School of Physical Sciences
Solapur University, Solapur
Course Structure (w.e.f. June 2015-16)
M.Sc- Physics (Materials Science)

Semester- III

PHMS - IX -Semiconductor Devices (C)	- 70+30=100
PHMS - X - Instrumentation (C)	- 70+30=100
PHMS - XI – Elements of Materials Science	- 70+30=100
PHMS - XII – Dielectric and Ferroelectric materials	- 70+30=100
Practical - V	- 70+30=100
Practical & Project - I	- 70

Semester IV

PHMS - XIII - Computational Methods & Programming (C)	- 70+30=100
PHMS - XIV - Microelectronics (C)	- 70+30=100
PHMS - XV – Magnetic Materials	- 70+30=100
PHMS - XVI – Nanoscience & Nano technology	- 70+30=100
Practical - VI	- 70+30=100
Project - II	- 70+30=100

The practical's examination at Sem.III & Sem. IV shall be of 2 laboratory practical's of 35 marks each & 1 project presentation. Each practical & project presentation shall carry 70 Marks.
(C) Indicates common courses of the school.
30 marks are for internal evaluation.

M.SC-II, SEME. III, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – IX - PH (AE / MS) : SEMICONDUCTOR DEVICES (C)

(Revised syllabus w. e. f. June 2015-2016)

Unit I : MIS Structure and MOS FETs (12)

Schottky diode, MIS structures, basic equations in flat band conditions, MIS capacitances, current flow mechanisms in MS junction and MIS junction, depletion and enhancement type MOS FETS, capacitances in MOS FETs, quantitative analysis of I - V characteristics, thresholds in MOSFETS, charge trapping and flat band voltage, study of CMOS devices.

Unit II: Power Devices (12)

Power diodes, ratings, reverses recovery characteristics, fast recovery diodes, Power transistors, Switching characteristics, construction of SCR, two transistors analogy, I - V characteristics, gate trigger characteristics, turn on and turn - off times, losses, reverse recovery characteristics, SCR ratings, dv/dt and di/dt characteristics, thyrister types, construction and characteristics of DIACs and TRIACs, static induction thyristors, , light activated thyristors, Gate turn off thyristors (GTO), MOS controlled thyristors, programmable Unijunction transistors, Silicon Unidirectional switch (SUS) , IGBT

Unit III: Charge Coupled and Transferred Electron Devices (12)

Charge storage, surface potential under depletion, construction of basic two and three phase of CCD, mechanism of charge transfer, Oxide Charges, charge trapping and transfer efficiency, dark current, buried channel CCD, application of CCD, Transferred Electron Effect, NDR (Negative differential resistivity of voltage and current controlled devices), formation of gunn domains, uniform and accumulation layer, operation modes, transistors and quenched diodes, layers and modes of operation, LSA mode of operation, frequency responses and overall device performance of Gunn devices.

Unit IV: Optoelectronic and Advanced Solid State Devices (15)

Light emitting diodes, Performance of LEDs, emission spectra, visible and IR LEDs, semiconductor LASER: p-n junction lasers, heterojunction lasers, materials for semiconductor LASER, threshold current density, effect of temp. Quantum well hetero structures,

Detectors: photoconductors, photocurrent gain and detectivity, photodiode types : p-n junction, p-i-n, avalanche characteristics, quantum efficiency, response speed, noise and optical absorption coefficient, efficiency, Solar cells – current voltage characteristics

Reference Book/Text Book:

1. D.A. Roustan: Bipolar Semiconductor Devices.
2. Mauro Zambuto: Semiconductor Devices.
3. D. Nagchoudhari: Semiconductor Devices.
4. Karl Hess: Advanced theory of semiconductors devices.
5. S. M. Sze: Physics of Semiconductor Devices 2nd edition..
6. A Dir - Bar - Lev: Semiconductor and Electronic Devices.
7. M. H. Rashid: Power Electronics.
8. P. C. Sen: Power electronics
9. B. G. Streetman and S. Banergee : Solid state Electronic Devices

M.SC-II, SEME. III, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – X - PH (AE / MS) : INSTRUMENTATION (C)

(Revised syllabus w. e. f. June 2015-2016)

Unit I: Transducers (12)

Transducers classification Resistance, Capacitance, Inductance, Piezoelectric, Thermoelectric, Hall effect, Tachogenerator, Optical and Digital transducers, Measurements of displacement, Velocity, Acceleration, position, Force, pressure, flow, level, Torque, Strain, Speed and Sound, flow humidity, PH, position, Piezoelectric devices, micromechanical devices and smart sensors.

