MSC PHYSICS
COURSE OF STUDY AND SCHEME OF EXAMINATIONS
2015-2016 ONWARDS

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

SEMESTER	NAME OF COURSE	INST. HOURS	CREDITS	EXAM. HRS	MAX MARKS	
					CIA	EXTL
II	PAPER 5-QUANTUM MECHANICS II(Revised)	5 HRS	4	3	25	75
	PAPER 6-ELECTROMAGNETIC THEORY AND PLASMA PHYSICS(Revised)	5 HRS	4	3	25	75
	PAPER 7-COMPUTATIONAL METHODS AND C PROGRAMMING(Revised)	5 HRS	4	3	25	75
	ELECTIVE I- SPECTROSCOPY (Revised)	4 HRS	3	3	25	75
	EXTRA DISCIPLINARY I- BIOINFORMATICS	3 HRS	3	3	25	75
	PRACTICAL I (General)	4HRS	4	4	40	60
	PRACTICAL II (Electronics)	4 HRS	4	4	40	60

III	PAPER 8- STATISTICAL MECHANICS(Revised)	6 HRS	4	3	25	75
	PAPER 9- NUCLEAR AND PARTICLE PHYSICS(Revised)	5 HRS	4	3	25	75
	ELECTIVE II- NANOSCIENCE AND TECHNOLOGY(Revised)	4 HRS	3	3	25	75
	ELECTIVE III- CRYSTAL PHYSICS	4 HRS	3	3	25	75
	EXTRA DISCIPLINARY II- HUMAN RESOURCE MANAGEMENT	3 HRS	3	3	25	75
	PRACTICAL III(General)	4 HRS	-	-	-	-
	PRACTICAL IV	4 HRS	-	-	-	-
IV	PAPER 10- CONDENSED MATTER PHYSICS(Revised)	6 HRS	4	3	25	75

	ELECTIVE IV- MICROPROCESSOR AND MICROCONTROLLER (Revised)	5 HRS	3	3	25	75
	ELECTIVE V- MATERIAL SCIENCE (Revised)	5 HRS	3	3	25	75
	PRACTICAL III(General)	4 HRS	4	4	40	60
	PRACTICAL IV (MICROPROCESSOR 8085 AND 8086, MICROCONTROLER AND COMPUTER EXPERIMENTS).	4 HRS	4	4	40	60
	PROJECT	6 HRS	4		20	80
		TOTAL	81			

SOFT SKILL

SEMESTER	NAME OF COURSE	SUB CODE	CREDITS	MAX. MARKS	
				CIA	EXTL.
II	ESSENTIALS OF SPOKEN AND PRESENTATION SKIL	SSA	2	20	80
	ESSENTIALS OF SPOKEN AND PRESENTATION SKILL ADVANCED LEVEL	SSB	2	20	80
III	PERSONALITY ENRICHMENT	SSC	2	20	80
IV	LIFE AND MANAGERIAL SKILL	SSD	2	20	80
INTERNSHIP (I YEAR SUMMER VACATION)		ISP	2		
TOTAL			10		

Note:
II Semester- M.Sc Physics Department Handles Basics of Nanscience and Nanotechnology for the students of M.Sc. PBPB.

III Semester- M.Sc Physics Department Handles Energy Physics for the students of M.A. HRM

Total Credits = Academic + Soft Skill
= 81 + 10
= 91

SYLLABUS
DEPARTMENT OF PHYSICS (PG)
FOR ACADEMIC YEARS 2013-2014 ONWARD

SUB CODE: PPH/CT/1001

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.
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UNIT 2: **Linear Differential Equations and Green's Function**

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

One-dimensional Green's function - Eigenfunction expansion of the Green's function - Reciprocity theorem.

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 – $C_{2v,}C_{3v.}$

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.
8. **Sathyaprakash,** Mathematical Physics, 2012,6th Edition,Sultan Chand and Sons, India.
9. **B.D.Gupta,** Mathematical Physics, 1986, Vikas publications.

BOOK FOR REFERENCE:

1. **Tulsi Dass** and **S. K. Sharma,** 1998**,** Mathematical Methods in Classical and Quantum Physics, Universities Press(INDIA), Hyderabad.

