COURSE OF STUDY AND SCHEME OF EXAMINATIONS FROM ACADEMIC YEARS 2009-2011 ONWARDS

SEMESTER	NAME OF COURSE	INST. HOURS	CREDITS	EXAM HRS	MAX MARKS	
					CIA	EXTL.
I	PAPER 1- MATHEMATICAL PHYSICS	6 HRS	4	3	25	75
	PAPER 2- CLASSICAL MECHANICS AND RELATIVITY	6 HRS	4	3	25	75
	PAPER 3- QUANTUM MECHANICS I	6 HRS	4	3	25	75
	PAPER 4- INTEGRATED ELECTRONICS AND MICROPROCESSOR	6 HRS	4	3	25	75
	PRACTICAL I	6 HRS	4	4	40	60
II	PAPER 5- QUANTUM MECHANICS II	6 HRS	4	3	25	75
	PAPER 6- ELECTROMAGNETIC THEORY	5 HRS	4	3	25	75

	PAPER -7 COMPUTATIONAL METHODS AND PROGRAMMING	5 HRS	4	3	25	75
	ELECTIVE I- SPECTROSCOPY	4 HRS	3	3	25	75
	EXTRA DISCIPLINARY I- HUMAN RESOURCE MANAGEMENT	4 HRS	3	3	25	75
	PRACTICAL II	6 HRS	4	3	40	60
III	PAPER -8 STATISTICAL MECHANICS	6 HRS	4	3	25	75
	PAPER -9 NUCLEAR AND PARTICLE PHYSICS	6 HRS	4	3	25	75
	ELECTIVE II- NANOSCIENCE AND TECHNOLOGY	6 HRS	4	3	25	75
	EXTRA DISCIPLINARY II GENETIC ENGINEERING	6 HRS	3	3	25	75
	PRACTICAL III	6 HRS	4	4	40	60
	PAPER 10- CONDENSED MATTER PHYSICS	6 HRS	4	3	25	75

IV	ELECTIVE III- MICROPROCESSOR AND MICROCONTROLLER	6 HRS	4	3	25	75
	ELECTIVE IV- MATERIAL SCIENCE	6 HRS	4	3	25	75
	PRACTICAL IV	6 HRS	4	4	25	75
	PROJECT	6 HRS	4			
		TOTAL	81			

Note:
II Semester- M.Sc Physics Department Handles Energy Physics for the students of M.A. HRM

III semester - M.Sc Physics Department Handles Basics of Nanoscience and Nanotechnology for the students of M.Sc PBPB.

Paper 1: MATHEMATICAL PHYSICS (revised)

(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

UNIT 1: Linear Vector Spaces

Linear operators – Vectors in n-dimensions – Matrix representation of vectors and operators in a basis - Linear independence, dimension - Inner product - Schwarz inequality - Orthonormal basis - Gram-Schmidt Process – Eigenvalues and Eigenfunctions of operators/matrices – Hermitian and unitary operators/matrices – Cayley-Hamilton theorem - Diagonalizing matrix.

UNIT 2: Linear Differential Equations and Green's Function

Second order linear differential equations – Wronskian - Sturm - Liouville theory - Orthogonality of eigenfunctions - Illustration with Legendre, Laguerre, and Hermite differential equations –- Dirac delta function.

One-dimensional Green's function - Eigenfunction expansion of the Green's function - Reciprocity theorem - Sturm - Liouville type equations in one dimension and their Green's functions.

UNIT 3: Complex Variables

Functions of a complex variable - Single and multivalued functions - Analytic functions - Cauchy - Riemann conditions - Singular points - Cauchy's theorem and integral formulae - Taylor and Laurent expansions - Zeros and poles - Residue theorem and its applications

UNIT 4: Laplace and Fourier Transforms

Laplace transforms - Solution of linear differential equations with constant coefficients - Fourier integral - Fourier transforms (Infinite), Fourier sine and cosine transforms - Convolution theorems.

UNIT 5: Group Theory

Basic definitions - Lagrange's Theorem - Invariant subgroup - Homomorphism and Isomorphism between groups - Representation of a group - Unitary representations - Schur's lemmas - Orthogonality theorem - Character table - Simple applications to symmetry groups and molecular vibrations.

BOOKS FOR STUDY:

1.P. K. Chattopadhyay, 1990, Mathematical Physics, Wiley Eastern, Madras.
2.G. Arfken and H. J. Weber, 2001, Mathematical Methods for Physicists, 5th Edition,. Harcourt (India), New Delhi.
3.A. W. Joshi, 1997, Elements of Group Theory for Physicists, 4th Edition, New Age International, New Delhi.
4.A. W. Joshi, 1995, Matrices and Tensors in Physics, 3rd Edition, Wiley Eastern, Madras.
5.E. Kreyszig, 1999, Advanced Engineering Mathematics, 8th Edition, Wiley, New York.
6.M. D. Greenberg, 1998, Advanced Engineering Mathematics, 2nd Edition, International Ed., Prentice - Hall International, New Jersey.
7.F. A. Cotton, Chemical Application of Group Theory. 3rd Edition, John Wiley and Sons, New York.

BOOK FOR REFERENCE:

8.Tulsi Dass and S. K. Sharma, 1998, Mathematical Methods in Classical and Quantum Physics, Universities Press(INDIA), Hyderabad.
9.S. Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw - Hill, New York
10 E. Butkov, 1968, Mathematical Physics Addison - Wesley, Reading, Massachusetts.
11.P. R. Halmos, 1965, Finite Dimensional Vector Spaces, 2nd Edition, Affiliated East-West, New Delhi.
12.M. Hamermesh, 1962, Group Theory and Its application to Physical Problems, Addison Wesley, Reading.
13.C. R. Wylie and L.C. Barrett, 1995, Advanced Engineering Mathematics, 6th Edition, International Edition, McGraw-Hill, New York.
14.W. W. Bell, 1968, Special Functions for Scientists and Engineers, Van Nostrand, London.
15.M. A. Abramowitz and I. Stegun (Editors), 1972, Handbook of Mathematical Functions Dover, New York.

WEB SITES:

1.http://www.mpipks-dresden.mpg.de/~jochen/methods/outline/html
2.http://phy.syr.edu/~trodden/courses/mathmethods/
3.http://dmoz.org/Science/Physics/Mathematical_Physics/
4.http://www.thphys.nuim.ie/Notes/engineering/frame-notes.html
5.http://www.thphys.nuim.ie/Notes/frame-notes.html

SUB CODE:PH12

PAPER 2: CLASSICAL MECHANICS AND RELATIVITY
(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

UNIT 1: Lagrangian and Hamiltonian Formulations

Hamilton's variational principle - Lagrange's equations of motion – Canonical momenta – Cyclic coordinates and conservation of corresponding momenta – Legendre transformation and Hamiltonian - Hamilton's equations of motion - Two-body central force problem –Kepler Problem and Kepler's laws - Scattering by central potential - Two-particle scattering - Cross-section in lab Frame.

UNIT 2: Mechanics of Rigid Bodies

Rigid body motion – Kinematics – Euler angles – Infinitesimal rotations – Rate of change of a vector – Coriolis force - Dynamics - Angular momentum and kinetic energy - Moment of inertia tensor - Euler's equations of motion - Torque-free motion - Symmetrical top.

UNIT 3: Canonical Transformation

Canonical transformations and their generators – Simple examples - Poisson brackets – Equations of motion in Poisson bracket formalism - Symmetries and conservation laws - Hamilton-Jacobi theory - Application to harmonic oscillator problem.

