

## Approval: 9<sup>th</sup> Senate Meeting

<b>Course Name</b>	<b>: Experimental Research Techniques</b>
<b>Course Number</b>	<b>: PH 614P</b>
<b>Credits</b>	<b>: (0-0-7-4)</b>
<b>Prerequisites</b>	<b>: First year I-Ph.D. courses</b>
<b>Intended for</b>	<b>: PG</b>
<b>Distribution</b>	<b>: Core</b>
<b>Semester</b>	<b>: Odd</b>

**Preamble** : According to Newton's third law, we can just move the earth up and down by just throwing the ball up and down. But why don't we feel it? Its simply because its immeasurable within the uncertainty of the measuring set up. Performing an experiment with out the knowledge of uncertainty has no meaning. The students will be given a flavour of what does it really mean by (a) performing an experiment; (b) developing a mini experiment (c) assembling and engineering tools.

**Course Outline** : The aim of the proposed course is to amalgamate the concepts in Physics through assembling, developing mini experiments and building components.

### **Modules :**

#### **Transport properties of materials using homemade set up.**

This experiment involves measuring temperature dependent resistivity of any material using four probe method and Vander Pauw methods. The skills that one will develop are to make fine contacts on the sample, learn the intricacies involved in making this set up.

#### **Electronic properties of material using photoemission technique.**

Photoemission experiments will be done on any material and its electronic properties will be studied. The skills that one will develop are the intricacies involved in conducting experiments in ultra high vacuum conditions.

#### **Seebeck coefficient measurement using homemade semi automated set up.**

Develop mini Seebeck coefficient experiment to distinguish n-type and p-type semiconductors from a mixture of it.

#### **Structural properties of materials using powder x-ray diffraction (xrd) technique.**

To understand structural phase transition of any given material. The skills that one will develop are to understand the intricacies involved in any diffraction experiment, temperature variation set up, analysis of any powder xrd pattern.

### **Optical pumping.**

The technique is useful to measure the difference between the atomic energy levels with great precision. One can also measure the resonance frequencies, and thereby measure the Zeeman splitting, the nuclear spins and the strength of the Earth's magnetic field. Students will develop skills to handle laser, lock in amplifier and nonlinear curve fitting.

### **Two slit interference-one photon at a time**

This experiment will give hands on familiarity to confront wave-particle duality in a precise and definite way. It will develop the skill of single photon detection and theoretical modeling.

### **Molecular absorption and emission spectrophotometer.**

The objective is to study photophysical properties of molecules by measuring absorption and emission spectra. Preparation of molecular solution and data analysis skills will be developed.

### **Reverse engineering of any vacuum pump.**

A rotary pump along with its manual will be provided to the students. They have to dismantle this pump and assemble it and learn about its internal parts. This process helps in the development of skills related with assembling (spatial skills).

### **Design and making of any components**

This involves training to make technical drawing, operate lathe for shaping and making any given components.

### **Skill development for carpentry.**

Self explanatory