2. **S. Lipschutz,** 1987, *Linear Algebra,* Schaum's Series, McGraw - Hill, New York
3. **E. Butkov,** 1968, *Mathematical Physics* Addison - Wesley, Reading, Massachusetts.
4. **P. R. Halmos,** 1965, *Finite Dimensional Vector Spaces,* 2nd Edition, Affiliated East-West, New Delhi.
5. **M. Hamermesh,** 1962, *Group Theory and Its application to Physical Problems,* Addison Wesley, Reading.
6. **C. R. Wylie** and **L.C. Barrett,** 1995, *Advanced Engineering Mathematics,* 6th Edition, International Edition, McGraw-Hill, New York.
7. **W. W. Bell,** 1968, *Special Functions for Scientists and Engineers,* Van Nostrand, London.
8. **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: PPH/CT/1002

Paper 2: CLASSICAL MECHANICS AND RELATIVITY (REVISED)

(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.

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.
4. **G.Aruldhas,** Classical Mechanics, 2008, PHI Learning Pvt.Ltd, New Delhi, Second Printing Aug 2009.

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: PPH/CT/1003

Paper 3: QUANTUM MECHANICS - I

(REVISED)

(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.

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/

SUBCODE: PPH/CT/1004

Paper4: INTEGRATED ELECTRONICS AND MICROPROCESSOR (REVISED)

(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**

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**

Analog Integrator, differentiator – Design of analog circuits for solution of differential equation and simultaneous equations using Op-Amps.

Active filter circuits–Low Pass , High Pass, Band Pass.Butterworth Filter circuits.Timer 555–Monostatble and Astable operations.

UNIT 4: **8085, Programming and Interfacing**

Registers and flags-Instruction set-Addressing modes – Assembly language programs. Interfacing Memory and I/O – Memory system – Timing diagram for Memory READ and Memory WRITE cycles.

IN and OUT Instructions– 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-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: PPH/CT/2005

Paper 5: QUANTUM MECHANICS II

(REVISED)

(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.

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: PPH/CT/2006

Paper 6: ELECTROMAGNETIC THEORY AND PLASMA PHYSICS

(REVISED)

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

UNIT 1: **Electrostatics**

Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar co ordinates

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- 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.

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

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: PPH/CT/2007

Paper 7: COMPUTATIONAL METHODS AND PROGRAMMING 'C'

(REVISED)

(CORE COURSE, SECOND YEAR, THIRD 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– Numerical solution of ordinary differential equations – Euler and Runge Kutta methods.

UNIT 5: **PROGRAMMING WITH 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*, 5th 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: PPH/CE/2001

ELECTIVE I: SPECTROSCOPY (REVISED)

(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: 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 3: 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 4: NMR and ESR Spectroscopy

Bloch equations -Quantum theory of NMR –Steady state solutions- Design of CW NMR Spectrometer – Chemical Shift-Interpretation of proton NMR spectrum of 1-nitro propane.

Quantum Theory of ESR – Design of ESR Spectrometer – Hyperfine Structure – Triplet state study of ESR – Applications-Structural determination-Study of free radicals.

UNIT V: NQR and Mass bauer Spectroscopy

Quadrapole Nucleus-Priciple of Nuclear Quarapole resonance-Transition for axially and non axially symmetric system-NQR instrumentation-Regenerative continues wave oscillator method.

Recoilless emission and absorption-Experimental technique-source and absorber-Mossbauer Spectrometer-Isomer shift-Quadrapole interaction-Magnetic hyperfine interaction-applications.

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.
4. H.Kaur, 2009, Spectroscopy, Pragathi prakashan publication, 5th edition, meerut.

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: PPH/NE/2BN1

NON MAJOR ELECTIVE PAPER I (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 (difintions and uses)-Quantumdot, production and applications.

UNIT 3: **Tools of Nanoscience**

Construction, Principle and Working -Scanning electron microscope- Atomic force microscope- Transmission electron microscope-Nanolithography: Dip pen lithography

UNIT 4: **Nanoscale Crystal growth**

Nanoscale growth:Top down approach –milling- bottom up approach-sol-gel method.

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: PPH/CP/2001

PRACTICAL – I (At the end of I year)
(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

(GENERAL)

External Examination: 4 hrs., Marks:60 (10 marks for record & 50 marks for experiment)

Internal Examination: 40 Marks

Any **TEN** Experiments:

1. Cornu's method – Young's modulus by Elliptic fringes.
2. Young's modulus – Hyperbolic fringes
3. Stefan's constant.
4. Band gap energy - Thermistor / Semiconductor
5. Hydrogen spectrum - Rydberg's constant.
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. Determination of strain hardening coefficients.
12. Viscosity of liquid – Meyer's disc.
13. F. P. Etalon using spectrometer.
14. Arc spectrum – Iron.
15. Edser and Butler fringes – Thickness of air film.
16. B – H loop using Anchor ring.
17. Specific charge of an electron – Thomson's method.

