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| **Course Code** : PHY2005 | **Course Title : Introduction to Nanotechnology** | | | **TPC** | 3 | 0 | 3 |
| **Version No.** | 1.0 | | | | | | |
| **Course Pre-requisites/ Co-requisites/ anti-requisites (if any). Otherwise, please indicate as ‘None’** | None | | | | | | |
| **Objectives:** | To understand the basic concepts involved in Nanoscience and to gain knowledge about various methods of synthesis, characterization and applications in Nanotechnology. | | | | | | |
| **Expected Outcome:** | Have a clear understanding the fundamental concepts for Nanoscience.  Be aware of the synthesis methods for various important Nanomaterials  Have knowledge of the Nanoscale Characterization techniques  Get an appreciation of applications of Nanotechnology in various fields of Science and Engineering. | | | | | | |
| **Module No. 1** | Basic Concepts | 8 Hours | | | | | |
| Basic properties of Conductors, Insulators and Semiconductors; Band diagram concept of typical semiconductors; Basic Chemistry Concepts; Physical aspects, Bonding, Wave-particle duality, Heisenberg Uncertainty Principle, Schrödinger wave equation, Quantum confinement in 1-D, 2-D and 3-D; Effects of the nanometer length scale- Change in properties. | | | | | | | |
| **Module No. 2** | Nanomaterials | 8 Hours | | | | | |
| Basic Types of Nanostructures- Quantum wells, Quantum Wires, Carbon Nanotubes, Graphene and Graphennas, Nanowires; Quantum Dots, Nanoclusters; Nanoparticles- Colloidal nanoparticle crystals, Functionalized nanoparticles | | | | | | | |
| **Module No. 3** | Fabrication Method | 8 Hours | | | | | |
| Top-down processes, Bottom-up processes, Nanolithography techniques, Arc discharge method, Laser Ablation method, Ion Implantation, Chemical Vapour deposition, Sol-Gel method. | | | | | | | |
| **Module No. 4** | Carbon Nanotubes & its applications | 7 Hours | | | | | |
| Synthesis of CNTs, Electronic properties, Mechanical properties; Applications- CNTs as interconnects, CNTFETs, CNTs for solar cell and energy storage applications | | | | | | | |
| **Module No. 5** | Characterization Technhques | 8 Hours | | | | | |
| Classification of characterization methods, Different Microscopy techniques-Light Microscopy, Principle & Resolution, Electron Microscopy- Scanning Electron Microscopy (SEM), Principle & Resolution, Scanning Probe Microscopy- Scanning Tunnelling Microscopy (STM) & Atomic Force Microscopy (AFM), Principle & Resolution. | | | | | | | |
| **Module No. 6** | Nanosensors | | 6 Hours | | | | |
| Nano sensors based on quantum size effect; electrochemical sensors; sensors based on physical properties; Nano biosensors; Smart Dust-Sensors of the future | | | | | | | |
| **Text Books**  1. R.W. Kelsall, I.W.Hamley and M. Geoghegan, “Nanoscale Science and Technology”, John Wiley and Sons, 2015. | | | | | | | |
| **References**  1. Timp Gregory, “Nanotechnology”, Springer, New York, 2015  2. Charles P. Poole and Frank J. Owens, “Introduction to Nanotechnology”, John Wiley and Sons, New Delhi, 2017.  3. Paul Harrison, “Quantum wells, wires and dots”, 2nd Edition, Wiley, 2005.  4. T. Pradeep, “Nano. The Esentials : Understanding Nanoscience and Nanotechnology” Tata McGraw-Hill PCL, New Delhi (2008) | | | | | | | |
| **Mode of Evaluation** | Continuous Assessment (Quizzes, CATs, Assignments etc.).   |  |  |  | | --- | --- | --- | | CAT-1 | Weightage (in %) | 25 | | CAT-2 | Weightage (in %) | 25 | | CAT-3 | Weightage (in %) | 25 | | Assignment-1 | Weightage (in %) | 15 | | Assignment-2 | Weightage (in %) | 10 | |  | **Total** | **100** | | | | | | | |
| **Recommended by the Board of Studies on** | 9th April 2019 | | | | | | |
| **Date of Approval by the Academic Council** | 3rd Academic Council 27.04.2019 | | | | | | |