INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

INTRODUCTION TO NANO TECHNOLOGY								
VII Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAED52	Elective	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Aerospace Materials and Production Technology								

I. COURSE OVERVIEW:

Design and analysis of nano structures discusses about different requirements of composite structures will be discussed within the framework of the course and associated design concepts will be introduced. In particular, the requirements associated with production, assembly and loads occurring during operation will be considered.

II. COURSES OBJECTIVES:

The students will try to learn:

I. Impart the basic knowledge in Nano Science and Technology.

II. Give insight into many aspects of Nano science, technology and their applications in the prospective of materials science.

III. Develop new devices and technologies for applications in a wide range of industrial sectors including information technology, medicine, manufacturing, high-performance materials.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Summarize the complexity of nano-structured materials, fascinating nanostructures, applications of nanomaterials.

CO2 Make use of Nanocrystalline Materials, magnetic Nanocrystalline alloys, giant magnetic resonance.

CO3 Determine which synthesis routes should be paired to approaches like bottom up and top-down approaches.

CO4 Discuss tools to characterize nano materials and Nanoindentation.

CO5 Demonstrate different tools used for the characterization of the materials.

CO6 Analyze the applications of nano materials through a case study and mathematical Nano-electronics strategy.

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION (09)

History and scope, can small things make a big difference, classification of nano-structured materials, fascinating nanostructures, applications of nano materials, Nature: The best of nanotechnologist, challenges, and future prospects.

MODULE-II: UNIQUE PROPERTIES OF NANOMATERIALS (10)

Microstructure and Defects in Nanocrystalline Materials: Dislocations, twins, stacking faults and voids, grain boundaries, triple, and disclinations, effect of Nano-dimensions on materials behavior: Elastic properties, melting point ,diffusivity ,grain growth characteristics ,enhanced solid solubility; Magnetic Properties: Soft magnetic Nanocrystalline alloy, permanent magnetic Nanocrystalline materials, giant magnetic resonance, electrical properties, optical properties, thermal properties and mechanical properties

MODULE-III: SYNTHESIS ROUTES (11)

Bottom-up approaches: Physical vapor deposition, inert gas condensation, laser ablation, chemical vapor deposition, molecular beam Epitaxy, solgel method, self-assembly.

Top-down approaches: Mechanical alloying, Nano-lithography, consolidation of Nano powders: Shockwave consolidation, hot isostatic pressing and cold isostatic pressing spark plasma sintering.

MODULE-IV: TOOLS TO CHARACTERIZE NANOMATERIALS (09)

X-Ray Diffraction (XRD), small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

MODULE-V: APPLICATIONS OF NANOMATERIALS (09)

Nano-electronics, micro- and Nano-electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, food and agricultural industry, cosmetic and consumer goods, structure and engineering, automotive industry, water treatment and the environment, Nano-medical applications, textiles, paints, energy, defense and space applications, concerns and challenges of Nanotechnology.

V. TEXT BOOKS:

1. B.S.Murthy, et al., “Text Book of Nano Science and Nanotechnology”, University Press-IIM.
2. Charles P.Poole, Jr., and Frank J. Owens, “Introduction to Nanotechnology”, Wiley India Edition, 2012.

VI. REFERENCE BOOKS:

1. T. Pradeep, “Nano: The Essentials”, McGraw-Hill Education.
2. David Ferry, “Transport in Nano structures”, Cambridge University Press, 2000.
3. Challa S, S.R. Kumar, J.H. Carola, “Nano fabrication towards Biomedical Application: Techniques, tools”, Application and impact Edition.
4. Michael J.O’Connell, “Carbon Nanotubes: Properties and Applications”, Cambridge University Press.
5. S. Dutta, “Electron Transport in Mesoscopic Systems”, Cambridge University Press.

VII. ELECTRONICS RESOURCES:

1. https://www.dummies.com/education/.../useful-nanotechnology-information-websites/
2. https://www.ncbi.nlm.nih.gov/books/NBK21031/
3. https://libguides.northwestern.edu›LibGuides

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation