St. PETER'S UNIVERSITY

St. Peter's Institute of Higher Education and Research
(Declared under section 3 of UGC Act 1956)
Avadi, Chennai – 600 054.

M.Sc. (PHYSICS) PROGRAMME

(Full Time)

(I to IV SEMESTERS)

REGULATIONS AND SYLLABI

REGULATIONS – 2014

(With a retrospective amendment in the credits from the batch of students admitted in 2014-15)

M.Sc. PHYSICS

Regulations -2014

(Effective from the Academic Year 2014-'15)

(With a retrospective amendment in the credits from the batch of students admitted in 2014-15)

1. **Eligibility:** Candidates who passed B.Sc. (Physics) degree examination of this University or an examination of other University accepted as equivalent thereto are eligible for admission to Two Year M.Sc. Programme in Physics.

2. **Duration**: Two year comprising 4 semester. Each semester has a minimum 90 working days with a minimum of 5 hours a day and a minimum of 450 hours per semester. Candidates who have completed the duration of the programme of study are permitted to appear for the arrear subjects examinations, if any within two year after the duration of the programme.

3. **Medium:** English is the medium of instruction and examination.

4. **Weightage for Continuous and End Assessment:** The weightage for Continuous assessment (CA) and End Assessment (EA) be 25: 75 unless the ratio is specifically mentioned in the scheme of Examinations. The Question Paper is to be set for a maximum of 100 Marks.

5. **Choice Based Credit System:** Choice Based Credit system is followed with one credit equivalent to one hour for a theory paper and two hours for a practical per week in a cycle of 18 weeks (that is, one credit is equal to 18 hours for each theory paper and one credit is equal to 36 hours for a practical in a semester) in the Time Table. The total credits for the programme (4 semesters) is 90.

6. **Scheme of Examinations**

I Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
114PMPT01	Mathematical Physics	5	25	75	100
114PMPT02	Classical Mechanics & Relativity	3	25	75	100
114PMPT03	Quantum Mechanics- I	4	25	75	100
114PMPT04	Integrated circuits & Microprocessor 8085	5	25	75	100
Practical					
114PMPP01	Advanced Physics & Electronics	4	25	75	100
	TOTAL	**21**	**125**	**375**	**500**

II Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
214PMPT01	Statistical Mechanics	3	25	75	100
214PMPT02	Quantum Mechanics- II	4	25	75	100
214PMPE01	**Elective I:** Spectroscopy	4	25	75	100
214PMPE02	**Elective II :**Materials Synthesis & Characterization	4	25	75	100
214PMPE03	**Elective III :** Medical Physics	4	25	75	100
Practical					
214PMPP01	Advanced Physics & Microprocessor 8085	4	25	75	100
	TOTAL	**23**	**150**	**450**	**600**

III Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
314PMPT01	Electromagnetic Theory & Plasma Physics	4	25	75	100
314PMPT02	Nuclear & Particle Physics	4	25	75	100
314PMPT03	Computational Methods & Programming	4	25	75	100
314PMPE01	**Elective IV-** Microcontroller & Interfacing Techniques	4	25	75	100
314PMPE02	**Elective- V -** Lasers and Applications	4	25	75	100
Practical					
314PMPP01	Advanced Physics and Computational Methods	3	25	75	100
	TOTAL	**23**	**150**	**450**	**600**

IV Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
414PMPT01	Condensed Matter Physics	4	25	75	100
414PMPE02	**Elective VI** - Nano Science & Applications	4	25	75	100
414PMPE04	**Elective VII-** Energy Physics	4	25	75	100
Practical					
414PMPP01	Advanced Physics and Microcontroller	3	25	75	100
414PMPP02	Project	8	25	65	100
	Viva Voce			10	
	TOTAL	**23**	**125**	**375**	**500**

List of Electives

S.No.	Code No.	Subject	Credit
1.	.14PMPE01	Spectroscopy	4
2.	.14PMPE02	Materials Synthesis & Characterization	4
3.	.14PMPE03	Medical Physics	4
4.	.14PMPE04	Microcontroller & Interfacing Techniques	4
5.	.14PMPE05	Lasers and Applications	4
6.	.14PMPE06	X-Ray Crystallography & Bio Physics	4
7.	.14PMPE07	Nano Science & Applications	4
8.	.14PMPE08	Advanced Materials	4
9.	.14PMPE09	Energy Physics	4
10.	.14PMPE10	Ultrasonics & Applications	4
11.	.14PMPE11	Geo Physics	4

7. **Passing Requirements:** The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it is specifically mentioned in the Scheme of Examination.