UNIT 4: Small Oscillations

Formulation of the problem - Transformation to normal coordinates - Frequencies of normal modes - Linear triatomic molecule.

UNIT 5: Relativity

Lorentz transforamtions - Four vectors - Lorentz invariance of the four product of two four vectors - Invariance of Maxwell's equations - Relativistic Lagrangian and Hamiltonian for a free particle.

BOOKS FOR STUDY:

1. H. Goldstein, 2002, Classical Mechanics. 3rd Edition, C. Poole and J. Safko, Pearson Education, Asia, New Delhi.
2. S. N. Biswas, 1998, Classical Mechanics, Books and Allied Ltd., Kolkata.
3. Upadhyaya, 1999, Classical Mechanics , Himalaya Publishing Co., New Delhi.

BOOKS FOR REFERENCE:

1. L. D. Landau and E. M. Lifshitz, 1969, Mechanics, Pergomon Press, Oxford.
2. K. R. Symon, 1971, Mechanics, Addison Wesley, London.
3. J. L. Synge and B. A. Griffith, 1949, Principles of Classical Mechanics, Mc Graw-Hill, New York.
4. C. R. Mondal, Classical Mechanics, Prentice-Hall of India, New Delhi.
5. R. Resnick, 1968, Introduction to Special Theory of Relativity, Wiley Eastern, New Delhi.
6. R. P. Feynman, 1962, Quantum Electrodynamics, Benjamin, Reading, MA.

WEB SITES

1. http://astro.physics.sc.edu/selfpacedunits/unit56.html
2. http://www.phy.auckland.nz/staff/smt/453310SC.html
3. http://www.damtp.cam.ac.uk/user/tong/dynamics.htm
4. http://farside.ph.utexas.edu/teaching/301/lectures/lectures.html
5. http://www.lancs.ac.uk/depts/physics/teaching/py332/phys332.htm

SUB CODE: PH13

Paper 3: QUANTUM MECHANICS - I

(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

UNIT 1: Basic formalism

Interpretation and conditions on the wave function - Postulates of quantum mechanics and the Schroedinger equation - Ehrenfest's theorem- Stationary states - Hermitian operators for dynamical variables - Eigenvalues and eigenfunctions - Uncertainty principle.

UNIT 2: One Dimensional Problems and Three Dimensional Problems

Particle in a box - Square-well potential - Barrier penetration - Simple harmonic oscillator - Ladder operators method.
Orbital angular momentum and spherical harmonics - Central forces and reduction of two-body problem - Particle in a spherical well - Hydrogen atom.

UNIT 3: General Formalism

Hilbert space - Dirac notation - Representation theory - Co-ordinate and momentum representations - Time evolution - Schroedinger, Heisenberg and Interaction pictures- Symmetries and conservation laws - Unitary transformations associated with translations and rotations - Parity and time reversal.

UNIT 4: Approximation methods

Time-independent perturbation theory for non-degenerate and degenerate levels - Variation method, simple applications - WKB approximation - Connection formulae (no derivation) - WKB quantization rule - Application to simple harmonic oscillator - Hydrogen molecule, covalent bond and hybridization.

UNIT 5: Angular Momentum and Identical particles

Eigenvalue spectrum from angular momentum algebra - Matrix representation - Spin angular momentum - Non-relativistic Hamiltonian including spin - Addition of angular momenta - Clebsch - Gordan Coefficients.
Symmetry and anti-symmetry of wave functions - Spin and Pauli matrices.

BOOKS FOR STUDY:

1. P. M. Mathews and K. Venkatesan, 1976, A Text book of Quantum Mechanics, Tata McGraw-Hill, New Delhi.
2. L. I. Schiff, 1968, Quantum Mechanics, 3rd Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo.
3. V. Devanathan, 2005, Quantum Mechanics, Narosa Publishing House, New Delhi.

BOOKS FOR REFERENCE:

1. E. Merzbacher, 1970, Quantum Mechanics 2nd edition, John Wiley and Sons, New York.
2. V. K. Thankappan, 1985, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi.
3. P. A. M. Dirac, 1973, The Principles of Quantum Mechanics, Oxford University Press, London.
4. L. D. Landau and E. M. Lifshitz, 1976, Quantum Mechanics Pergomon Press, Oxford.
5. S. N. Biswas, 1999, Quantum Mechanics, Books And Allied Ltd., Kolkata.
6. G. Aruldhas, 2002, Quantum Mechanics, Prentice Hall of India, New Delhi.
7. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India.
8. J. S. Bell, Gottfried and M.Veltman, 2001, The Foundations of Quantum Mechanics World Scientific, Singapore.

9.R. P. Feynman, R. B. Leighton, and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 3, Narosa, New Delhi.

10.V. Devanathan, 1999, Angular Momentum Techniques in Quantum Mechanics, Kluwer Academic Publishers, Dordrecht.

WEB SITES

1. http://www.netsa.org.lk/OcwWeb/Physics/index.htm
2. http://www.theory.caltech.edu/people/preskill/ph229/
3. http://www.nscl.msu.edu/~pratt/phy851/lectures/lectures.html
4. http://walet.phy.umist.ac.uk/QM/LectureNotes/
5. http://www.ks.uiuc.edu/Services/Class/PHYS480/
6. http://www.mat.univie.ac.at/~gerald/ftp/book-schroe/index.html
7. http://people.deas.harvard.edu/~jones/ap216/lectures/lectures.html
8. http://www.netsa.org.lk/OcwWeb/Chemistry/5-73Introductory-Quantum-Mechanics-IFall2002/LectureNotes/index.htm
9. http://www.glue.umd.edu/~fivel/
10. http://www.phys.ualberta.ca/~gingrich/phys512/latex2html/phys512.html
11. http://www.eas.asu.edu/~vasilesk/EEE434.html
12. http://minty.caltech.edu/Ph125a/

13. http://walet.phy.umist.ac.uk/QM/LectureNotes/

SUB CODE: PH14

Paper 4: INTEGRATED ELECTRONICS AND MICROPROCESSOR

(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

UNIT 1: Semiconductor Devices

FET, MOSFET, UJT, SCR, TRIAC – Structure and constructional features – Working principle and I-V Characteristics – FET as Common Source and Common Drain amplifier -Biasing of FET and MOSFET- UJT relaxation oscillator – SCR, TRIAC for power control.

IC Technology – Monolithic, Thin film and Hybrid technologies – Limitations in IC Technology – VLSI

UNIT 2: Digital Electronics

Logic families and circuits – DTL, TTL, ECL, I^2L and CMOS – CMOS Devices – Inverters, NAND and NOR gates – Comparative study. PLA, PLC and PLD.

Design of Asynchronous feedback technique counters – Design of synchronous counters – Design of random sequence counters – Serial parallel registers – Shift registers – Applications.

Binary weighted resistor D/A converter – R-2R ladder DAC – FLASH, Counter type, successive approximation and dual slope ADC.

UNIT 3: Applications of Op-Amps

DC Analysis of IC Op-Amp – Instrumentation amplifier – Transducer Bridge Instrumentation Amplifier – Applications – Temperature Indicator, Flux meter & Weighing machine - Analog Integrator, differentiator – Design of analog circuits for solution of differential equation and simultaneous equations using Op-Amps – Sample and Hold system – Analog multiplexer.

Active filter circuits – Low Pass , High Pass, Band Pass- 1^{st} Order, 2^{nd} Order Butterworth Filter circuits – Wide Band and Narrow Band reject Filters. Timer 555 – Internal architecture and working – Monostatble and Astable operation. Voltage control oscillator (VCO) IC 566- PLL concept – Phase Locked loop IC 565 – Application – Frequency multiplier, FSK modulator and Demodulator.