Unit II: Instrumentation Electronics (12)

Instrumentation Amplifiers, basic characteristics, D.C. Amplifiers, Isolation amplifiers, feedback transducers system, feedback fundamentals, Inverse transducers, temperature balance system, Phase sensitive detection, Absolute value circuit, peak detector, sample and hold circuits, RMS converter, Logarithm (Amplifier, Frequency to Voltage and Voltage to Frequency Converter,

Unit III: Measuring Instruments (14)

True RMS measurement and DMM, R, L, C, Q measurement technique, active passive component testing, Automatic Test Equipment. Function generator, Sine, square, triangular, ramp wave generator, pulse generator, sine wave synthesis, arbitrary waveform generator. Oscilloscope: Dual Trace Oscilloscope, sweep modes, active, passive probes, delay line, Digital Storage Oscilloscope and its features like roll, refresh, sampling rate, application of the same in instrumentation and measurement, sampling oscilloscope. Wave analyzer, Distortion analyzer, spectrum analyzers.

Unit IV: Signal Processing Circuits (10)

ADC and DAC techniques, types, and their specifications, V to F converter, Sample and hold, analog multiplexer, data loggers. Digital Instrumentation: Universal counter and its mode – totalizing frequency, period, time. interval, ratio, measurement errors, application of counters for, frequency meter, capacitance, meter and timers, automation digital instruments. Virtual Instrumentation and its applications,

Reference Books:

1. Transducer Theory and Application: John A Alloca, Allen Stuart (Reston Publishing Company Inc.)
2. Transducer and Display Devices: B. S. Sonde.
3. Integrated Electronics: K. R. Botkar.
4. W. D. Cooper & A. D. Helfrick, ‘Electronic Instrumentation And Measurement Techniques’, PH I, 4th e/d, 1987
5. Kalsi H. S., ‘Electronic Instrumentation’, TMH, 2nd e/d, 2004

M.SC-II, SEME. III, PHYSICS (MAT. SCIENCE)

Paper – XI - PH (MS): ELEMENTS OF MATERIALS SCIENCE (Elective Paper)

(Revised syllabus w. e. f. June 2015-2016)

Unit I: Introduction to materials: Classification, Properties and Requirements (08)

Introduction, Classification of Engineering Materials, Metals, Alloys, ceramics, Polymers and Semiconducting materials, Application of Engineering Materials.

Chemical Bonding: Introduction, Crystalline and Non-crystalline Solids, Classification of Bonds, Ionic Bond or Electrovalent Bond, Covalent Homopolar Bonds, Metallic Bonds, Molecular Bonds, Hydrogen Bond, van der Walls bond (Inter-molecular and Intra-molecular bonds).

Unit II: Optical Properties of Materials (10)

Introduction, Classification of Optical Materials, Interaction of light with matter, Absorption in Metals, Insulators and Semiconductors, Reflection, Refraction, Transmission and Scattering, Traps, Excitons, Colour Centers, Tauc and Lambert-Beer laws, Optical properties of Photonic material.

Unit III Luminescence and Photoconductivity (12)

Luminescence: Introduction, Principle, Classification of Luminescence, Photoluminescence, Cathodoluminescence, Electroluminescence, Thermoluminescence, Phosphorescence, Chemiluminescense, Applications.

Photoconductivity: Introduction, Photoconductivity, Characteristics of Photoconductivity Materials, Photodiodes, Photoresistor, Photodetectors, Photodetector Bias Circuit, Performance of Photodetector, Applications, Light emitting diodes (LED) and LASER's.