8. **Grading System:** Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA) = $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

= $\frac{\sum (CA+EA)\, C}{\sum C}$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

= (CA+EA)C

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. **Pattern of the Question Paper for Theory Subjects:** The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

   Part A: 10 questions (with equal distribution to all units in the syllabus). Each question carries 2 marks.

   Part B: 5 questions with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks.

10. **Effective Period of Operation for the Arrear Candidates:** Two Year grace period is provided for the candidates to complete the arrear examination, if any.

Registrar

11.Syllabus

I Semester

114PMPT01 - MATHEMATICAL PHYSICS

Unit 1: Vector analysis

Concept of vector and scalar fields – Gradient, divergence, curl and Laplacian – Vector identities– Line integral, surface integral and volume integral – Gauss theorem, Green's Theorem, Stoke'stheorem and applications – Orthogonal curvilinear coordinates – Expression for gradient,divergence, curl and Laplacian in cylindrical and spherical co-ordinates - Definitions – Linear independence of vectors – Schmidt's orthogonalisation process – Schwartz inequality.

Unit 2: Tensors and Matrix Theory

Transformation of coordinates – Summation convention – Contravariant, covariant and mixed tensors – Rank of a tensor – Symmetric and anti symmetric tensors – contraction of tensor –Charateristic equation of a matrix – Eigen values and eigenvectors – Cayley – Hamilton theorem-Reduction of a matrix to diagonal form – Jacobi method – Sylvester's theorem.

Unit 3: Complex Analysis

Functions of complex variables – Differentiability -- Cauchy-Riemann conditions – Complexintegration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series –Residues and singularities - Cauchy's residue theorem – Evaluation of definite integrals.

Unit 4: Special Functions

Gamma and Beta functions – Sturm- Liouville problem – Legendre, Associated Legendre, Bessel, Laugerre and Hermite differential equations : series solution – Rodriguez formula – Generating functions – Orthogonality relations – Important recurrence relations.

Unit 5: Group Theory

Definition of groups, subgroups and conjugate classes - Symmetry elements, Transformation, Matrix representation - Point groups - representation of a group - Reducible and irreducible representations - Orthogonality theorem - character of a representation - character Table C_{2v} and C_{3v} - Application to Infrared and Raman active vibrations of XY_2 and XY_3 type molecules - Projection operators – Construction of symmetry coordinate for XY_2bent symmetric type molecule

Books for Study:

1. A.W. Joshi, Matrices and Tensors in Physics, Wiley Eastern Ltd., New Delhi (1975)
2. Eugene Butkov, Mathematical Physics, Addison Wesley, London (1973)
3. L.A.Pipes and L.R. Harvill, Applied Matematics for Engineers and Physcists, McGraw Hill Company, Signgapore (1967)
4. P.K.Chattopadhyay, Mathematical Physics, Wiley Eastern Ltd., New Delhi (1990)
5. A.K. Ghattak, T.C.Goyal and S.J. Chua, Mathematical Physics, Macmillan, New Delhi (1995)
6. G.Arfken and H.J.Mathemattical Methods for Physicists, 4th ed. *Physicists* (Prism Books, Banagalore, 1995).
7. M.D.Greenberg, Advanced Engineering Mathematics, 2nd ed. International ed., Prentice – Hall International, NJ, (1998)
8. E.Kreyszig, Advanced Engineering Mathematics, 8th ed. Wiley, NY (1999)
9. W.W.Bell, *Special Functions for Scientists and Engineers* (Van Nostrand, New York, 1968).
10. A.W. Joshi, *Elements of Group Theory for Physicists* (Wiley Eastern, New Delhi, 1971).
11. F.A. Cotton, *Chemical Applications of Group Theory* (Wiley Eastern, New Delhi, 1987).
12. H.Goldstein, Classical Mechanics, Narosa Book distributors, New Delhi (1980)
13. N.C.Rana and P.S.Joag Classical Mechanics, Tata Mc: Graw Hill, New Delhi (1991)

Books for reference:

1. P.R. Halmos, Finite Dimensional Vector Spaces, 2ndEd. (Affiliated East-West, New Delhi, 1965).
2. M. Hamermesh, Group Theory and Its application to Physical Problems (Addison Wesley)
3. C.R. Wylie and L.C. Barrett, Advanced Engineering Mathematics, 6th Ed., International Ed. (McGraw-Hill,NY, 1995).
4. P.K. Chakrabarti and S.N. Kundu, A Text Book of Mathematical Physic (New Central Book Agency,Kolkata, 1996).
5. A.K. Ghatak, I.C. Goyal and S.J. Chua, MathematicalPhysics (Macmillan India, New Delhi, 2002).
6. W.W. Bell, Special Functions for Scientists andEngineers, (Van Nostrand, London, 1968).
7. M.A. Abramowitz and I. Stegun (Editors), Handbook ofMathematical Functions (Dover, Ny, 1972).
8. R.P. Feynman, R.B. Leighton, and M. Sands, TheFeynman Lectures on Physics, Vols. 1, 2 and 3 (Narosa,New Delhi, 1998).

114PMPT02 - CLASSICAL MECHANICS & RELATIVITY

Unit I: Lagrangian and Hamiltonian Formulations
Hamiltonian variation 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 II: Mechanics of Rigid body
Rigid body motion-Kinematics-Euler angles-Infinitesimal rotations-Rate of change of a vector- Carioles force Dynamics-Angular moment a and kinetic energy-Moment of inertia tensor-Euler's equation of motion –Torque free motion-Symmetrical top.

Unit III: 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- Applications of harmonic oscillator problem.

Unit IV: Small Oscillations
Formulation of the problem- Transformation of normal co ordinates- Frequencies of normal modes- Linear tri atomic molecule.

Unit V: Relativity
Lorentz transformations- 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, Classical Mechanics, 3rd Ed., C. Poole and J. Safko (Pearson Eduction Asia, New Delhi, 2002).
2. T.W.B. Kibble, Classical Mechanics.
3. R. Resnick, Introduction to Special Theory of Relativity.

Books for reference:
1. L.D. Landau and E.M. Lifshitz, Mechanics.
2. K.R. Symon, Mechanics.
3. J.L. Synge and B.A. Griffith, Principles of ClassicalMechanics.
4. S.N. Biswas, Classical Mechanics (Books and Allied,Kolkata, 1999).0

114PMPT03 - QUANTUM MECHANICS I

Unit I: Basic Formalism
Interpretations and conditions on the wave function- Postulates of quantum mechanics and the Schrodinger Equation- Ehrenfest's theorem- Stationery states- Hermitian operators for dynamic variables- Eigen values and eigen functions- Uncertainty principle.

Unit II: One Dimensional Problem 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 III: General Formalism
Hilbert space- Dirac notation- Representation theory- co-ordinate momentum representations- Time evolution- Schrodinger , Heisenberg and Interaction pictures- Symmetries and conservation laws- Unitary transformations associated with translations and rotations- Parity and time reversal.

Unit IV: 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 V: Angular Momentum and Identical Particles
Eigen value 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, A Text Book of Quantum Mechanics.
2. L.I. Schiff, Quantum Mechanics, 3rd edition.

Books for reference:
1. E. Merzbacher, Quantum Mechanics (Second edition).
2. V.K. Thankappan, Quantum Mechanics, 2nd Edition.
3. J.L. Powell and B. Crasemann, Quantum Mechanics.
4. P.A.M. Dirac, The Principles of Quantum Mechanics.

114PMPT04 - INTEGRATED CIRCUITS AND MICROPROCESSOR 8085

Unit I: Linear ICs and Applications
Operational amplifier- Solution of simultaneous equations and differential equations- Instrumentation amplifier- Log and Antilog amplifiers- Analog multiplication and division- Generation of square, triangular and sine waves- Pulse generation- Schmitt trigger- Active filters (Second order Butter worth design)- Timer %%%- Internal Architecture and working – Astable and constable multi vibraotrs - Phase Locked Loops.

Unit II: Data counters
Binary weighted and R/2R ladder DAC- Accuracy and resolution- Dual slope DAC-ADC- Simultaneous conversion- Counter method- Successive approximation.

Unit III: Combinational and Sequential Logic Circuits
4-bit binary adder and subtractor- Encoder and decoder- Multiplexer and demultiplexer – Flip Flops- RS, D-type, JK and M/S JK Flip flop, Counters- Asynchronous, synchronous an Modulus counters- BCD counters- Shift registers- Ring counter- Johnson counter.

