SAURASHTRA UNIVERSITY

Accredited by NAAC With "A" Grade

[3rd Cycle]

Faculty of Science

Syllabus

for

B.Sc. / M.Sc. (Applied Physics) Integrated

Semester - IX

Under

Department of Nanoscience

&

Advanced Materials

Saurashtra University,
University Road, University Campus
Rajkot– 360005
Gujarat, India

SYLLABUS FOR

SEMESTER IX : CORE - IX : PAPER- IX

NANOMATERIALS II: PROPERTIES AND APPLICATIONS

UNIT-I:

(a) Chemical Properties:

Examples of nanostructures in chemistry, Effect of nanomaterials on chemical reactivity, Effect of chemistry on nanostructures

(b) Optical Properties:

Refractive index, Absorption coefficient, Reflection, Color centers (Photocromy), Luminescent glasses.

UNIT-II: Magnetic and electron transport properties

Microstructure, Magnetic Properties, Electrical transport properties, Giant Magneto Resistance (GMR) property, Electrical conduction in Bi-Se glasses & nanoparticles, DC conduction of nanoparticles, Correlation between electronic conduction and magnetic data.

UNIT-III:

- **Magnetic and structural properties**:

  Particle size variation and distribution, Effect of particle size on magnetic properties, Solvated Metal atom dispersion technique (SMAD).

- **Mechanical Properties**:

  Nanocrystalline metals and alloys, Super plasticity- High temperature properties.

UNIT-IV: Applications of nanomaterials

Nanotribology : Nanotribometer, Surface force apparatus, Quartz crystal microbalance (QCM), Super lubricity, Hard disk capacity, Micro-electromechanical system (MEMS), **Nano sensors :** Nano scale organization, self-assembly, Quantum size effects, Electrochemical sensors, Nano-Biosensors, Future prospects, **Nanomedicine :** Developments, Various nano systems in use, Diagnostic and therapeutic applications, **Nanobiology :** Biological Imaging, Biomarker, Immunogold labeling, Targeted drug delivery, Nanobiotechnology.

Text Books:

1. Nanomaterials : Synthesis, Properties & Applications- Ed. by A. S. Edelstein & R. C. Cammarata J.Y. Bottero, Institute of Physics, UK, 1998.
2. Nanomaterials – A. K. Bandyopadhyay, New age international publishers, New Delhi, 2009.
3. Nano : The Essentials – T. Pradeep, McGraw-Hill Education, New Delhi, 2009.

SYLLABUS FOR

SEMESTER IX : ID – 1 : PAPER- X

NUMERICAL TECHNIQUES FOR COMPUTATIONAL ANALYSIS

UNIT-I: Roots of Nonlinear Equations

Introduction, Method of solution, interactive methods starting & stopping an interactive process, Evaluation of polynomial, bisection method, false position method (lineal interpolation method), Newton - Raphson method, secant method, fixed point method.

UNIT-II: Curve fitting: Interpolation

Introduction, Polynomial form, Lines interpolation, Lagrange interpolating polynomials, Newton interpolating polynomials, divided difference table, Spline interpolation.

UNIT-III: Curve fitting: Regression

Introduction, Fitting lineal equation, Fitting Transcendental fitting, polynomial function, multiple lineal regression.

UNIT-IV:

- **Numerical Differentiation**:
  Need & Scope, Differentiation continuous function, Differentiation tabulated function, Richardson extrapolation.
- **Numerical Integration**:
  Need & Scope, Newton-cotes method, Trapezoidal rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Romberg's integration, Gaussian Integration.

Text Book:

1. Numerical Methods by E Balagurusamy, TATA McGraw HILL PUB

SYLLABUS FOR

SEMESTER IX : ELECTIVE GROUP C - 1 : PAPER XI

PHYSICS OF ACCELERATORS

UNIT I: Introduction to Accelerators

History and basic principle of various particle accelerators, DC Accelerators, Cyclic Accelerators, Linear Accelerators, Synchrotrons and High energy Accelerators, Ion Sources and types

UNIT II: Beam Theory and Optic elements

Vacuum System, Beam Theory, Beam Acceleration, Beam Optics Calculations, Magnets, Beam Sterrers, Quadrupoles, Profile Meters etc.

UNIT III: Control of Accelerators

Control Systems, Devices communication, Fiber Optics communication, Power Supplies (Low and High Voltage, Low and High Currents)

UNIT IV: Application of Accelerators

Accelerators in daily life, Semiconductors, Health Sciences, Industry applications etc.

Reference Book:

1. The physics of particle accelerators: an introduction by Klaus Wille, Oxford Press USA, 2000.
2. Accelerator physics by S.Y. Lee, World Scientific Publishing Company, Year: 2004
3. Particle Accelerator physics by H. Wiedemann, Springer, Year: 2007

SYLLABUS FOR

SEMESTER IX : ELECTIVE GROUP C - 2 : PAPER XII

MATERIAL MODIFICATIONS WITH LOW ENERGY ION BEAMS

UNIT I: Ion -Solid interaction- I: Fundamentals

Interaction of Charged Particles with Matter: Basic ion bombardment processes in solids- general phenomenon, ion penetration and stopping, ion range parameters, energy loss mechanisms; Electronic and nuclear energy loss, classical stopping power equation for electronic energy-loss, behavior of electronic energy-loss curve as a function of ion velocity.

UNIT II: Ion -Solid interaction-II: Theory

Coulomb explosion and thermal spike models, concept of energy straggling and range straggling and their correlation; Basic ion beam simulation programs: SRIM; TRIM, channeling; sputtering process and ion beam mixing.

UNIT III: Doping, Diffusion and Defects in Ion –Implanted Si

Junctions and transistors, defects, laws of diffusion, diffusion mechanisms, irradiation – enhanced diffusion

UNIT IV: Crystallization and Regrowth of Amorphous (A) - Si

Introduction, epitaxial growth of implanted amorphous Si, ion beam induced enhanced crystallization, laser annealing of Si

Reference Book:

1. Ion Implantation and Synthesis of Materials by Michael Nastasi, J. W. Mayer, Springer-2006.
2. 2. Swift Heavy Ions for Materials Engineering and Nano structuring, Springer, Awasthi, D. K., and Mehta, G. K.
3. Physics of Ion Implantation Phenomena, Mathur D, Springer Verlag, 1991.