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: PPH/CP/2002

PRACTICAL – II (At the end of I year)
(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

(ELECTRONICS)

External Examination: 4 hrs., Marks:60 (10 marks for record & 50 marks for experiment)

Internal Examination: 40 Marks

Any **SIX** 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
9. Op.amp. – solving simultaneous equations
10. Op.amp. – 4-bit D/A & A/D converters using R-2R ladder network
11. Op.amp. – active filters
12. IC 555 timer – astable & monostable multivibrator
13. IC 555 timer – Schmitt trigger
14. IC 7476 – shift register, ring counter & Johnson counter
15. Arithmetic operations using IC 7483
16. IC 7490 as scalar and seven segment display using IC 7447

Any **SIX** Experiments:

MICROPROCESSOR 8085:

1. Microprocessor 8085 – addition & subtraction of 8- & 16-bit numbers
2 .Microprocessor 8085 – multiplication (8-bit & 16-bit) & division (8-bit)
3. Sum of a set of N data (8-bit numbers)
4. Picking up the smallest & largest number in an array & sorting in ascending & descending order
5. LED interface – single LED on / off, binary, BCD, ring & Johnson Counters
6. Interfacing of seven segment display
7. Microprocessor 8085 – counter under switch control
8. D/A conversion & waveform generation using op.amp.
9.. Square & square root of 8-bit numbers
10..Code conversion (8- & 16- bit numbers) :
11.a) binary to BCD b) BCD to binary
12.Clock program – 12 / 24 hrs.
13. DAC 0800 interface & waveform generation
14. ADC using DAC & Op.amp. comparator
15. ADC 0809 interface
16 Hex keyboard interface
17. Stepper motor interface

BOOK FOR REFERENCE:

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

SUB CODE: PPH/CT/3008

Paper 7 : STATISTICAL MECHANICS (REVISED)

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

UNIT 1**: Phase Transitions**

Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics.

Order parameters - Landau theory of phase transition - Critical indices.

UNIT 2: **Statistical Mechanics and Thermodynamics**

Microcanonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics-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 (Qualitative treatment only) - 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**

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.

BOOKS FOR STUDY:

1. **S.K.Sinha** , 1990 , *Statistical Mechanic*s , 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, Mac Graw-Hill New York.

7.**B.B.Laud**, Fundamentals of Statistical Mechanics, New Age International(P) Limited,2007.

8. **J.P.Agarwal and Sathyaprakash**, Thermodynamics and Statistical Physics, 10th Edition, Pragati Publication, 1993.

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: PPH/CT/3009

Paper 8 : NUCLEAR AND PARTICLE PHYSICS (REVISED)

(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– 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– 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

SUBCODE: PPH/CE/3002

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: TOP DOWN APPROACH

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: BOTTOM UP APPROACH

Carbon Nanotubes- synthesis- Mechanism of Growth-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.
4.**Charles Poole** and Jr., Frank.J.Owens, Introduction to Nanotechnology, Illustrated, John Wiley and Sons, 2003.

WEBSITES

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

SUBCODE:PPH/CE/3003

ELECTIVE III: CRYSTAL PHYSICS

UNIT I: CRYSTAL GROWTH PHENOMENA

Nucleation- Homogeneous and Hetrogeneous nucleation-Gibbs Thomson equation for vapour-Energy of formation of a nucleus- Spherical nucleus- cylindrical nucleus- Cap shaped nucleus-Disc shaped nucleus.

UNIT II: CRYSTAL GROWTH -EXPERIMENTAL

Classification of methods of growth.

Solution growth

Solution, solubility and supersolubility-supersaturation-Methods of crystallization- slow cooling method-slow evaporation method-Temperature gradient method.

Gel growth

Principle of Gel Growth-Various types of gel-structure of gel-Importance of gel technique-Single diffusion method.

Melt growth

Growth from melt-The Bridgman and related techniques.

Epitaxial growth

Liquid phase epitaxy-Tipping technique. Vapour phase epitaxy- Principles of method and apparatus. Molecular beam epitaxy.

UNIT III: CHARECTERIZATION

Powder XRD- FTIR- UV-Visible-Thermal characterization- Micro-hardness- Etching.

UNIT IV: CRYSTAL STRUCTURE DETERMINATION

Braggs law in one dimension-Concept of reciprocal lattice-Construction of X ray diffractometer-Steps in crystal structure determination- Soft wares for structure determination and visualization-WinGX.

UNIT V: CRYSTAL STRUCTURE ANALYSIS

Conformation of Molecules – Five membered and six membered rings – Packing of molecules-Bonding in solids - Types of Bonding- Covalent bond-Ionic bond-Vanderwaals bond-Hydrogen bond- Bond order-Bond length- Bond energy-electronegativity.