UNIT 4: 8085, Programming and Interfacing

Addressing modes – Instruction set – Programming techniques – Assembly language programs. Interfacing Memory and I/O – Memory system – Linear selection addressing - Coincidence selection addressing – Two dimensional addressing – 2K x 8, 4k x 8 ROM Interface – 2k x 8, 4k x 8 RAM Interface – Timing diagram for Memory READ and Memory WRITE cycles.

IN and OUT Instructions – Timing diagram – Device selection – Design of Input port and output port using I/O - Mapped I/O and memory mapped I/O techniques – Difference between I/O mapped I/O memory mapped I/O – Simple Polled I/O and Hand shaking operations.

UNIT 5: INTERFACING PERIPHERAL I/O SYSTEMS

Programmable peripheral device 8255 – Interfacing keyboard – Matrix Scanning – Interfacing multiplexed 7 segment display – DAC and ADC Interface – Waveform generation using DAC interface – Stepper motor interface – clockwise, anticlockwise and wiper action

BOOKS FOR STUDY:

1.S. M. Sze, 1985, Semiconductor Devices - Physics and Technology, Wiley, New York.

2.Millman and Halkias, Integrated Electronics.

3.R. A. Gaekwad, 1994, OpAmps and integrated circuits EEE.

4.Taub and Shilling, 1983, Digital Integrated Electronics, Mc Graw-Hill, New Delhi.

5.Malvino and Leech, Digital Electronics,
6.J. Millman, 1979, Digital and Analog Circuits and Systems, Mc Graw-Hill, London.
7..R. S. Gaonkar, 1997, Microprocessor Architecture, Programming and Application with the 8085, 3rd Edition, Penram International Publishing, Mumbai.

BOOKS FOR REFERENCE:

1. R. F. Coughlin and F. F. Driscol, 1996 OpAmp and linear integrated circuits Printice Hall of India, New Delhi.
2. M. S. Tyagi, Introduction to Semiconductor Devices, Wiley, New York.
3. P. Bhattacharya, 2002, Semiconductor Optoelectronic Devices, 2nd Edition. Printice-Hall of India, New Delhi.
4. B. Somnath Nair, 2002, Digital Electronics And Logic Design, Printice-Hall of India, New Delhi.
5. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 8th Edition, Pearson Education.
6. B. Ram, Fundamentals of Microprocessors and Micro Computers, Dhanpat Rai Publications, New Delhi.
7. V. Vijayendran, 2002, Fundamentals of Microprocessor 8085 – Architecture, Programming and Interfacing, Viswanathan, Chennai

SUB CODE:PH1A

PRACTICAL - I
(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

Part – A – Electronics & Microprocessor 8085
External Examination: 4 hrs., Marks:30 (5 marks for record & 25 marks for experiment)

Any TEN Experiments:

Electronics:

1. FET CS amplifier – frequency response, input impedance, output impedance
2. Study of attenuation characteristics of Wien bridge network & Wien bridge oscillator using op.amp.
3. Study of attenuation characteristics of phase shift network & phase shift oscillator using op.amp.
4. Op.amp. – Schmitt trigger
5. Op. amp. – astable & monostable multivibrators
6. Study of R-S, clocked R-S & D flip-flops using NAND / NOR gates
7. Study of J-K, D & T flip-flops using IC 7476 / 7473
8. Clock generators using IC 7400 and 7413

Microprocessor 8085:

9. Microprocessor 8085 – addition & subtraction of 8- & 16-bit numbers
10. Microprocessor 8085 – multiplication (8-bit & 16-bit) & division (8-bit)
11. Sum of a set of N data (8-bit numbers)
12. Picking up the smallest & largest number in an array & sorting in ascending & descending order
13. LED interface – single LED on / off, binary, BCD, ring & Johnson Counters
14. Interfacing of seven segment display
15. Microprocessor 8085 – counter under switch control
16. D/A conversion & waveform generation using op.amp.

Part – B – General

External Examination: 4 hrs., Marks:30 (5 marks for record & 25 marks for experiment)

Any FIVE Experiments:

1. Cornu’s method – Young’s modulus by Elliptic fringes.
2. Stefan’s constant.
3. Band gap energy - Thermistor / Semiconductor
4. Hydrogen spectrum - Rydberg’s constant.
5. Thickness of the enamel coating on a wire – by diffraction.

6. Coefficient of linear expansion – Air wedge method.
7. Permittivity of a liquid using an RFO.
8. L-G Plate.
9. Lasers: Study of Laser Beam Parameters
10. Arc Spectrum - Copper.
11. Impedance measurement using LCR bridge

BOOK FOR REFERENCE:

1. D. Chattopadhyay, P. C. Rakshit, and B. Saha, 2002, An Advanced Course in Practical Physics, 6^{th} Edition, Books and Allied, Kolkata.

SUB CODE:PH21

Paper 5: QUANTUM MECHANICS II

(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

UNIT 1: Scattering Theory

Scattering amplitude - Cross sections - Born approximation - Partial wave analysis -Effective range theory for S-wave - Transformation from centre of mass to laboratory frame.

UNIT 2: Perturbation Theory

Time dependent perturbation theory - Constant and harmonic perturbations - Transition probabilities - Adiabatic approximation - Sudden approximation - The density matrix - Spin density matrix and magnetic resonance - Semi-classical treatment of an atom with electromagnetic radiation - Selection rules for dipole radiation.

UNIT 3: Relativistic Quantum Mechanics

Klein-Gordon equation - Dirac equation - Plane-wave solutions - Interpretation of negative energy states - Antiparticles - Spin of electron - Magnetic moment of an electron due to spin - Energy values in a Coulomb potential.

UNIT 4: Dirac Equation

Covariant form of Dirac equation - Properties of the gamma Matrices - Traces -Relativistic invariance of Dirac equation – Probability density-current four vector – Bilinear covariants - Feynman's theory of positron (Elementary ideas only without propagation formalism).

UNIT 5: Second Quantization

Second quantization of Klein-Gordon field - Creation and annihilation operators - Commutation relations - Quantization of electromagnetic field - Creation and annihilation operators - Commutation relations.

BOOKS FOR STUDY:

1. P. M. Mathews and K. Venkatesan, 1976, A Text book of Quantum Mechanics, Tata McGraw-Hill, New Delhi.
2. L. I. Schiff, 1968, Quantum Mechanics, 3rd Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo.
3. E. Merzbacher, 1970, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York.
4. V. K. Thankappan, 1985, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi.
5. J.D. Bjorken and S.D. Drell, 1964, Relativistic Quantum Mechanics, MacGraw-Hill New York.
6. V. Devanathan, 2005, Quantum Mechanics, Narosa Publishing House, New Delhi.

BOOKS FOR REFERENCE:

1. P. A. M. Dirac, 1973, The Principles of Quantum Mechanics, Oxford University Press, London.
2. L. D. Landau and E. M. Lifshitz, 1958 Quantum Mechanics, Pergomon Press, London.
3. S. N. Biswas, 1999, Quantum Mechanics, Books and Allied, Kolkata.
4. G. Aruldhas, 2002, Quantum Mechanics, Prentice-Hall of India, New Delhi.
5. J. S. Bell, Gottfried and M.Veltman, 2001, The Foundations of Quantum Mechanics, World Scientific.
6. V. Devanathan, 1999, Angular Momentum Techniques in Quantum Mechanics, Kluwer Academic Publishers, Dordrecht.