Unit IV: Functional Materials (18)

Nanophase Materials: Introduction, Synthesis and techniques, Nucleation and growth mechanism, Characterization of Nanostructured Materials, Properties of Nanophase Materials, Applications.

Advanced Ceramics: Introduction, Classification of Ceramics, Structure of the Ceramics, Ceramic Processing, Properties of Ceramics, Applications.

Polymer Materials: Introduction, Polymerization Mechanism, Degree of Polymerization, Classification of Polymers, Structures of polymer and preparation methods, important properties and applications of commercial polymers-viz-polyethylene. Polyvinylchloride, Polystyrene, Nylon, Polyesters, Silicones, Composites, Composite material including nano-materials.

Reference Books:

1. Materials Science : V. Rajendran, A. Marikani, Tata MC Graw Hill
2. Materials Science of Engineering: Raghavan, Tata MC Graw Hill
3. Materials Science: Arumugam
4. Materials Science & Metallurgy : O. P. Khanna
5. Materials Science and Engineering : Callister S.

M.SC-II, SEME. III, PHYSICS (MAT. SCIENCE)

Paper – XII - PH (MS): DIELECTRIC AND FERROELECTRIC MATERIALS (Elective Paper)

(Revised syllabus w. e. f. June 2015-2016)

Unit I: Introduction (06)

Maxwells equations, Amperes law, Faradays law, Gauss law in presence of dielectric, Electric field, Electric flux density, Polarization, Permittivity, electric susceptibility, Dipole moment , Polar and non-polar dielectrics.

Unit II: Electric Polarization And Relaxation (18)

Fundamentals: Force acting on the boundary between two different dielectric materials, Force elongating a dielectric fluid, Dielectrophoretic force, Electrostriction force, Electrostatic induction , Electric polarization and relaxation in static electric fields, Vacuum space, Conducting materials.

Dielectric Materials and its Polarization: Mechanism of electric polarization, Electronic polarization, Classical and Quantum Mechanical Approach, Atomic or Ionic Polarization, Orientational polarization, Polarizability, Spontaneous polarization, Space charge polarization, Hopping polarization, Interfacial polarization, Classification of dielectric materials, Non-ferroelectric and ferro-electric materials, Internal fields, Local fields for Non-dipolar materials, Clausius-Mosotti Equation.

Dielectrics in AC field: Lorentz - Lorenz equation, Reaction Field for dipolar materials, Electric polarization and relaxation in time -varying electric fields, Time domain approach and the frequency - domain approach, Complex permittivity, Time dependent electric polarization, Kramers - Kronig equations, Debye equations, Absorption, and Dispersion for dynamic polarizations, Effects of the local field, Effects of DC conductivity, Cole - Cole plot, Temperature dependence of complex permittivity, Field dependence of complex permittivity of ferroelectric materials, Insulating materials, Dielectric relaxation phenomena.

Unit III: Optical and Electro-Optic Processes. (06)

Modulation of light, Double refraction and birefringence, Quarter - Wave plate, Electro - Optic effects: Linear Electro – Optic effect, Photorefractive effect, Magneto - Optic effect, Faraday effect, Voigt effect, Acousto-Optic effect.

Unit IV: Ferroelectrics, Piezoelectrics and Pyroelectrics (18)

Ferroelectrics: Ferroelectric phenomena, Representative crystal, types of ferroelectrics: Properties of Rochelle salt, $BaTiO_3$, Theory of ferroelectric displacive transitions, Thermodynamic theory, Ferroelectric and antiferroelectric transition, Formation and dynamics of ferroelectric domains, Experimental evidence of domain structure, Applications of ferroelectric materials

Piezoelectrics: Piezoelectric phenomena, Phenomenological approach to piezoelectric effects, Piezoelectric parameters and their measurements, Piezoelectric materials and their applications.

Pyroelectrics: Pyroelectric phenomena, Phenomenological approach to pyroelectric effects, Pyroelectric parameters and their measurements, Pyroelectric and thermally sensitive materials, NTC and PTC materials, Applications of pyroelectric materials.

References Books :

1. Kwan Chi Kao and F. R. de Boer;Dielectric Phenomena in Solids, Elsevier Academic Press (2004).
2. J. P. Srivastava, Elements of Solid State Physics, 2nd Edi Prentice – Hall of India(P) Ltd. (2007)
3. Charles Kittle; Introduction to Solid State Physics, 7th Edition, John Wiley & Sons, (1996).
4. Saxena, Gupta, Saxena; Fundamentals of Solid State Physics, Pragati Prakashan, (2012).
5. A. J. Dekkar; Solid State Physics, 1st Ed. Macmillan (2000).
6. M.A. Wahab; Solid State Physics: Structure and Properties of Materials, Alpha Science International (2005)
7. S.O. Pillai; Solid State Physics, 6th Ed., New Age International (p) Ltd publishers, (2005)
8. Neil W. Ashcroft, N. David Mermin, Solid State Physics; Saunders College, (1976).

M.SC-II, SEME. IV, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – XIII - PH (AE / MS) : COMPUTATIONAL METHODS AND PROGRAMMING (C)

(Revised syllabus w. e. f. June 2015-2016)

Unit I: Introduction to programming in C (12)

Elementary information about digital computer, hardware software, machine language system, assembly language program, assembler, disadvantages of machine and assembly language programming, High level language programs, interpreter and compilers, flow charts-symbols and simple flowcharts. Structure of C program, header files, constant and variables, data types and their declarations, operators-arithmetic operators, relational operators, logical operators, assignment operators, conditional operator. Built in functions in C, input/output functions for integer, floating points, character and strings. Control statements-if, if-else, do-while. For loop, nested if and nested for loops, go to statement. Library functions-mathematical and trigonometric. Arrays- one dimensional and two dimensional.

Unit II: Curve fitting, Interpolation and Roots of equation (12)

The principle of Least squares, fitting a straight line, fitting a parabola, fitting an exponential curve, fitting curve of the form $y=ax^b$,fitting through a polynomial, Linear interpolation, difference schemes, Newton's forward and backward interpolation formula, Lagrange's interpolation formula. Polynomial and transcendental equations, limits for the roots of polynomial equation. Bisection method, false position method, Newton-Raphson method, directs substitution method.

Unit III: Numerical integration and Solution of simultaneous equation (12) Newton cotes formula, Trapezoidal rule, Simpson's one third rule, Simpsons three eight rule, Gauss quadratics, Monte Carlo method. Gaussian elimination method, pivotal condensation method, Gauss-Jordan elimination method, Gauss-Seidal iteration method, Guass-Jorden matrix inversion method.

Unit IV: Solution of differential equation and Random numbers (12)

Taylor series method, Euler's method, Runge-Kutta method, predictor-corrector method,

Concept of stability and order of accuracy of each method, Random numbers Random walk, generation of pseudo random numbers.

Text and Reference books:

1. Introductory method of numerical analysis: Sastry
2. Numerical analysis: Rajaraman
3. C Programming: Balgurusamy
4. Numerical methods for Scientists and Engineers: H.M.Anita
5. Numerical Computational methods: P.B.Patil and U.P.Verma
6. Numerical methods and computation-B.K.Bafna
7. Computer applications in Physics- Suresh Chandra, Narosa Publisher.
8. Advanced Engineering Mathematics: Erwin Kreszing 5 th or 7th edition, John Willey and Sons Inc.
9. Numerical Methods-G.S.Grewal

M.SC-II, SEME. IV, PHYSICS (APPL. ELEC. / MAT. SCIENCE)
Paper- XIV - PH (AE / MS): MICROELECTRONICS (C)
(Revised syllabus w. e. f. June 2015-2016)

Unit I: Single crystalline Silicon and crystal structure (12)

(111) and (100) planes, Characteristics of substrates: physical (dimensional), electrical, dielectric, mechanical, Wafer cleaning process and wet chemical etching techniques, Environment for VLSI technology: clean room and safety requirements.