BOOKS FOR STUDY AND REFERENCE

1.**Dr.P.SanthanaRaghavan and Dr.P.Ramasamy**, Crystal Growth processes and methods.

2.**Dr.P.Ramasamy and Dr. F.D. Gnanam**, UGC Summer school on Recent trends in crystal growth.

3.**D. Velmurugan**, Elementary Crystallography, MJP Publishers.

4.**Koog Holler and Crouch**, Principles of instrumentation analysis, 6^{th} edition, Thomson books/cole publications.

SUB CODE: PEL/NE/3SE2

NON MAJOR ELECTIVE II (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.

SUBCODE: PPH/CT/4010

PAPER 10: CONDENSED MATTER PHYSICS

(REVISED)

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

UNIT 1: **Crystal structure**

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.

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-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: PPH/CE/4004

ELECTIVE IV : MICROPROCESSOR AND MICROCONTROLLER(REVISED)

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

UNIT 1: **Peripheral and interfacing devices**

Interval timer (8254/8253), DMA controller-programmable peripheral interfaces-8155,8255.

UNIT 2: **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 3: **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– Code Conversion: Binary to BCD , BCD to Binary.

UNIT 4: **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 5: **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.

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: PPH/CE/4005

ELECTIVE V*:* 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.

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: PPH/CP/4003

Practical III (At the end of II year)
(CORE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

GENERAL

External Examination: 4 hrs., Marks:60 (10 marks for record & 50 marks for experiment)
Internal Examination: 40 Marks

Any **TEN** 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.
13. Solar constant – Lee's Disc
14. Solar Spectrum – Fraunhoffer lines
15. Thickness of enamel coating wire – Air wedge.
16. Measurement of Curie temperature.
17. Raman spectroscopy.
18. Impedance measurement –LCR bridge.

Book for Reference:

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

SUB CODE: PPH/CP/4004

PRACTICAL IV (At the end of II year)
(CORE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

PART – A – MICROPROCESSOR 8086, PART –B- MICROCONTROLLER 8051 & PART –C- C PROGRAMMING
(Compulsory for those who take the Elective: Microprocessor and Microcontroller)

Any **TWELVE** Experiments:

External Examination: 4 hrs., Marks:60 (10 marks for record & 50 marks for experiment)
Internal Examination : 40 Marks

Part-A- Any **FIVE** 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

Microprocessor 8086

6. Addition & subtraction
7. Multiplication & division
8. Multibyte addition & subtraction
9. Sorting in ascending & descending order
10. Generation of Fibonacci series

Part-B- Any **THREE** Experiments:

Microcontroller 8051 Experiments:

11. Addition & subtraction
12. Multiplication & division
13. Sorting in ascending & descending order
14. LED interface
15. Stepper motor interface

Part-C- Any **FOUR** Experiments:

C Programming:

16. 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.

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

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

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

21. Numerical integration by Simpson's rule, with Algorithm, Flow-chart, C PROGRAM and output

22. Numerical solution of ordinary first-order differential equations by the Euler method, with Algorithm, Flow-chart, C PROGRAM, and output.

23. Solving simultaneous equations.

SUB CODE: PPH/CR/4001

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:

CAT I	**5**
CAT II	**5**
Model exam/Midsemester	**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)

*****ONE QUESTION IN EACH UNIT IS MANDATORY FOR ALL THE THREE SECTION OF THE QUESTION PAPER.**

SECTION A (10X2=20)

ANSWER ANY 10 OUT OF 12 QUESTIONS

SECTION B (5X5=25)

ANSWER ANY 5 OUT OF 7 QUESTIONS

SECTION C (3X10=30)

ANSWER ANY 3 OUT OF 5 QUESTIONS

NON MAJOR ELECTIVE
(For post graduate students of other departments admitted from the year 2015-2016)
(Candidates admitted during the academic year 2014-2015)
LOGIC GATE AND MICROPROCESSOR

4 hours/week
Credits: 3

OBJECTIVE: To impart practical working knowledge of Logic gate and Microprocessor 8085 to the students.

Internal - 40 marks Practical - 60 marks

1. Study of Logic Gates- AND, OR, NOT gate.
2. Study of Logic Gates- NAND, NOR, EX-OR gate.
3. NAND gate as universal gate.
4. NOR gate as universal gate.
5. Microprocessor – 8085 – 8 bit Addition
6. Microprocessor – 8085 – 8 bit Subtraction
7. Microprocessor – 8085 – 8 bit Multiplication
8. Microprocessor – 8085 – 8 bit Division
9. Microprocessor – 8085 – Sorting of given set of numbers in ascending order
10. Microprocessor – 8085 – Sorting of given set of numbers in descending order