SUB CODE:PH22

Paper 6: ELECTROMAGNETIC THEORY

(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

UNIT 1: Electrostatics

Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar co ordinates – Examples of solutions for boundary value problems.

Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Molecular polarisability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion.

UNIT 2: Magnetostatics

Biot-Savart Law - Ampere's law - Magnetic vector potential and magnetic field of a localised current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magnetostatic energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetised sphere.

UNIT 3: Maxwell Equations

Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem - Lorentz force - Conservation laws for a system of charges and electromagnetic fields.

UNIT 4: Wave Propagation

Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface - Waves in a conducting medium - Propagation of waves in a rectangular wave guide.

Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole.

UNIT 5: Elementary Plasma Physics

The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations - The Debye shielding problem - Plasma confinement in a magnetic field - Magneto-hydrodynamic waves - Alfven waves and magnetosonic waves.

BOOKS FOR STUDY:

1. D. J. Griffiths, 2002, Introduction to Electrodynamics, 3rd Edition, Prentice-Hall of India, New Delhi.
2. J. R. Reitz, F. J. Milford and R. W. Christy, 1986, Foundations of Electromagnetic Theory, 3rd edition, Narosa Publication, New Delhi.
3. J. D. Jackson, 1975, Classical Electrodynamics, Wiley Eastern Ltd. New Delhi.
4. J. A. Bittencourt, 1988, Fundamentals of Plasma Physics, Pergamon Press, Oxford.

BOOKS FOR REFERENCE:

1. W. Panofsky and M. Phillips, 1962, Classical Electricity and Magnetism, Addison Wesley, Lodon.
2. J. D. Kraus and D. A. Fleisch, 1999, Electromagnetics with Applications, 5th Edition, WCB McGraw-Hill, New York.
3. B. Chakraborty, 2002, Principles of Electrodynamics, Books and Allied, Kolkata.
4. R. P. Feynman, R. B. Leighton and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 2, Narosa, New Delhi.

WEB SITES:

1. http://www.plasma.uu.se/CED/Book/index.html
2. http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html
3. http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html
4. http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/

SUB CODE:PH23

Paper 9: COMPUTATIONAL METHODS AND PROGRAMMING
(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

UNIT 1: SOLUTIONS OF EQUATIONS

Determination of zeros of polynomials –Roots of nonlinear algebraic equations and transcendental equations – Bisection and Newton-Raphson methods – Convergence of solutions.

UNIT 2: LINEAR SYSTEMS

Solution of simultaneous linear equations – Gaussian elimination – Matrix inversion – Eignenvalues and eigenvectors of matrices – Power and Jacobi Methods.

UNIT 3: INTERPOLATION AND CURVE FITTING

Interpolation with equally spaced and unevenly spaced points (Newton forward and backward interpolations, Lagrange interpolation) – Curve fitting – Polynomial least – squares fitting.

UNIT 4: DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS

Numerical differentiation – Numerical integration – Trapezoidal rule – Simpon's rule – Error estimates – Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite and Gauss-Chebyshev quadratures – Numerical solution of ordinary differential equations – Euler and Runge Kutta methods.

UNIT 5: PROGRAMMING WITH FORTRAN/C

Flow-charts – Integer and floating point arithmetic expressions – Built-in functions – Executable and non-executable statements – Subroutines and functions – Programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials/non-linear
equations by the Newton-Raphson method, (c) Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.

BOOKS FOR STUDY:

1. V. Rajaraman, 1993, Computer oriented Numerical Methods, 3 rd Edition. PHI, New Delhi
2. M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3 rd Edition, New Age Intl., New Delhi
3. S. S. Sastry, Introductory Methods of Numerical analysis, PHI, New Delhi
4. F. Scheid, 1998, Numerical Analysis, 2 nd Edition, Schaum's series, McGraw Hill, New York
5. W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, 1992, Numerical Recipes in FORTRAN, 2 nd Edition, Cambridge Univ. Press
6. W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, 1992, Numerical Recipes in C, 2 nd Edition, Cambridge Univ. Press
7. V. Rajaraman, Programming in FORTRAN / Programming in C, PHI, New Delhi
8. E. Balagurusamy, 1998, Numerical Methods, TMH

Books for Reference:

1. S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis-an algorithmic approach, 3 rd Edition, McGraw Hill,)
2. B. F. Gerald, and P. O. Wheatley, 1994, Applied Numerical analysis, 5^{th} Edition., Addison-Wesley, MA.
3. B. Carnagan, H. A. Luther and J. O. Wilkes, 1969, Applied Numerical Methods, Wiley, New York.
4. S. S. Kuo, 1996, Numerical Methods and Computers, Addison-Wesley.

WEB SITES

1.http://www.sst.ph.ic.ac.uk/angus/Lecturs/compphys/comphys.html

2.http://www.library.cornell.edu/nr (numerical recipes online book on C & FORTRAN)

SUB CODE:EPA23

ELECTIVE I: DIGITAL COMMUNICATION
(ELECTIVE COURSE, FIRST YEAR, SECOND SEMESTER, 3 CREDITS, FOR 2008-2010 BATCH)

UNIT 1: SIGNAL ANALYSIS

Fourier transforms of gate functions, delta functions at the origin- Two delta function and periodic delta function- Properties of Fourier transform- Frequency shifting- Time shifting- Convolution- Graphical representation- Convolution theorem- Time Convolution theorem- Frequency Convolution theorem- Sampling theorem.

UNIT 2: INFORMATION THEORY

Communication system- Measurement of information- Coding- Bandot Code- CCITT Code- Hartley Law- Noise in a information Carrying Channel- Effects of noise- Capacity of noise in a channel- Shanon Hartley theorem- Redundancy.

UNIT 3: PULSE MODULATION

Pulse amplitude modulation- Natural sampling- Instantaneous sampling- Transmission of PAM Signals- Pulse width modulation- Time division multiplexing- Band width requirements for PAM Signals. Pulse Code Modulation- Principles of PCM- Quantizing noise- Generation and demodulation of PCM- Effects of noise- Companding- Advantages and applications of PCM- Other digital pulse modulating systems Differential PCM- Delta modulation.

UNIT 4: ERROR CONTROL CODING

Introduction to Linear Block Codes, Hamming Codes, BCH Coding, RS Coding, Convolutional Coding, Coding Grain Viterbi Coding.

UNIT 5: SPREAD SPECTRUM SYSTEMS

Pseudo Noise sequences, Generation and Correlation properties, direct sequence spread spectrum systems, frequency HOP Systems, processing gain, antijam and multipath performance.

UNIT 5: SPREAD SPECTRUM SYSTEMS

Pseudo Noise sequences, Generation and Correlation properties, direct sequence spread spectrum systems, frequency HOP Systems, processing gain, antijam and multipath performance.

BOOKS FOR STUDY

1. B.P.Lathi, Communication system, Wiley Eastern
2. George Kennedy, Electronic Communication Systems, 3rd Edition, McGraw Hill
3. Simon Haykin, Communication system, 3rd Edition, John Wiley & Sons.

.

BOOKS FOR REFERENCE

1. Simon Haykin, 1988, Digital Communication, John Wiley.
2. John Proakis, 1995, Digital Communication, 3rd Edition, McGraw Hill, Malaysia.
3. M.K.Simen, 1999, Digital Communication Techniques, Signal Design and detection, Prentice Hall of India.

