectors, photomultiplier tubes, radiation spectroscopy	3
6.	Some specialized experiments	Thin film deposition, microscopy using SEM, AFM, X-ray diffraction, Rutherford backscattering, Autocorrelation	6

C) Laboratory experiments: Thin Film deposition*, Johnson noise/ Shot noise*, Lock-in amplifier*, 4-f imaging*, Interferometry, Gamma Ray spectroscopy, Resistivity measurement - Four probe technique, PID controller, Chaos – electronic circuits, Rutherford Backscattering using Tandetron Accelerator, Force measurement etc.

D) Pre-requisites, if any (*examples: a- PSO201A,or b- PSO201A or equivalent*): None

E) Short summary for including in the Courses of Study Booklet

This course is to discuss basic concepts of experimental measurements and introduction of experimental and data analysis techniques used in various domains of experimental research. The course will comprise of lectures on selected topics as well as laboratory sessions and hands-on instrumentation.

Lecture topics: Theory of Error Analysis, Data analysis and Numerical techniques, Vacuum Technology, Electronics and Instrumentation, Radiation Detection and Measurement, Some specialized experiments

Laboratory experiments: Thin Film deposition*, Johnson noise/ Shot noise*, Lock-in amplifier*, 4-f imaging*, Interferometry, Gamma Ray spectroscopy, Resistivity measurement - Four probe technique, PID controller, Chaos – electronic circuits, Rutherford Backscattering using Tandetron Accelerator, Force measurement etc.

7. Reference
   books:
   Data reduction and error analysis by Bevington and Robinson
   Vacuum Technology by Nagamitsu Yoshimura
   Radiation detection and measurement by G. F. Knoll
   Art of Electronics by Horowitz and Hill
8. Any other remarks:

Dated: 16/6/25 Proposer: Aditya H. Kelkar

Dated: DUGC/DPGC Convener:

The course is approved / not approved

Chairman, SUGC/SPGC

Dated: