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**FIRST SEMESTER 2021 - 2022**

# **Course Handout Part II**

20.08.2021

In addition to part‑I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

Course No. : BITS F416

Course Title : Introduction to Nanoscience

Instructors : **B. HARIHARA VENKATARAMAN;** V. Satya narayanamurthy

***Course Description*:**  Introduction; Nanoscience in Nature; Fundamental science behind nanomaterials; Synthesis and properties of nanomaterials; Tools to study the properties, Size and shape determinations, Application of nanomaterials in Science and Engineering; Future trend.

***Scope & Objectives*:** This is a course for the science and engineering students to introduce the concept of Nanoscience at a basic level. It shows that nanomaterials are there in nature in abundance. Proper appreciation and unfolding them can lead to various fruitful applications in Sciences, as well as in Engineering. The various techniques (conventional and ultra-modern) to synthesize and study nanomaterials are covered. The course ends with the direction towards which the field of Nanoscience is growing at the moment.

**Text Books**: G L Hornyak, J. Dutta, H. F. Tibbals and A. K. Rao, Introduction to Nanoscience, CRC press 2008. (TB1)\*

G L Hornyak, J. J. Moore, H. F. Tibbals and J. Dutta, Fundamentals of Nanotechnology, CRC press 2009.

Relevant research articles and textbooks related to the content of this course will also be referred.

**References:** F. J. Owens, *Introduction to Nanotechnology*,Wiley Interscience 2003; G. L. Hornyak,

S. M. Lindsay, *Introduction to Nanoscience*, Oxford University Press, 2010;

C. P. Poole Jr. and Frank J. Owens, Wiley-India, 2009.

\* Textbook 1

**Learning Outcomes:**

* Basic Science required to understand the physical and chemical properties of nanomaterials
* Ability to identify fabrication methods to prepare nanoparticles
* Ability to identify the correct experimental tools to characterize nanomaterials

## **Course Plan:**

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| **Lecture**  **No.** | **Learning Objectives** | **Topics to be covered** | **Chapter in the text book** |
| 1 - 2 | Introduction | What is Nanoscience? Societal and Ethical implications of Nanoscience; Environmental Implications; Advanced Materials; Future of Nanotechnology | Chapter 1 (TB1) &  Lecture notes |
| 3 - 12 | Nanophenomenon in Nature and Science behind Nanoscience | Lycurgus cup, Lotus effect, Materials, Structure and the Nanosurface; Energy at the nanoscale; Thermodynamics in nanomaterials; Chemical interactions at the nanoscale; Basic quantum mechanics and Solid state Physics | Chapter 2, 6 (TB1) &  Lecture notes |
| 13 - 17 | Characterization and analysis | Scanning Tunneling microscopy and Scanning Probe Microscopy | Chapter 3 (TB1) &  Lecture notes |
| 18 - 21 | Special Topic | Nano-magnetism | Lecture notes |
| 22 - 25 | Physics : Properties and Phenomena | Materials, Structure and Nanosurface  (General Perspective) | Chapter 5 (TB1) &  Lecture notes |
| 26 - 29 | Fabrication Methods | Fabrication routes to synthesize nanomaterials/ nanocomposites | Lecture notes |
| 30 - 36 | Characterization of Nanomaterials | * Structural determination of Nanomaterials by X - ray diffractometer * Microstructural Analysis of Nanomaterials (Size and Shape determination) by Transmission/Scanning electron microscopy | Chapter 3 (TB1) &  Lecture notes |
| 37 - 40 | Special Topic | Nano crystal composites and its applications | Lecture notes |
| 41 - 42 | Future Trend | Future prospects of nanomaterials in science and engineering applications | Lecture notes |

***Evaluation Scheme:***

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| **EC No.** | **Evaluation Scheme** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of**  **Component** |
| 1 | Midsem Examination | 90 min | 35 | 23/10/2021 9.00 - 10.30AM | Open Book |
| 2 | 2 Quizzes | 30 min | 25 | To be announced in the class | Open Book |
| 3 | Comprehensive Examination | 120 min | 40 | 27/12 AN | Open Book |

*Chamber Consultation Hour:*To be announced in the class.

*Notices:*Notices concerning the course will be put up in **CMS**.

**Make-up Policy:** Make up will be given strictly to **genuine cases only** i.e. **(i)** Sickness leading to hospitalization, **(ii)** Out of station with prior intimation & permission.

**No make-up for Quiz**.

**Academic honesty and integrity policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge

B. HARIHARA VENKATARAMAN