

Course Curriculum for Ph.D Nano Science & Technology



Department of Bio & Nano Technology
Guru Jambheshwar University of Science & Technology,
Hisar-125 001, Haryana

SCHEME OF EXAMINATION Ph.D (NANO SCIENCE & TECHNOLOGY)

Sr. No.	Course No.	Title	L	T	P	Credits
1	DNL/P-901	Advances in Nano Science & Technology	3	0	1	4
2	DNL/P -902	Advances in Nanobiotechnology	3	0	1	4
3	DNL -903	Advances in Nanomaterials & Nanostructures	4	0	0	4
4.		Common Paper*	4	0	0	4
Total			14	0	2	16

***Any one of the following below mentioned courses:**

- 1. Statistical Methods**
- 2. Information and Communication techniques.**
- 3. Analytical /Fabrication Technologies.**

DNL/P-901 Advances in Nano Science & Technology (3+0+1)

Introduction & Background: Introduction to Nanotechnology, recent advances and future aspects, Applications of Nanotechnology in different fields- Agriculture, medical applications, Space, Defence, Food processing, Cosmetics etc, Societal implications & Ethical issues in Nanoscience and Nanotechnology.

Instrumentation Techniques for Nanotechnology: FTIR, DSC, DTA, TGA, Low Energy Electron Diffraction (LEED), Scanning Probe Microscopy-principle of operation, instrumentation and probes, Low temperature Scanning Probe Microscopy, Auger, SEM, TEM, XRD (Powder/Single crystal), (AFM), Scanning Tunneling Microscopy (STM), EDX, ESCA etc, recent advancements.

Laboratory Experiments: Students will be required to complete at least 10 experiments:

Books/ References:

1. Poole Jr., C.P., Owens, F.J. "Introduction to Nanotechnology", Wiley (2003).
2. Roco, M.C.; Bainbridge, W.S. (eds.): 2001, *Societal implications of nanoscience and nanotechnology*, (Proceedings of a workshop organized by the National Science Foundation, September 28-29, 2000), Kluwer, Dordrecht.
3. Keiper, Adam: *The Nanotechnology Revolution*. The New Atlantis, summer 2003, pp. 17-34.
4. Bhushan, Bharat. 2004. Handbook of Nanotechnology. Springer.
5. Avouris, P., Klitzing, K. Von, Sakaki, H. & Wiesendanger, R. 2003. NanoScience and Technology Series. Scanning Probe Microscopy- Analytical Methods (R. Wiesendanger eds), Springer.
6. Avouris, P. Klitzing, K. von H. Sakaki & Wiesendanger, R., 2003. NanoScience and Technology Series. Noncontact Atomic Force Microscopy (S.Morita & R. Wiesendanger eds), Springer.
7. Zander, C., Enderlein, J. & Keller, R.A. 2002 Single Molecule Detection in Solution. Wiley-VCH Verlag.

DNL/P -902 Advances in Nanobiotechnology (3+0+1)

Bionanotechnology – Advances in Nanobiotechnology, Bionanomachines in action. Molecular recognition & cellular communication, current research & future aspects, DNA nanomechanical devices.

Modern Biomaterials- Proteins , Nucleic acids, Lipids, Polysaccharides, Natural Bionanomachinery, Protein folding, self assembly and self- organization, molecular recognition and flexibility.

Advances in Biomolecular Design: Molecular Modeling and Biomolecular structure determination, DNA-Protein Nanostructures, DNA directed immobilization, DNA Gold Nanoparticles conjugates- Chip Based DNA detection assays, Microarray Technologies, protein microarrays, Luminescent quantum dots for Biological Labeling, Emerging materials.

Advances in functional aspects of Bionanotechnology: Biomolecular motors, Biomolecular sensing, Information driven Nanoassembly, Energetics, chemical transformation, regulation, Bionanotechnology- Future capabilities, Nanomedicine today, DNA computers, hybrid materials, artificial life and biosensors.

Laboratory Experiments: Students will be required to complete at least 10 experiments:

Books/ References:

1. Goodsell, David S. 2004. Bionanotechnology- Lessons from Nature. John Wiley & Sons, INC., Publication.
2. Niemeyer C.M. & Mirkin, C.A. 2004. Nanobiotechnology- Concepts, Applications and Perspectives, Wiley-VCH Verlag.
3. Avouris, P., Klitzing, K. Von, Sakaki H. & Wiesendanger, R. 2003. NanoScience and Technology Series. Springer.
4. Scherge, M. and Gorb, S.N. 2003. Biological Micro- and Nanotribology- Natures solution, Springer.

DNL -903 Advances in Nanomaterials & Nanostructures (4+0+0)

Nanomaterials- Properties, synthesis and applications; Carbon Nanotubes- current status of the scientific research, synthesis, devices, properties, characterization methods & CNT electronics/ integrated systems, applications in biotechnology and biomedicine; Nanowires- synthesis methods, physical properties, characterization methods and applications, Smart materials, Nanoparticles- in paints, adhesives, and coatings, pressure sensitive adhesives in biotechnology, Nanostructured Fluids and Soft Materials- types, applications in drug solubilization and delivery, nutraceuticals, functional foods, antimicrobial and cosmetic nanoemulsions, food colloids etc.

Micro/Nanofabrication Techniques- MEMS and NEMS, Advances in material aspects & fabrication techniques, stamping techniques, Nanolithographic techniques; applications, current challenges and future aspects, Therapeutic nanodevices

Micro fluidics and their Applications: Advances in microfluidic research, material aspects for Micro fluidic devices, active and smart passive Micro fluidics devices, Lab-on-a-chip for Biochemical analysis.

Books/ References:

1. Kohler, M., Fritzsche, W. 2005. Nanotechnology- An Introduction to Nanostructuring Techniques. Wiley-VCH Verlag.
2. Ajayan, P., Schadler, L.S. & Braun, P.V., 2003. Nanocomposite Science and Technology. Wiley-VCH Verlag.
3. Rao, CNR, Muller, A., Cheetham, A.K., 2004. The Chemistry of Nanomaterials, Volume 1&2, Wiley-VCH Verlag.
4. Balzani, V., Credi, A. & Verturi, M. 2003. Molecular Devices and Machines- A Journey into Nanoworld. Wiley-VCH Verlag.
5. Bhushan, Bharat, 2004. Handbook of Nanotechnology. Springer.
6. Hodes, G., 2001. Electrochemistry of Nanomaterials. Wiley-VCH Verlag.
7. Lyshevski, Sergey Edward, 2001. Nano- and Microscience, Engineering, Technology, and Medicine Series. CRC press.
8. Cao, G. 2004. Nanostructures and Nanomaterials. Imperial College Press.