Department of Sustainable Energy Engineering
Indian Institute of Technology Kanpur

Proposal for a New Course

Course title	:	Engineering Measurements Laboratory
Number	:	SEE4XX
Credits (L-T-P [C])	:	2-0-3-0[9]
Departments proposing the course	:	Sustainable Energy Engineering
Name of the proposer	:	Laltu Chandra, Lalit Pant
Offered for	:	1st year Integrated PhD students of the SEE department taken through JAM
Status of the course	:	UG
Type of Course	:	DC
Prerequisite(s) for the course	:	None
Faculty members interested in teaching	:	All SEE Faculty
Other departments/programs whose students are expected to take up the course	:	NA

Course Objectives:

An Engineering Measurements Laboratory is planned for Integrated PhD course at the Department of Sustainable Energy Engineering. This multi-disciplinary laboratory aims to offer hands-on training to the inducted students, mainly from an undergraduate science background, on some of the engineering measurement techniques. The objective is to enable and transform these students to, eventually, undertake interdisciplinary research problems, spread across different thematic areas, and meaningfully contribute to the same by way of technology development. The experiments may be offered, but not limited to, in the following thematic areas:

Theme 1: Build Environment and Fuel Cells

Theme 2: Power Systems/Power Electronics

Theme 3: Materials Characterization

Theme 4: Thermo-Fluid Engineering

Course Outline:

Number of basic (measurement) experiments: 2 per theme (x 4) = 8

Number of applied experiments: 1 per theme (x 4) = 4

Total number of experiments: 12 for a semester

Theme	Experiments	Objective &	Expected Outcomes
Build Environment and Fuel Cells	Impedance Analysis on Fuel Cells (B)	To measure the impedance of different circuits and create equivalent circuit models	Students will learn about which components impact impedance in which way and will gain a preliminary understanding of impedance spectroscopy
	Measurement of Solar Angles and Apperant Sun Path (B)	To study the solar angles and the sun's path at different latitudes using a heliodon.	Students will learn about solar angles and the Sun path during the different months of the year for different locations on the earth
	Galvanic Cell (A)	To study the working principle of a galvanic cell and measure the electrical output generated through electrochemical reactions.	Students will understand redox reactions, electrode roles, and the effect of operating parameters on cell voltage and current, with relevance to batteries and fuel cells.
Power Systems/Power Electronics	Calibration and testing of single-phase energy meter (B)	To calibrate and test the given Single phase energy meter by direct loading.	Understanding of the major components and operating mechanism of a single-phase energy meter used for the measurement of energy in domestic and industrial AC circuits.
	Design and testing of a DC-DC converter (B)	To study the design and operation of DC-DC converters (buck, boost, and buck-boost) and analyze their voltage regulation characteristics.	Students will understand the relationship between duty cycle, input-output voltage, and load conditions, and gain practical insight into DC power conversion techniques.
	Performance assessment of a solar PV-panel using an analyzer kit and grid integration (A)	To measure the PV performance curves in the field and compare with the built-in PV model.	Understanding the PV performance curves and impact of ambient irradiance and module cell temperature conditions on it through the PV Analyzer kit.
Materials Characterization	Electrical property measurement of materials (B)	To study the electrical properties of materials using Hall effect and four-probe measurement techniques.	Students will understand charge transport mechanisms in materials and analyse parameters such as resistivity, carrier concentration, mobility, and semiconductor type.
	Optical Property Measurement of Absorber Materials for Solar Cell Applications (B)	To study the optical properties of materials using UV–Vis and emission spectroscopy techniques.	Students will understand light-matter interaction and analyse optical parameters such as absorbance, reflectance, emission characteristics, and optical bandgap relevant to solar energy materials.

	Solar cell device fabrication and testing (A)	To fabricate a basic solar cell device and evaluate its electrical performance under illumination.	Students will understand the device fabrication steps and analyse key performance parameters such as current-voltage characteristics, power conversion efficiency, and fill factor of solar cells.
Thermo-Fluid Engineering	Flow (air/water) measurement and pressure calibration techniques (B)	To study different flow measurement techniques and perform calibration of flow and pressure measuring devices under controlled operating conditions.	Students will understand the working principles of various flow meters, learn pressure and differential pressure measurement methods, and analyse the calibration and accuracy of flow measurement systems.
	Temperature measurement and heat transfer in a pipe with different fluids with radiation as heat source (B)	(a) Temperature measurement using different devices and their calibration (b) Assessment of thermal efficiency for heat transfer in a straight pipe	(a) Hands-on training with some of the widely-utilized temperature measurement devices like k-type thermocouples, Pt100, etc., and their comparative assessment. (b) To understand all the different modes of heat transfer in an integrated system.
	Solar Concentrator	To study the working principle and thermal performance of a solar concentrator system under different operating and environmental conditions.	Students will understand solar thermal energy concentration, evaluate system efficiency and heat losses, and analyse the effect of parameters such as solar insolation, flow rate, and ambient conditions on system performance.

Course proposed by **Recommended/Not recommended** **This course is approved/not approved**

(Laltu Chandra / Lalit M. Pant) Convener, DPGC (SEE) Chairman, SPGC