

CENTRAL UNIVERSITY OF GUJARAT
SCHOOL OF NANO SCIENCES
DOCTOR OF PHILOSOPHY IN NANO SCIENCES
SYLLABUS for Ph.D course work

The Ph.D programme in Nano Sciences will be implemented as per regulations approved by the Academic Council for all Schools of the Central University of Gujarat, for direct admission to Ph.D along with the existing Ordinances applicable for Advanced Studies and Research. However, with specific reference to the School of Nano Sciences, all students will have to complete 16 credits during the first year of enrollment. The courses would enable students to understand basic research methodology, grasp statistical techniques required to analyse data, using various computer softwares. In addition they will also be exposed to basic aspects of nanosciences. The course content would include the following:

SEMESTER I

Course 1: Research methodology and writing - 3C

Unit 1: Introduction to research

Meaning and nature of research, types of research, research theories, scientific and experimental methods in research, interdisciplinary and multidisciplinary research, inductive, deductive and intuitive sources of knowledge, qualities of a researcher

Unit 2: The research process

Research design, Definition and identification of research problems, Aims and objectives of research, Hypothesis: meaning, types and significance, Survey and review of literature, Methods of data collection, Validity of data

Unit 3: Research writing

Writing research report and research proposals, structure and content of reports, styles of referencing and citations, bibliography, use of endnote, publication styles of journals, ethics in research, forma of plagiarism, copyright regulations

Text/References:

- 1.Introduction to educational research by Charlse C.M and Martler C.A, Pearson boston publishing, Boston, 2002.
- 2.Social research methods by Oxford University Press, Oxford, USA, 2002.

Course 2: Computer: basic functions and use for research purpose - 3C

Unit 1: Introduction to computers

Fundamentals of computers and their components, Hardware and software, Operating systems

Unit 2: Basic computer functions

Word processing programme: basics, editing, referencing, Spread sheet programme: application, features and functions, formulas, statistics, graphs, Presentation programme: application, features and functions, creating presentations, Database management systems: Creation, updating, indexing and searching of data

Unit 3: ICT in research

Use of ICT for research purpose, Web based resources, search engines and techniques, Web as a tool for scientific literature survey, archive browsing, Research purpose software

Text/References:

1. Introduction to Computing Explorations in Language, Logic, and Machines by David Evans, University of Virginia, 2011
2. Computer Networks 5th By Andrew S. Tanenbaum , 2010, Pearson publications

Course 3: Statistics and data analysis - 3C

Unit 1: Measurement scales and normal distribution

Types of scales: Nominal, ordinal, interval and ratio, Establishing reliability of scale and other instruments of evaluation, Normal distribution: Introduction and importance, Properties of normal probability distribution, Divergence from normal distribution, Application of normal probability curve

Unit 2: Correlation, regression, prediction and factorization

Correlation: introduction, linear and curvilinear correlation, calculation methods, testing significance,
Regression: Introduction, equations, Multiple correlation and partial regression, Path analysis, Factor analysis

Unit 3: Inferential and non-parametric statistics

Inferential: difference between percentages, means (t-test), analysis of variance and co-variance, Non-parametric: Chi-square test, Sign test, Man-Whitney U test

Text/References:

Fundamental statistics in psychology and education by Guilford J.P and Fruchter B, McGraw Hill Kogakusha LTD, New Delhi, 1978

SEMESTER II

Course 4: Applied Nanochemistry - 3C

Unit 1: Application of Organic nanoparticles

Application of Lipids, CNTs, Proteins, peptides, Dendrimer, cyclodextrin, Polysaccharide based organic nanoparticles in nanomedicine and drug delivery through, applications of zero-dimensional Nanoparticles, applications of one dimensional nanotubes and nanowires, application of Nanoporous materials, Application of Nanopolymers: Preparation and characterization of diblock Copolymer based nanocomposites, Nanoparticles polymer ensembles; Applications of Nanopolymers in Catalysis

Unit 2: Application of Nano ceramics

Dielectrics, ferroelectrics, magnetoceramics, and multiferroics Magnetism, Dia-, Para-, Ferro-, Antiferro-, Ferri-magnetism, Magnetic properties, Superconducting nanomaterials & their properties and applications. application of Thermo Electric Materials (TEM): Concept of phonon, Thermal conductivity, Specific heat; application of Carbon Nano Structures: DLCs, C60, C80 SWNT and MWNT, application of Nanocomposites: Metal-Metal nanocomposites, Polymer-Metal nanocomposites, Ceramic nanocomposites

Text/References:

1. Nanochemistry: A Chemical Approach to Nanomaterials by G. A. Ozin, A.C. Arsenault, and L. Cademartiri, The Royal Society of Chemistry, Cambridge, 2nd Ed., 2009.
2. Nanostructures & Nanomaterials: Synthesis, Properties, and Applications by Guozhong Cao, Imperial College Press, London, 2004.
3. Nanoscale Science and Technology, edited by R. W. Kelsall, I. W. Hamley, and M. Geoghegan, Wiley, West Sussex, 2005.
4. Novel Nanocrystalline Alloys and Magnetic Nanomaterials by Brian Cantor. Polymer nanocomposites, edited by Yiu-Wing Mai and Zhong-Zhen Yu, First published 2006, Woodhead Publishing Limited and CRC Press LLC, USA.

Course 5: Bio-Nanotechnology - 2C

Unit 1: Bionanotechnology Concept

Structural Principle of Bionanotechnology, Function of Biological Nanomolecules, Molecular motors, force, elasticity, damping, mechano-chemical coupling, Bionanomachines in Action, Biofilm inhibition by nanoparticles, small angle scattering, DNA computers and DNA microprocessors, Biotechnology based genetic engineering

Unit 2: Nanotechnology in Drug Delivery

Nanoparticle in Drug delivery: Manufacture of Nanoparticles, Targeted drug delivery, Nanoparticle delivery for Cancer and other disease Treatment

Text/ References:

1. Nanotechnology in Biology and Medicine: Methods, Devices and Application by Tuan Vo-Dinh .CRC press, 2007.
2. Nanosystem characterization tools in the life sciences by Challa Kumar. WileyVCH, 2006.

Course 6: Instrumentation - 2C

Unit 1: Basic concept of Instrumentation

Spectroscopy: UV-VIS-NIR, FT-IR, NMR, Fluorescence Spectroscopy, Atomic Absorption Spectrophotometer, Scanning Tunnelling Spectroscopy, Photoluminescence Spectroscopy, Electrochemical Impedance Spectroscopy, Chromatography: GC, HPLC, GC-MS, HPTLC, PCR, Electrophoresis

Unit 2: Advance Instrumentation Techniques

Principle, Theory, Working and Application: XRay Diffraction, X-Ray Reflectivity, Polarized neutron Reflectivity, Differential thermal and Gravimetric Analysis, Dynamic Mechanical Analysis, Universal Testing Machine, Vibrating sample Magnetometer, Vector network Analyzer, Vibrating Sample Magnetometer, Brunauer-Emmett Teller surface areas, Zeta sizer, Microscopy: Scanning Electron Microscopy, Transmission Electron Microscopy, High Resolution Transmission Electron Microscopy, Field Emission Scanning Electron Microscopy, Atomic Force Microscopy

Text/ References:

- 1) Nanostructures and Nanomaterials, synthesis, properties and applications by Guozhong Cao, Imperial College Press, 2004.
- 2) Nanomaterials – Handbook by Yury Gogotsi, CRC Press, Taylor & Francis group, 2006.
- 3) Nanomaterials: synthesis, Properties and Applications by Edelstein A S and Cammarata R C, Taylor and Francis, 2012.