SUB CODE :EPB23

ELECTIVE I: SPECTROSCOPY

(ELECTIVE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS, FOR 2009-2011 BATCH ONWARDS)

UNIT 1: Microwave Spectroscopy

Rotational spectra of diatomic molecules - Polyatomic molecules - Linear and symmetric top molecules - Hyperfine structrure and quadrupole moment of linear molecules - Experimental techniques - Stark effect.

UNIT 2: Normal Coordinate Analysis

Selection rules for Raman and IR vibrational normal modes – Normal for Raman and IR activity C2V and C3V point groups – Representation of Molecular Vibrations in Symmetry co-ordinates – Normal coordinate analysis for H2O molecule

UNIT 3: Infrared Spectroscopy

Vibrations of diatomic and simple polyatomic molecules - Anharmonicity – Fermi Resonance – Hydrogen Bonding – Normal Modes of Vibration in a crystal – Solid State Effects – Interpretation of Vibrational Spectra – Instrumentation techniques – FTIR spectroscopy

UNIT 4: Raman Scattering

Vibrational and Rotational Raman spectra – Mutual Exclusion principle – Raman spectrometer – Polarization of Raman Scattering light. Structure Determination through IR and Raman spectroscopy – Phase transitions – Resonance Raman Scattering

UNIT 5: NMR and ESR Spectroscopy

Quantum theory of NMR – Bloch equations – Design of CW NMR Spectrometer – Principle and block diagram of PT NMR – Chemical Shift – Application to molecular structure.

Quantum Theory of ESR – Design of ESR Spectrometer – Hyperfine Structure – Anisotropic systems – Triplet state study of ESR – Applications – Crystal defects -Biological studies

BOOKS FOR STUDY:

1. C. N. Banwell and E. M. McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition TMH, New Delhi.
2. G. Aruldas, 2001, Moleclar Structure and Spectroscopy, Prentice Hall of India Pvt. Ltd. New Delhi.
3. D. N. Satyanarayana, 2004, Vibrational Spectroscopy and Applications, New Age International Publication

BOOKS FOR REFERENCE:

1. D. D. Jyaji and M. D Yadav 1991, Spectroscopy, Amol Publications
2. Atta ur Rahman, 1986, Nuclear Magnetic Resonance, Spinger Verlag.
3. D. A. Lang, Raman Spectroscopy, Mc Graw-Hill International
4. Raymond Chang, 1980, Basic Principles of Spectroscopy Mc Graw-Hill Kogakusha, Tokyo.

SUB CODE:PH2A

PRACTICAL - II

(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

Part – A – Electronics & Microprocessor 8085
External Examination: 3 hrs., Marks:30 (5 marks for record & 25 marks for experiment)

Any TEN Experiments:

Electronics:

1. Op.amp. – solving simultaneous equations
2. Op.amp. – 4-bit D/A & A/D converters using R-2R ladder network
3. Op.amp. – active filters
4. IC 555 timer – astable & monostable multivibrator
5. IC 555 timer – Schmitt trigger
6. IC 7476 – shift register, ring counter & Johnson counter
7. Arithmetic operations using IC 7483
8. IC 7490 as scalar and seven segment display using IC 7447

Microprocessor 8085:

1. Square & square root of 8- & 16-bit numbers
2. Code conversion (8- & 16- bit numbers) : a) binary to BCD
   b) BCD to binary
3. Clock program – 12 / 24 hrs.
4. DAC 0800 interface & waveform generation
5. ADC using DAC & Op.amp. comparator
6. ADC 0809 interface
7. Hex keyboard interface
8. Stepper motor interface

Part – B – General
External Examination: 4 hrs., Marks: 30 (5 marks for record & 25 marks for experiment)

Any FIVE Experiments:

1. Young's modulus – Hyperbolic fringes.
2. Determination of strain hardening coefficients.
3. Viscosity of liquid – Meyer's disc.
4. F. P. Etalon using spectrometer.
5. Solar constant.
6. Solar spectrum – Hartmann's formula.
7. Arc spectrum – Iron.
8. Edser and Butler fringes – Thickness of air film.
9. B – H loop using Anchor ring.
10. Specific charge of an electron – Thomson's method.
11. FFT & DFT of certain signals

BOOK FOR REFERENCE:

1. D. Chattopadhyay, P. C. Rakshit, and B. Saha, 2002, An Advanced Course in Practical Physics, 6th Edition, Books and Allied, Kolkata.

SUB CODE:NPH21

NON MAJOR ELECTIVE I (OFFERED TO OTHER DEPARTMENTS- 3 CREDITS)

ENERGY PHYSICS

UNIT 1: INTRODUCTION TO ENERGY SOURCES

Renewable and Conventional Energy Sources - Commercial Energy Sources – fossil fuels ,Water power,Nuclear power-Energy alternatives.

UNIT 2: APPLICATIONS OF SOLAR ENERGY

Solar heating and Cooling of buildings – Solar Water Heater – Solar Ponds – Solar Thermal Power Generation – Solar Electric Power Generation.

UNIT 3: BIOMASS ENERGY

Photosynthesis – Bio Fuels - Biomass resources - Biomass Conversion Technologies – Biogas Production from waste Biomass – Land Fill Reactors - Biomass Energy Programme in India.

UNIT 4: GEOTHERMAL ENERGY

Origin and Distribution of Geothermal Energy – Exploration and Development of Geothermal Resources – Environmental Consideration.

UNIT 5: OCEAN ENERGY

Tidal Energy-Origin and nature of tidal energy-Limitations of tidal energy-Present status-Environmental Impact.

BOOKS FOR STUDY:

1. Fundamentals of Renewable Energy Systems – D. Mukherjee and S. Chakrabarti, New Age International Publishers, Reprint 2007.
2. Non Conventional Energy Resources – B.H. Khan, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, Reprint 2008.
3. Solar Energy (Principles of Thermal Collection and Storage) – S.P. Sukhatme & J.K. Nayak, Tata Mc Graw Hill Publishing Company Ltd., New Delhi,Third Edition 2008.
4. Solar Energy Utilisation – G.D. Rai, Khanna Publishers, Fifth edition, Seventh Reprint 2006, Delhi.

SUB CODE:PH31

Paper 7 : STATISTICAL MECHANICS
(CORE COURSE, SECOND YEAR, THIRD SEMESTER, 4 CREDITS)

UNIT 1: Phase Transitions

Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics.
Order parameters - Landau theory of phase transition - Critical indices - Scale transformations and dimensional analysis.

UNIT 2: Statistical Mechanics and Thermodynamics

Foundations of statistical mechanics - Specification of states of a system - Microcanonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an ideal gas using the microcanonical ensemble - Entropy of mixing and Gibb's paradox.

UNIT 3: Canonical and Grand canonical Ensembles

Trajectories and density of states - Liouville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations.

UNIT 4: Classical and Quantum Statistics

Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzman statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT 5: Real Gas, Ising Model and Fluctuations

Cluster expansion for a classical gas - Virial equation of state – Calculation of the first virial coefficient in the cluster expansion - Ising model - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one-dimension.

Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin theory - Fluctuation-dissipation theorem - The Fokker-Planck equation.

BOOKS FOR STUDY:

1. S.K.Sinha , 1990 , Statistical Mechanics , Tata Mc Graw – Hill, New Delhi .
2. B. K. Agarwal and M. Eisner, 1998, Statistical Mechanics, Second Edition New Age International, New Delhi.
3. J. K. Bhattacharjee, 1996, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi.
4. F. Reif, 1965, Fundamentals of Statistical and Thermal Physics, Mac Graw-Hill, New York .
5. C. Kittel, 1987, Thermal Physics, 2nd edition, CBS Publication, New Delhi
6. M. K. Zemansky, 1968, Heat and Thermodynamics, 5th edition, Mc Graw-Hill New York.