Unit IV: 8085 Programming, Peripheral Devices and their Interfacing
Instruction set- Adressing modes- Programming techniques- Memory mapped I/O scheme- I/O mapped I/O scheme- Memory and I/O interfacing- Data transfer schemes- Interrupts of 8085- Programmable pheripheral interface (PPI)- Control group and control word- Programmable DMA controller- Programmable interrupt controller – programmable communication interface- Programmable counter /interval timer.

Unit V: 8085 Interfacing Applications
Seven segment display interface- Interfacing of Digital to Analog converter and Analog to Digital converter- Stepper motor interface- Measurement of electrical quantities –Voltage and current) Measurement of physical quantities(Temperature an strain).

Books for Study:
1. R.S. Gaonkar, 1997, Microprocessor Architecture, programming and Application with the 8085, 3rd Edition, Penram International Publishing, Mumbai.
2. V. Vijayendran, 2002, Fundamentals of Microprocessor – 8085 - Architecture, Programming and interfacing, Viswanathan Publication, Chennai.

Books for Reference:
1. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai publications, New Delhi.
2. R. Theagarajan, S. Dhanasekaran and S. Dhanapal, Microprocessor and its applications, New Age International, New Delhi.

Practical

114PMPP01 - ADVANCED PHYSICS & ELECTRONICS

(Any FIVE)

1. Cornu's Method- Young's Modulus and Poison's ratio by elliptic fringes.
2. Stefan's Constant
3. Band gap energy- Thermistor
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. FP Etalon
9. Laser Experiments: Study of Laser beam parameters.
10. Arc spectrum: Copper

Electronic and Microprocessor 8085 (Any TEN)

1. FET CS amplifier- design, Frequency response, input impedance, output impedance
2. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
3. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
4. Designs of Schmitt trigger circuit using IC 741 for a given hysteresis- application as squarer.
5. Design of square wave oscillator using IC741- Triangular wave oscillator using IC 741- Triangular wave oscillator
6. Construction of pulse generator using the IC 741 – application as frequency divider
7. Op-Amp- 4 bit Digital to Analog converter (R/2R ladder network)
8. Study of R-S, clocked R-S and D-Flip flop using NAND/NOR gates
9. Study of J-K, D and T flip flops using IC 7476/7473
10. Arithmetic operations using IC 7483- 4 bit binary addition and subtraction.
11. IC 7490 as scalar and display using IC7447
12. 8-bit addition and subtraction, multiplication and division
13. Sum of a set of N data (8 bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending order.
14. Code conversion (8 bit number):a) Binary to BCD b) BCD to binary.
15. Addition to multi byte numbers, Factorial
16. Clock program- 12/24 hours.
17. LED interface – single LED on/off, binary, BCD, ring and Johnson counters.

II SEMESTER

214PMPT01 - STATISTICAL MECHANICS

Unit I: 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 II: Statistical Mechanics and Thermodynamics
Foundations of statistical mechanics- Specifications of states of a system- Micro canonical ensemble **–** Phase space-Entropy- Connection between statistics and thermodynamics- Entropy of an ideal gas using the micro canonical ensemble- Entropy of mixing and Gibb's paradox.

Unit III: Canonical and Grand canonical Ensemble
Trajectories and density states- Liouville's theorem- Canonical and Grand canonical Ensembles- Partition function- Calculation of statistical quantities- Energy and density fluctuations.

Unit IV: Classical and quantum Statistics
Density matrix- Statistics of ensembles- Statistics of indistinguishable particles- Maxwell-Boltzmann statistics- Fermi Dirac statistics- Ideal Fermi gas- Degeneracy- Bose- Einstein statistics- Plank radiation formula- Ideal Bose gas- Bose- Einstein condensation.

Unit V: Real Gas, Ising Model and Fluctuations
Cluster expansion for a classical gas- Virial equation of state- Calculation of the first virial coeffeicient in the cluster expansion- Ising Model- Mean- field of the ising model in three, two and one dimensions- Exact solutions in one dimension. Correlation of space time dependent fluctuations- Fluctuations dissipation theorem- The Fokker-Plank equation.

Books for study:
1. F. Reif, Fundamentals of Statistical and ThermalPhysics.
2. B.K. Agarwal and M. Eisner, Statistical Mechanics,Second Edition (New Age International, New Delhi,1998).
3. C. Kittel, Thermal Physics.
4. M.K. Zemansky, Heat and Thermodynamics.
5. K. Huang, Statistical Mechanics.