Epitaxial Process

Epitaxial Growth: VPE, LPE and MBE techniques, Mechanism, Chemisty and growth kinetics, evaluation of grown layer, Epitaxial defects,

Unit II : Oxidation and Impurity Incorporation (12)

Oxide growth: dry, wet, rapid thermal oxidation; Deal Grove model of thermal oxidation, anodic and plasma oxidation, electronic properties of oxide layer, masking characteristics, oxide charges, oxide stress, Oxide characteristics

Impurity Incorporation: Interstitial and substitutional diffusions, diffusivity, laws governing diffusion, constant source and instantaneous source diffusion, Solid Source, liquid source and gas source Boron and Phosphorus diffusion systems, Ion implantation: modeling, technology and damage annealing; Characterization of impurity profiles, buried layers

Unit III: Lithographic and Deposition Techniques (12)

Lithography: Types, Optical lithography –contact, proximity and projection printing, masks, resists: positive and negative, photo - resist pattering, characteristics of a good photo - resist, Mask generation using co-ordinatograph and electron beam lithography.

Deposition Techniques for polysilicon and metals

Chemical Vapour deposition techniques: CVD technique for deposition of polysilicon, silicon dioxide and silicon nitride films;

Metallisation techniques: Resistive evaporation and sputtering techniques. (D.C. and magnetron), Failure mechanisms in metal interconnects; multilevel metalisation schemes.

Unit IV: Device fabrication, Assembling and Packaging (12)

Masking Sequence and Process flow for pnp and npn devices , p-MOS and n-MOS, Die separation, bonding and attachments, encapsulation, package sealing, flat package, PGA (Printed Grid Array), BGA (Ball Grid Array)

Reference Books:

1. S.M.Sze (Ed), "VLSI Technology", 2nd Edition, McGraw Hill, 1988.
2. Streetman," VLSI Technology". Prentice Hall, 1990
3. C.Y. Chang and S.M. Sze (Ed), "VLSI Technology", McGraw Hill Companies Inc., 1996.
4. S.K.Gandhi, "VLSI fabrication Principles", John Wiley Inc., New York, 1983.
5. Sorab K. Gandhi, "The Theory and Practice of Microelectronics", John Wiley & Sons
6. A.S Grove, "Physics and Technology of semiconductor devices", John Wiley & Sons,
7. Integrated Ckts: Design principles and Fabrication: Warner.

Topics for Tutorials/Seminars: The problem/ exercise / short questions answers/ block diagrams given in the reference books will from the Tutorial Course.

M.SC-II, SEME. IV, PHYSICS (MAT. SCIENCE)

Paper – XV - PH (MS): MAGNETIC MATERIALS (Elective Paper)

(Revised syllabus w. e. f. June 2015-2016)

Unit I: Introduction (10)

Measurement of Field Strength, Hall Effect, Electronic Integrator or Fluxmeter, Magnetic Measurements in Closed Circuits, Demegnetizing Fields, Magnetic Shielding, Demagnetizing Factors, Magnetic Measurements in Open Circuits, Instruments for Measuring Magnetization, Vibrating - Sample Magnetometer, Altering (Field) Gradient Magnetometer - AFGM or AGM, (also called Vibrating Reed Magnetometer), Magnetic Circuits and Parameters, Permanent Magnet Materials, Susceptibility Measurements.

Unit II: Magnetism in Materials (20)

Diamagnetism and Para magnetism:

Introduction, Magnetic Moments of Electrons, Magnetic Moments of Atoms, Theory of Diamagnetism, Diamagnetic Substances, Classical Theory of Para magnetism, Quantum Theory of Para magnetism, Gyro magnetic Effect, Magnetic Resonance

Ferromagnetism: Introduction, Molecular Field Theory, Exchange Forces, Band Theory, Ferromagnetic Alloys, Theories of Ferromagnetism

Antiferromagnetism: Introduction, Molecular Field Theory, Above $T_{N,}$ Below $T_{N,}$ Comparison with Experiment, Neutron Diffraction, Antiferromagnetic, Ferromagnetic, Rare Earths , Antiferromagnetic Alloys.