BOOKS FOR REFERENCE:

1. R. K. Pathria, 1996, Statistical Mechanics, 2nd edition, Butter Worth-Heinmann, New Delhi.
2. L. D. Landau and E. M. Lifshitz, 1969, Statistical Physics, Pergomon Press,Oxford.
3. K. Huang, 2002, Statistical Mechanics, Taylor and Francis, London
4. W. Greiner, L. Neise and H. Stoecker, Thermodynamics and Statistical Mechanics, Springer Verlang, New York.
5. A. B. Gupta, H. Roy, 2002, Thermal Physics, Books and Allied, Kolkata.
6. A. Kalidas, M. V. Sangaranarayanan, Non-Equilibrium Thermodynamics, Macmllan India, New Delhi.
7. M. Glazer and J. Wark, 2001, Statistical Mechanics, Oxford University Press, Oxford.
8. L. P. Kadanoff, 2001, Statistical Physics - Statics, Dynamics and Renormalization, World Scientific, Singapore.
9. F. W. Sears and G. L. Salinger, 1998, Thermodynamics, Kinetic Theory and Statistical Thermodynamics, 3rd Edition, Narosa, New Delhi.

WEB SITES

1. http://www.nyu.edu/classes/tuckerman/stat.mech/lectures.html
2. http://www.abo.fi/~mhotokka/mhotokka/lecturenotes/sm.html
3. http://www-f1.ijs.si/~vilfan/SM/cont.html
4. http://web.mit.edu/8.334/www/lectures/
5. http://cs.physics.sunysb.edu/verbaarschot/html/lectures/phy306-05/notes.html

SUB CODE:PH32

Paper 8 : NUCLEAR AND PARTICLE PHYSICS
(CORE COURSE, SECOND YEAR, THIRD SEMESTER, 4 CREDITS)

Unit 1 – Nuclear interactions

Nucleon-nucleon interaction – Tensor forces – Meson theory of nuclear forces – Yukawa potential – Nucleon-Nucleon scattering – Effective range theory – Spin dependence of nuclear forces – Charge independence and charge symmetry of nuclear forces – Isospin formalism

Unit 2 – Nuclear reactions

Types of reactions and conservation laws – Energetics of nuclear reactions –Dynamics of nuclear reactions – Q-value equation – Scattering and reaction cross sections – Compound nucleus reactions – Direct reactions – Resonance scattering – Breit-Wigner one level formula

Unit 3 – Nuclear Models

Liquid drop model – Bohr-Wheeler theory of fission – Experimental evidence for shell effects – Shell model – Spin-orbit coupling - Magic numbers – Angular momenta and parities of nuclear ground states – Qualitative discussion and estimate of transition rates – Magnetic moments and Schmidt lines – Collective model of Bohr and Mottelson

Unit 4 – Nuclear decay

Beta decay – Fermi theory of beta decay – Shape of the beta spectrum – Total decay rate - Mass of the neutrino – Angular momentum and parity selection rules – Allowed and forbidden decays – Comparative half-lives – Neutrino physics – Non-conservation of parity – Gamma decay – Multipole transitions in nuclei – Angular momentum and parity selection rules – Internal conversion – Nuclear isomerism

Unit 5 – Elementary particle physics

Types of interaction between elementary particles – Hadrons and leptons – Symmetries and conservation laws – Elementary ideas of CP and CPT invariance – Classification of hadrons – SU(2) and SU(3) multiplets – Quark model - Gell-Mann-Okubo mass formula for octet and decuplet hadrons – Charm, bottom and top quarks

BOOKS FOR STUDY

1. K. S. Krane, 1987, Introductory Nuclear Physics, Wiley, New York.
2. D. Griffiths, 1987, Introduction to Elementary Particle Physics, Harper & Row, New York.
3. R. R. Roy and B.P. Nigam, 1983, Nuclear Physics, New age Intl. New Delhi.

BOOKS FOR REFERENCE:

1. H. A. Enge, 1983, Introduction to Nuclear Physics, Addison-Wesley, Tokyo
2. Y. R. Waghmare, 1981, Introductory Nuclear, Physics, Oxford-IBH, New Delhi.
3. Ghoshal, Atomic and Nuclear Physics, Vol. 2
4. J. M. Longo, 1971, Elementary particles, McGraw-Hill, New York.
5. R. D. Evans, 1955, Atomic Nucleus, McGraw-Hill, New York.
6. I. Kaplan, 1989, Nuclear Physics, Narosa, New Delhi
7. B. L. Cohen, 1971, Concepts of Nuclear Physics, TMH, New Delhi
8. M. K. Pal, 1982, Theory of Nuclear Structure, Affl. East-West, Chennai.
9. W. E. Burcham and M. Jobes, 1995, Nuclear and Particle Physics, Addison-Wesley, Tokyo.

WEB SITES

1. http://ocw.mit.edu/OcwWeb/Physics/8-701Spring 2004/Lecture notes
2. http://faraday.physics.utoronto.ca/General Interest/D.Bailey/SubAtomic/ Lectures/ Lect.html

Books for Reference:

5. S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis-an algorithmic approach, 3 rd Edition, McGraw Hill,)
6. B. F. Gerald, and P. O. Wheatley, 1994, Applied Numerical analysis, 5^{th} Edition., Addison-Wesley, MA.
7. B. Carnagan, H. A. Luther and J. O. Wilkes, 1969, Applied Numerical Methods, Wiley, New York.
8. S. S. Kuo, 1996, Numerical Methods and Computers, Addison-Wesley.

WEB SITES

1.http://www.sst.ph.ic.ac.uk/angus/Lecturs/compphys/comphys.html
2.http://www.library.cornell.edu/nr (numerical recipes online book on C & FORTRAN)

SUB CODE:PH3A

PRACTICAL III

COMPUTATIONAL METHODS – FORTRAN / C PROGRAMMING
(CORE COURSE, SECOND YEAR, THIRD SEMESTER, 4CREDITS)

All TWELVE experiments:

Determination of zeros of polynomials (Tables of Legendre, Laguerre, Hermite & Chebyshev polynomials should be provided during the Practical examination)

Bisection method / Newton-Raphson method

1. Zeros of the Legendre Polynomials $P_n(x)$ (or roots of the equation $P_n(x) = 0$ or nodes of the Gauss-Legendre quadrature), $2 \leq n \leq 6$, with Algorithm, Flow-chart, C PROGRAM, and output.

2. Zeros of the Laguerre Polynomials $L_n(x)$ (or roots of the equation $L_n(x) = 0$ or nodes of the Gauss-Laguerre quadrature), $2 \leq n \leq 6$, with Algorithm, Flow-chart, C PROGRAM, and output.

3. Zeros of the Hermite Polynomials $H_n(x)$ (or roots of the equation $H_n(x) = 0$ or nodes of the Gauss-Hermite quadrature), $2 \leq n \leq 6$, with Algorithm, Flow-chart, C PROGRAM, and output.

4. Zeros of the Chebyshev Polynomials $T_n(x)$ (or roots of the equation $T_n(x) = 0$ or nodes of the Gauss-Chebyshev quadrature), $2 \leq n \leq 6$, with Algorithm, Flow-chart, C PROGRAM, and output.