Books for reference:
1. R.K. Pathira, Statistical Mechanics.
2. L.D. Landau and E.M. Lifshitz, Statistical Physics.
3. J.K. Bhattarcharjee, Statistical Mechanics : AnIntroductory Text.
4. W. Greiner, L. Neise and H. Stoecker, thermodynamics and Statistical Mechanics.

214PMPT02 - QUANTUM MECHANICS II

Unit I: Scattering Theory
Scattering amplitude- Cross sections- Born approximation- Partial Wave analysis- Effective range theory for S –Wave- Transformation from center of mass to laboratory frame.

Unit II: 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 radiations- Selection rule for dipole radiation.

Unit III: Relativistic Quantum Mechanics
Klein- Gordon Equation- Dirac Equation- Plane –Wave Solutions- Interpretation of negative energy states- Anti particles – Spin of electron - Magnetic moment of an electron due to spin- Energy values in a coulomb potential.

Unit IV: Dirac Equations
Covariant form of Dirac equations- Properties of the gamma Matrices- traces- Relativistic invariance of Dirac Equations- Probability density- Current four vector- Bilinear covariant- Feynman's theory of positron (Elementary ideas only without propagation formalism).

Unit V: Second Quantization
Second Quantization of Klein- Gordon field- Creation and annihilation operators- Commutations relations-Quantization of electromagnetic field- Creation and annihilation operators-Commutations 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, McGraw-Hill,Kogakusha, Tokyo.
3. E. Merzbacher, 1970, Quantum Mechanics, 2nd Edition, John Wiley and Sons. New York.

Books for reference:
1. J.D. Bjorken and S.D. Drell, Relativistic QuantumMechanics.
2. J.L. Powell and B. Craseman,Quantum Mechanics.
3. P.A.M. Dirac, The Principles of Quantum Mechanics.
4. L.D. Landau and E.M. Lifshitz, Quantum Mechanics.
5. S.N. Biswas, Quantum Mechanics (Books and Allied,Kolkata, 1999).
6. A. Ghatak, Basic Quantum Mechanics (Macmillan India,New Delhi, 2002).
7. R.P. Feynman, R.B. Leighton, and M. Sands, The Feynman Lectures on Physics, Vols.1, 2 and 3 (Narosa)

Practical

214PMPP01 - ADVANCED PHYSICS AND MICROPROCESSOR 8085

Advanced Physics (Any FIVE)

1. Cornu's Method – Young's modulus and Poisson's ratio by Hyperbolic fringes.
2. Determination of strain hardening coefficient.
3. Viscosity of liquid – Meyer's disc.
4. LG Plate.
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. e/m by Millicon's method.

Part – 2B : Microprocessor 8085 (Any TEN)

1. Design of UJT relaxation oscillator for a frequency – Generation of positive and negative triggering pulses.
2. Solving simultaneous equations – IC 741 / IC LM324.
3. Op-Amp –Active filters : Low pass, High pass and Band pass filters (Second Order).
4. Construction of square wave generator using IC 555 – Study of VCO.
5. Design of Schmitt trigger circuit using IC555 for a given hysteresis – Application as squarer.
6. Construction of pulse generator using the IC 555 – Application as frequency divider.
7. IC 7476 / IC7473 – Study of binary up / down counters
8. IC 7476 – Shift register, ring counter and Johnson counter (twisted ring counter).
9. Interfacing of seven segment display.
10. Interfacing R / 2R ladder DAC (IC 741) – Wave form generation.
11. DAC 0800 interface and wave form generation.
12. ADC 0809 interface.
13. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action.
14. Interfacing of Temperature Controller and Measurement
15. Water level detector.

III Semester

314PMPT01 - ELECTROMAGNETIC THEORY AND PLASMA PHYSICS

Unit 1: Electrostatics
Boundary value problems and Laplace equation – Boundary conditions and uniquess 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 localized 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 magnetized 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 Boltzman Equation – Simplified magneto-hydrodynamic equations – Electron plasma oscillations – The Debye shielding problem – Plasma confinement in a magnetic field – Magneto-hydrodynamic waves – Alfen 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, London.
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,m 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.html
4. http://dmoz.org/Science/Physics/Electromagnetism/Courses and Tutorials/

314PMPT02 - NUCLEAR AND PARTICLE PHYSICS

Unit 1 – Nuclear Interactions
Nuclean-nucleon interaction- Tensor forces Meson theory of nuclear forces Yukawa potential – Nucleon scattering- Effective range theory- Spin dependence of nuclear forces – Charge independence and charge symmetry of nuclear forces – Isospin formalism.