Ferrimagnetism: Introduction, Structure of Cubic Ferrites, Saturation Magnetization, Molecular Field Theory, Above Tc, Below Tc, General Conclusions, Hexagonal Ferrites, Other Ferromagnetic Substances, y - $Fe_2O_{3,}$ Garnets, Alloys.

Unit III: Magnetic Anisotropy, Magnetostriction and the Effects of stress (12)

Magnetic Anisotropy: Introduction, Anisotropy in Cubic Crystals, Anisotropy in Hexagonal Crystals, Physical Origin of Crystal Anisotropy, Anisotropy Measurement, Torque Curves, Torque Magnetometers, Anisotropy Measurement (from Magnetization Curves), Fitted Magnetization Curve, Anisotropy Constants, Polycrystalline Materials

Magnetostriction: Introduction, Magnetostriction of Single Crystals, Cubic Crystals, Magnetostriction of Polycrystals, Physical Origin of Magnetostriction, Form Effect, Effect of Stress on Magnetic Properties, Effect of Stress on Magnetostriction, Applications of Magnetostriction, ΔE Effect, Magnetoresistance.

Unit IV: Domains and the Magnetization Process (08)

Introduction, Domain Wall Structure, Neel Walls, Magnetostatic Energy and Domain Structure, Uniaxial Crystals, Cubic Crystals, Domain Wall Motion, Magnetization in Low Fields, Magnetization in High Fields, Shapes of Hysteresis Loops.

Reference Books:

1. K. H. J. Buschow & F. R. de Boer: Physics of Magnetism and Magnetic Materials.
2. C. Kittle : Introduction to Solid State Physics.
3. Azoroff : Introduction to Solids.
4. Saxena, Gupta, Saxena: Fundamentals of Solid State Physics.
5. R. L. Singhal: Solid State Physics.
6. V. Raghavan: Materials Science and Engineering.
7. A. J. Dekkar : Solid State Physics.

M.SC-II, SEME. IV, PHYSICS (MAT. SCIENCE)

Paper – XVI - PH (MS): NANO SCIENCE AND TECHNOLOGY (Elective Paper)

(Revised syllabus w. e. f. June 2015-2016)

Unit I: Introduction (10)

Background of Nanoscience and Nanotechnology, Definition of Nanoscience and Nanotechnology, Possible Applications of Nanotechnology, Top-down and Bottom-up approach (Brief).

Band Structure and Density of States at Nanoscale: Introduction, Energy Bands, Density of States at Low - dimensional Structures, Quantum confinement – semiconductors, quantum wells, quantum wires, quantum dots, quantum rings. Manifestation of quantum confinement, quantum confinement effect, dielectric quantum confinement, effective mass approximation, core-shell quantum dots.

Unit II: Properties of Nanomaterials (12) Optical properties: Absorption, transmission, Beer-Lamberts law (derivation), Photoluminscence, Fluorescence, Phosporescence, cathodoluminscence, electroluminescence, Surface Plasmon resonance (SPR), effect of size of nanoparticles (metal, semiconductor) on absorption and SPR spectra.

Electrical transport: Electrical Conduction in Metals, Classical Theory - The Drude Model Quantum Theory - The Free Electron Model Conduction in Insulators/Ionic Crystals, Electron Transport in Semiconductors, Various Conduction Mechanisms in 3D (Bulk), 2D(Thin Film) and Low – dimensional Systems**,** Thermionic Emission Field – enhanced Thermionic Emission (Schottky Effect), Field - assisted Thermionic Emission from Traps (Poole - Frenkel Effect), Hopping Conduction, Polaron Conduction.

Unit III: Growth Techniques and Characterization Tools of Nanomaterials (18)

Growth techniques: Introduction, Top - down vs. Bottom - up Technique, Lithographic Process and its limitations , Nonlithorgraphic Techniques ,Plasma Arc Discharge Sputtering ,Evaporation, Chemical Vapour Deposition ,Pulsed Laser Deposition ,Molecular Beam Epitaxy, Sol - Gel Technique , Electrodeposition , Different chemical routes, Other Processes.