5. Lagrange interpolation with Algorithm, Flow-chart, C PROGRAM, and output.

6. Newton forward interpolation with Algorithm, Flow-chart, C PROGRAM, and output.

7. Newton backward interpolation with Algorithm, Flow-chart, C PROGRAM, and output.

8. Curve-fitting: Least-squares fitting with Algorithm, Flow-chart, C PROGRAM, and output.

9.Numerical integration by the trapezoidal rule, with Algorithm, Flow-chart, C PROGRAM, and output.

10.Numerical integration by Simpson’s rule, with Algorithm, Flow-chart, C

. PROGRAM, and output

11.Numerical solution of ordinary first-order differential equations by the

Euler method, with Algorithm, Flow-chart, C PROGRAM, and output.

12.Numerical solution of ordinary fourth-order differential equations by the Runge- Kutta method, with Algorithm, Flow-chart, C PROGRAM, and output.

SUB.CODE:EPA34/EPA33

ELECTIVE II: NANOSCIENCE AND TECHNOLOGY

(ELECTIVE COURSE, SECOND YEAR, THIRD SEMESTER, 4 CREDITS)

UNIT 1: INTRODUCTION TO NANOTECHNOLOGY

Introduction to nano structured materials- Size dependent property of Nanostructures- Types of Bonds- Covalent- Coordinate- Vanderwaal's and Hydrogen Bonds- Polymers- Ceramics- Biosystems- Molecular recognition.

UNIT 2: SYNTHESIS OF NANOCRYSTALS

Top down and bottom up processes - Quantum dots, quantum wire and quantum well – principles- quantum confinement of electrons in semiconductor nano structures- synthesis- Electronic structure of Nanocrystals- Applications- Single electron devices- Nano MOSFET- Heterogeneous Nano structures.

UNIT 3: CARBON NANOTUBES AND SELF ASSEMBLED MONO LAYERS

Carbon Nanotubes- synthesis- Mechanism of Growth- electronic structure- Properties- Applications- Self assembled monolayers- Growth process- Phase transitions-monolayers- Applications

UNIT 4: TOOLS OF NANOTECHNOLOGY

SEM, TEM, STM, AFM and Nano Lithography: E- Beam Lithography, Dip pen Lithography, Nano liftoff Lithography- Optical Microscopy: confocal Microscopy, Scanning Near Field Optical Microscopy- X Ray diffraction- Clean Room- Clean Room Practices

UNIT 5: NANOSCIENCE IN HEALTH CARE

Introduction to Nano Biology- Biological Imaging- Immuno fluorescent Biomarker- Imaging- Immunogold labeling- Diagnostic applications of Immuno targeted nano particles- Targeted Drug delivery- Materials for use in diagnostic and therapeutic applications: Gold Nano particle, Quantum dot and Magnetic nano particle.

BOOKS FOR STUDY AND REFERENCE:

1.Mark Ratner and Daniel Ratner, Nanotechnology Pearson Education, Indian Branch, New Delhi.
2.Branda paz, A Handbook of Nanoelectronics, Dominant Publishers and Distributors, New Delhi.
3.T. Pradeep, Nano:The essentials, Tata Mcgraw hill Publishing Co. Ltd., New Delhi

WEBSITES

http://nanotechnow.com/naotechnologybasics.com/nanotechnologylinks.com/nononet.rice.edu

SUB CODE: NPH32

NON MAJOR ELECTIVE PAPER II(OFFERED TO OTHER DEPARTMENTS- 3 CREDITS)

BASICS OF NANOSCIENCE AND TECHNOLOGY

UNIT 1:Introduction to Nanotechnology

Introduction to nano structured materials- Size dependent property of Nanostructures- Polymers- Ceramics- Biosystems- Molecular recognition.

UNIT 2:Different forms of Nanostructures

Nanowire, Nanotubes, Nanorods, Nanobelt, Nanocombs, Nanoeye, Nanoclock, Nanolaser and Nanoskin (defintions and uses)-Quantumdot, production and applications.

UNIT 3: Tools of Nanoscience

SEM- AFM-TEM-Nanolithography: Dip pen lithography

UNIT 4: Nanoscale Crystal growth

Nucleation kinectics- Nanoscale growth:Top down approach –milling- bottom up approach.

UNIT 5: Nano in Healthcare

Applications of Nano in Biology-Biological imagining: Using semiconductor Nanocrystals-Immuno fluorescent Bio marker imagining- Immunogold labeling-Targeted drug delivery using Nanoparticles

BOOKS FOR STUDY AND REFERENCE:

Mark Ratner and Daniel Ratner, Nanotechnology Pearson Education, Indian Branch, New Delhi.
Branda paz, A Handbook of Nanoelectronics, Dominant Publishers and Distributors, New Delhi.
T. Pradeep, Nano:The essentials, Tata Mcgraw hill Publishing Co. Ltd., New Delhi

WEBSITES

http://nanotechnow.com/naotechnologybasics.com/nanotechnologylinks.com/nononet.rice.edu

SUB CODE:PH41

Paper 10 : CONDENSED MATTER PHYSICS
(CORE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

UNIT 1: Crystal Physics

Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures – Atomic Packing Factor- Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc) – Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).

UNIT 2: Lattice Dynamics

Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umkalapp processes.

UNIT 3: Theory of Metals and Semiconductors

Free electron gas in three dimensions - Electronic heat capacity - Wiedemann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration – Temperature Dependence - Mobility - Impurity conductivity – Impurity states - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies - de Hass-van Alphen effect .

UNIT 4: Magnetism

Diamagnetism - Quantum theory of paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.

UNIT 5: Superconductivity

Experimental facts: Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors.

Theoretical Explanation: Thermodynamics of super conducting transition - London equation - Coherence length – Isotope effect - Cooper pairs - BCS Theory - Single
particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors - SQUIDS.

BOOKS FOR STUDY:

1. C. Kittel, 1996, Introduction to Solid State Physics, 7th Edition, Wiley, New York.
2. M. Ali Omar, 1974, Elementary Solid State Physics - Principles and Applications, Addison - Wesley
3. H. P. Myers, 1998, Introductory Solid State Physics, 2nd Edition, Viva Book, New Delhi.

BOOKS FOR REFERENCE:

1. N. W. Aschroft and N. D. Mermin, Solid State Physics, Rhinehart and Winton, New York.
2. J. S. Blakemore, 1974 , Solid state Physics, 2nd Edition, W.B. Saunder, Philadelphia
3. A. J. Dekker, Solid State Physics, Macmillan India, New Delhi.
4. H. M. Rosenburg, 1993, The Solid State, 3rd Edition, Oxford University Press, Oxford.
5. S. O. Pillai, 1997, Solid State Physics, New Age International, New Delhi.
6. S. O. Pillai, 1994, Problems and Solutions in Solid State Physics, New Age International, New Delhi.
7. S. L. Altmann, Band Theory of Metals, Pergamon, Oxford.
8. J. M. Ziman, 1971, Principles of the Theory of Solids, Cambridge University Press, London.
9. C. Ross-Innes and E. H. Rhoderick, 1976, Introduction to Superconductivity, Pergamon, Oxford.
10. M. Tinkham, Introduction to Superconductivity, McGraw-Hill, New York.
11. J. P. Srivastava, 2001, Elements of Solid State Physics, Prentice-Hall of India, New Delhi.

