TOPICS OF TWO (2) COURSES

1. Nanoscience of materials/ Properties nanoelectronic materials

Fundamental study of materials in nanosize domain is very important since the modern technology and application are using more nanotechnology. Size matters. This course focuses on structure, bonding, surface energy, mechanical, thermal, optical, magnetic, electrical and electronic properties. This course will give introduction to size and shape of nano materials, nano thin films, polymer nanocomposites and catalysis. Properties of Nanomaterials, Zero dimension, one dimension and two dimensional nanostructures, smart materials will be briefly explained.

Course Outcome:

1. Explain methods of fabricating nanostructures.
2. Relate the unique properties of nanomaterials to the reduce dimensionality of the material.
3. Describe tools for properties of nanostructures.
4. Discuss applications of nanomaterials and implication of health and safety related to nanomaterials.

Course Content:

Introduction to nanostructures
Bonding and structure of the nanomaterials
Mechanical and thermal properties
Electrical and magnetic properties
Electrical and electronic properties
Nano thin films and nanocomposites
Potential application of nanomaterials.

Reference Books:

1. Introduction to Nanoscale Science and Technology (Nanostructure Science and Technology) by Massimiliano Ventra, Stephane Evoy and James R. Heflin
2. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications (World Scientific Series in Nanoscience and Nanotechnology) by Guozhong Cao and Ying Wang
3. Understanding Nanomaterials by Malkiat S. Johal

2. Nanomaterials Synthesis and Characterization Techniques

This course will demonstrate the details of different methods of synthesizing nanomaterials using bottom up and top down approaches. The characterization techniques such as BET surface area analyzer, Atomic force Microscopy (AFM), Scanning Electron Microscopy (SEM); Transmission Electron Microscopy (TEM); X-ray Diffraction (XRD); Small Angle X-ray Scattering (SAXS); High Power X-ray (Syncrotron) Diffraction, Electrical Impedance Spectroscopy (EIS), Electrical transport measurement, Thermal Conductivity, Magnetic transport properties characterization, UV-VIS Spectrophotometer; FT-IR Spectrophotometer; Micro-raman Spectrometer; Thermal Gravimetric Analysis (TGA), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC) and Differential Mechanical Analysis (DMA) will be explained in detail.

Course Outcome:

1. Explain different methods used to characterize materials.
2. Relate fundamental of physics to the basic operation of the equipment
3. Interpret the results obtained from different equipment

Course Content:

Optical Microscopy
X-ray diffraction
Scanning probe microscopy
Transmission electron microscopy
UV-VIS-NIR
Auger electron spectroscopy
Fourier transform infrared spectroscopy
Secondary ion mass spectroscopy,
Differential scanning calorimetry
Electrical impedance spectroscopy
Four-point probe,
Thermogavimetry

Reference Books:

1. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods by Y. Leng (Jun 2, 2008)
2. Materials Characterization Techniques [Hardcover] Sam Zhang (Author), Lin Li (Author), Ashok Kumar (Author)
3. Surface Analysis: The Principal Techniques [Paperback] John C. Vickerman (Editor), Ian Gilmore (Editor)