Characterization Tools of Nanomaterials: Scanning Probe Microscopy (SPM): Introduction, Basic Principles of SPM Techniques, The Details of scanning Tunneling Mocroscope (STM), General Concept and Definite Characteristics of AFM, Scanned - Proximity Probe Microscopes Laser Beam Deflection, AFM Cantilevers ,Piezoceramics, Feedback Loop Alternative Imaging Modes. Electron Microscopy: Introduction, Resolution vs. Magnification Scanning Electron Microscope SEM Techniques, Electron Gun Specimen Interactions Environmental SEM (FESEM), Transmission Electron Microscope, High Resolution TEM Contrast Transfer Function. Near-field scanning optical microscopy (SNOM/NSOM), UV-Vis single and dual beam spectrophotometer, photoluminescence spectrometer, X-ray diffractometer.

Unit IV: Some Special Topics in Nanotechnology (08)

Introduction ,The Era of New Nanostructure of Carbon Buckminsterfullerene, Carbon Nanotubes , Nanodiamond, BN Nanotubes Nanoelectronics ,Single Electron Transistor, Molecular Machine, Nano-biometrics.

Reference Books:

1) **Introduction to Nanoscience and Nanotechnology:** K.K. Chattopadhyay and A.N. Banerjee, PHI Publisher
2) **Nanoscience and Technology:** V. S. Murlidharan, A. Subramanum.
3) **Nanotubes and Nanofibers:** Yury Gogotsi
4) **A Handbook of Nanotechnology :** A. G. Brecket
5) **Instrumentations and Nanostructures:** A. S. Bhatia
6) **Nanotechnology: Nanostructures and Nanomaterials -** M. B. Rao
7) **Nanotechnology-Principles and practices -** S. K. Kulkurni (Capital Publication Company)

Solapur University, Solapur.

Physics (Materials Science),

M.Sc. Part-II, Sem.-III, Practical Set-II

1. Inverting Adder for two inputs.
2. Non-inverting Adder for two inputs.
3. Op-Amp Subtractor.
4. Op-Amp integrator & Differentiator.
5. Op-Amp instrumentation amplifier with IC 324.
6. Op-Amp phase lag circuit.
7. Op-Amp phase lead circuit.
8. First order Low pass Filter.
9. First order High pass Filter.
10. Wave-form generator (Square and Triangular Wave Generator)

Solapur University, Solapur.

Physics (Materials Science),

M.Sc. Part-II, Sem.-IV, Practical Set-I

1. Oxidation of Copper
2. Structural studies of TiO_2 thin films.
3. Particle size estimation of TiO_2.
4. Auto combustion Synthesis of $CoFe_2O_2$ / $ZnFe_2O_4$.
5. Hydrothermal synthesis of ZnO.
6. Band gap determination of CdS film.
7. Resistivity measurement by two probe method.
8 Thermal evaporation of Cu.
9. Formation of hydroxide co-precipitates for synthesis of $CoFe_2O_2$/ $ZnFe_2O_4$.
10. Formation of oxalate co-precipitates for synthesis of $NiFe_2O_2$.
11. Study of phase diagram BaO and TiO_2 for synthesis of $BaTiO_3$.
12. Study of phase diagram NiO & Fe_2O_3 for synthesis $NiFe_2O_4$.
13. Electrodepostion of Mn.

Solapur University, Solapur.

Physics (Materials Science),

M.Sc. Part-II, Sem.-III, Practical Set-I

1. Band gap energy (Si diode) using four probe set up.
2. Resistivity by four probe method.
3. Thermoelectric power of given n-type semiconductor.
4. Absorption spectra cf I_2 molecule.
5. Rydberg constant.
6. Susceptibility of $FeCl_3$ solution.
7. Planks constants.
8. Fourier Analysis.
9. Curve fitting & Mathenatica-II
10. Chemical bath deposition (CBD) of CdS thin films.
11. Determination of lattice constants of TiO_2.