WEB SITES

1. http://www.physics.brocku.ca/courses/4p70/
2. http://www.physics.brocku.ca/courses/4p70/
3. http://web.mit.edu/afs/athena/course/6/6.732/www/texts.html
4. http://jas.eng.buffalo.edu/education/semicon/fermi/functionAndStates/functionAndStates.html
5. http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html
6. http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html

SUB CODE:PH4A

PRACTICAL IV
(CORE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

ANY TWO PARTS OUT OF PARTS A, B and C

Part – A – Microprocessor 8086 & Microcontroller 8051
(Compulsory for those who take the Elective : Microprocessor and Microcontroller)

External Examination: 4 hrs., Marks:30 (5 marks for record & 25 marks for experiment)

Any SIX Experiments:

Microprocessor 8086 programs using MASM:

1. Addition & subtraction
2. Multiplication & division
3. Multibyte addition & subtraction
4. Sorting in ascending & descending order
5. Generation of Fibonacci series

Microcontroller 8051 Experiments:

6. Addition & subtraction
7. Multiplication & division
8. Sorting in ascending & descending order
9. LED interface
10. Stepper motor interface

Part – B – Advanced Experiments I
(Compulsory for those who take the Elective : Materials Science)

External Examination: 4 hrs., Marks:30 (5 marks for record & 25 marks for experiment)

Any SIX Experiments:

1. GM counter – Characteristics, inverse square law, absorption coefficient.
2. GM counter - Feather's analysis : Range of Beta rays.

3. Michelson Interferometer – Wavelength, separation of wavelengths, thickness of mica sheet.
4. Hall effect.
5. Molecular spectra – ALO band .
6. Susceptibility by Quincke's method.
7. Susceptibility by Guoy's method.
8. Ultrasonics – Compressibility of a liquid.
9. Dielectric measurements in Microwave test bench.
10. B-H curve using CRO.
11. Miscibility measurement usingUltrasound Diffraction Method
12. Conductivity measurement using four probe method.

11.Miscibility measurement

Book for Reference:

1. D. Chattopadhyay, P. C. Rakshit, and B. Saha, 2002, An Advanced Course in Practical Physics, 6th EditionBooks and Allied, Kolkata.

SUB CODE: EPA42

ELECTIVE III : MICROPROCESSOR AND MICROCONTROLLER
(ELECTIVE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

UNIT 1: 8086 Architecture

8086 Architecture – Min.Mode, Max.Mode – Software Model – Segmentation- Segmentation of address – Pipe line Processing – Interrupts in 8086 – Interrupt types and 8086 response – NMI- Internal Interrupts – Interrupt Priorities.

UNIT 2: 8086 PROGRAMMING

Addressing Modes – Instruction Set- Constructing Machine Code – Instruction Templates for MOV Instruction– Data Transfer Instructions– Arithmetic, Logic, Shift, rotate instructions- Flag Control instructions- Compare, Jump Instructions– Loop and String instructions - Assembly programs- Block move, Sorting, Averaging, Factorial – Code Conversion : Binary to BCD , BCD to Binary.

UNIT 3: Microcontroller 8051

Introduction – 8 & 16 Bit Microcontroller families –Flash series – Embedded RISC Processor – 8051 Microcontroller Hardware – Internal registers – Addressing modes – Assembly Language Programming – Arithmetic, Logic & Sorting operations.

UNIT 4: INTERFACING I/O AND MEMORY WITH 8051

Interfacing I/O Ports, External memory, Counters & Timers. Serial data input/Output, Interrupts – Interfacing 8051 with ADC, DAC, LED display, Keyboard, Sensors and Stepper motor.

UNIT 5 : EMBEDDED MICROCONTROLLER

Embedded Microcontroller system – Types of embedded Operating system – Micro Chip P1C16C6X / 7X family – features –Architecture – Memory organization –Register file map – I/O Ports – Data & Flash program memory – Asynchronous serial port –Applications in Communication and industrial Controls.

BOOKS FOR STUDY

1.Douglas V. Hall : - Microprocessors and Interfacing programming and Hardware (Tata Mc Graw Hill) (Unit 1)
2. W.A. Triebel and Avatar Singh, The 8086 /8088 Microprocessors- Programming, Software, Hardware and application, Prentice Hall of India, New Delhi. (Unit 2)
3.Kenneth J. Ayala – The 8051 Micro Controller Architecture, Programming and Applications. 3rd Edition , Penram International, (Unit
4.John B. Peatman, 2004, Design with PIC Microcontrollers, 7th Indian reprint, Pearson Education. (Unit 4 &5)

SUB CODE:EPA43

ELECTIVE 4: MATERIALS SCIENCE

(ELECTIVE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

UNIT 1: Ceramics and Composites

Structural features – production of ceramics – forming and post forming process – mechanical properties – commercial ceramic system : Si-Al system technical ceramics – Zr and Si alloys – cement and concrete – composite materials – continuous and discontinuous fibre composites.

UNIT 2: Polymers:

Classification of polymers – structural features – mechanism – thermoplastics – rubber and elastomers – physical, chemical and mechanical properties – cellular plastics – liquid crystal polymers.

UNIT 3: Dielectrics:

Electrical polarisation – mechanism of polarization – optical, molecular and interfacial polarizability – classification of dielectric materials – piezoelectric, pyroelectric and ferroelectric materials – temperature and frequency effects on dielectric materials – applications of these materials.

UNIT 4: Electronic materials:

Purification of electronic materials – single crystal growth – pulling method – wafer manufacture – oxidation – photolithography – doping technique – epitaxial growth – metallization – circuits and process simulation and integration – junction formation – junction lasers – contact formation.

UNIT 5: Magnetic materials:

Classification of magnetism – origin and size of domain structure – hard magnetic materials – permanent magnetic alloys – magnetic steels and Al-Ni / Al-Ni-Co alloys – fine particle alloys – rare earth cobalt alloys – applications of permanent magnets – soft magnets – Si-Fe and nanocrystalline magnetic metals – microwave ferrites and garnets – magnetic bubbles.

BOOKS FOR STUDY:

1. V. Raghavan, 2003, Materials Science and Engineering 4th Edition, (Printice-Hall India, New Delhi,) (for units 2, 3, 4 and 5)
2. C.M. Srivastava and C. Srinivasan, 1987, Science of engineering materials, New Age Intl, New Delhi. (for units 1, 3 and 5)
3. J. C. Anderson, K.D. Leaver, R.D. Rawlings and J.M. Alexander, 1990, Material Science, 4th Edition, Chapman & Hall. London.
4. M. Arumugam, 2002, Materials Science, 3rd Edition, Anuradha Agencies.

BOOKS FOR REFERNCE:

1. G.K. Narula, K.S.Narula and V.K.Gupta, 1988, Materials Science, Tata McGraw-Hill.
2. Lawrence H. Van Vlack, 1998, Elements of Materials Science and Engineering, 6th Edition, second ISE reprint, Addison-Wesley
3. H. Iabch and H.Luth, 2001, Solid state Physics – An introduction to principles of Material Science, 2nd Edition, Springer

SUB CODE:PRPH

PROJECT

(SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

Internal marks:

Best Two Presentations out of 3	20

External marks:

Report	60
Viva	20
Total	100

EVALUATION

Internal marks	25
External marks	75
Total	100

a) Internal marks are given as follows:

Test (CAT I & II)	5
Model exam/Midsemester	5
Attendance	5
Seminar	5
Assignment	5
Total	25

PRACTICAL

i) Internal Marks:

Best two practicals out of 3	30
Record	5
Attendance	5
Total	40
ii) External Marks	60
Total	100

QUESTION PAPER PATTERN (MAX MARKS-75)

SECTION A- (5X2=10)

ANSWER ANY 5 OUT OF 7 QUESTIONS

SECTION B (4X5=20)

ANSWER ANY 4 OUT OF 7 QUESTIONS

SECTION C (3X15=45)

ANSWER ANY 3 OUT OF 5 QUESTIONS