

***University of Management and Technology***

***School of Science (SSC)***

***Department of Physics***

**Course Code: PH-7260**

**Course Title: EXPERIMENTAL TECHNIQUES IN PHYSICS**

**Program: MS (PH)/PhD (PH)**

**Course Outline**

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| **Lecture Schedule** | **Sunday** | **Pre-Requisite** | **Graduate Level Standing** |
| **Course Instructor** | **Dr.Sidra Khalid** | **Contact** |  |
| **Course Description** | This course is a specialized, descriptive and exploratory course. It provides fundamental knowledge on modern material syntheses in materials science and engineering. This emerging technology equips the students with knowledge in processing both pure elementary materials and compounds that can be prepared in crystalline, polycrystalline, nanocrystalline or amorphous forms. It is also designed to equip the students with the basic knowledge of synthesis and characterization tools which are normally used in the preparation/fabrication of alloys and semiconductor materials/thin films of various forms. It also stimulates ingenuity in experiment and material processing design as well as inventiveness in development of novel materials and nanomaterials. This course enables students to synthesize, characterize and analyze the findings of the characterization tools. The course represents an important interface between the school and industrial scientific practice. | | |
| **Expected Outcomes** | * Upon successful completion of this course, the student will be able to: (Knowledge based) * Know about the basics of materials. * Identify and explain different types of synthesis approaches. * Know about the basic of synthesis techniques normally used by researches to synthesize/fabricate nanostructures. * Discuss the applications of synthesis approaches and control over the process. * Know about the safety guidelines must be adopted during every process. * Know about the various experimental tools being used by the researchers and industry to characterize materials. * Know about the data analysis of various characterization | | |
| **Text Books and Reference Book** | 1. Microstructural Characterization of Materials, 2nd Edition: David Brandon, Wayne D. Kaplan **(Text Book)**  2. Introduction to Nanoscience and Nanotechnology, 2nd Edition by Chris Binns **(Text Book)**  3. Introduction to Nanoscience and Nanotechnology by K.K. Chattopadhyay and A.N. Banarjee **(Text Book)**  4. Spectroscopic Methods for Nanomaterials Characterization, Sabu Thomas, Raju Thomas, Ajesh Zachariah, Raghvendra Mishra **(Text Book)**  5. Essentials in Nanoscience and Nanotechnology, By Narendra Kumar, Sunita Kumbhat **(Reference Book)** | | |
| **Assignments** | Assignments will be given at  regular intervals. | **Quizzes** | All quizzes will be announced well before time. No make-ups will be offered for missed quizzes |
| Mid Term Examination | A 90-minutes exam will  Cover all the material covered during the first half of the semester. | Final Examination | A 120-minutes exam will cover all the material covered during the Semester. |
| **Attendance policy** | Students missing more than 20% of the lectures will receive an "SA" grade in the course and will not be allowed to take final exam. | | |
| **Grading Policy** | Assignment + Quizzes + Term Project and Presentation: 30%  Mid Term Examination: 30%  Final Examination: 40% | | |

***Lecture Plan***

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| **Week** | **Topics** | Book and Chapter |
| **1** | Introduction of crystal systems, 1D, 2D and 3D materials | 1B-CH-1 |
| **2** | Synthesis Techniques: PVD, CVD, Top-down and Bottom-up approach | 2B-CH-4 |
| **3** | Thermal Evaporation and Electron Beam Deposition, method, handling and application | 2B-CH-4 |
| **4** | Sputtering: methodology, applications and limitations | 3B-CH-6 |
| **5** | Sol Gel Method, methodology, applications and limitations | 3B-CH-6 |
| **6** | Ball milling method: methodology, applications and limitations | 3B-CH-6 |
| **7** | Lithography: methodology, applications and limitations | 2B-CH-4 |
| **8** | Electrodeposition: methodology, applications and limitations | 3B-CH-6 |
| **9** | X-ray diffraction (XRD): methodology, applications and Analysis | 1B-CH-2 |
| **10** | SEM+FTIR: methodology, applications and Analysis | 1B-CH-5  4B-CH-4 |
| **11** | TEM + Ellipsometry: methodology, applications and Analysis | 1B-CH-4 |
| **12** | UV-visible and Cyclic Volumetry: methodology, applications and Analysis | 4B-CH-2  4B-CH-3 |
| **13** | Dielectric Behavior of material: methodology, applications and Analysis | 4B-CH-10  4B-CH-10 |
| **14** | Magnetic characterization: Methodology, applications and Analysis | 4B-CH-11 |
| **15** | Revision | ……………. |