UNIT 2 – Nuclear reaction:
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-wignerone 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) multiples – Quark model – Gell-Okubo mass formula for octet and decuplet hadrons – Charm, bottom and top quarks.

Books for study:

1. **K. S. Kranc**, 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/Ocw Web/physics/8-701Spring 2004/Lecture notes
2. http://faraday.physics.utoronto.ca/General Interest/D.Bailey/Sub/AtomicLectures/Lect.html

314PMPT03 - COMPUTATIONAL METHODS AND PROGRAMMING

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 – Eigenvalues and eigenvectors of matrices – Power and Jacobi Methods.

UNIT 3: INTERPLATION AND CURVE FITING
Interpolation with equally spaced and unevenly spaced points (Newton forward and backward interpolations, Lgrange interpolation) – Curve fitting – Polynomial least – squares fitting.

UNIT 4: DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS
Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson'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 FORTRON/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, 3rd Edition. PHI, New Delhi.
2. **M. K. Jain, S. Iyengar** and **R. K. Jain**, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi.
3. **S. S. Sastry**, Introductory Methods of Numerical analysis, PHI, New Delhi.
4. **F. Scheid**, 1998, Numerical Analysis, 2nd 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, 2nd Edition, Cambridge Univ. Press
6. **W. H. Press**, **S. A. Teukolsky, W. T. Vetterling** and **B. P. Flannery**, 1992, Numerical Recipes in C, 2nd 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, 3rd 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.

WEBSITES
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)

Practical

314PMPP01 - ADVANCED PHYSICS AND COMPUTATIONAL METHODS

(Any FIVE)

1. GM counter – characteristics, inverse square law, absorption coefficient.
2. GM counter – Feather's analysis: Range of Beta rays.
3. Hall Effect.
4. Susceptibility by Quincke's method.
5. B-H curve using CRO.
6. Thermal diffusivity of brass.
7. Thermal relaxation of bulb.
8. Conductivity measurement using four probe methods.
9. Laser Experiments : (i) Diffraction at straight edge, (ii) Interference of laser beams – Lloyds single mirror method, (iii) Interference using an optically plane glass plate, (iv) Diffraction at a straight wire and (v) Diffraction at a circular aperture.
10. Experiments on optical fibres.

Computational Methods (Any TEN)

1. Lagrange interpolation with Algorithm, Flow chart, C PROGRAM, and output.
2. Newton forward interpolation with Algorithm, Flow chart, C PROGRAM, and output.
3. Newton backward with Algorithm, Flow chart, C PROGRAM, and output.
4. Curve-fitting : Least squares fitting with Algorithm, Flow chart, C PROGRAM, and output.
5. Numerical integration by the trapezoidal rule with Algorithm, Flow chart, C PROGRAM, and output.
6. Numerical integration by Simpson's rule with Algorithm, Flow chart, C PROGRAM, and output.
7. Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart, C PROGRAM, and output.
8. Numerical solution of ordinary first-order differential equations by the Runge-Kutta method with Algorithm, Flow chart, C PROGRAM, and output.
9. Computer Simulation – Simple Pendulum.
10. Computer Simulation – projectiles.
11. Computer Simulation – Compound Pendulum.
12. Computer Simulation – Diode & Zener diode characteristics.
13. Computer Simulation – FET Characteristics.

IV SEMESTER

414PMPT01 - CONDENSED MATTER PHYSICS

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 Process.

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-Penny 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 para magnetism – 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 ferri magnets – Theory of anti ferromagnetism – 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. **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 York
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.

Books for reference:

1. J.C. Anderson, K.D. Leaver, R.D. Rawlings and J.M.
2. Alexander, Materials Science, 4th Edition (Chapman-Hall, London, 1990)
3. J.S. Blakemore, Solid State Physics, 2nd Edition (W.B.Saunder, Philadelphia, 1974).
4. A.J. Dekker, Solid State Physics (Macmillan India).
5. H.M. Rosenburg, The Solid State, 3rd E. (Oxford University Press, Oxford, 1993).
6. C.M. Kachhava, Solid State Physics (Tata McGraw- Hill, New Delhi, 1990).
7. S.O. Pillai, Solid State Physics (New Age International, New Delhi, 1997).

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

Practical

414PMPP01 - ADVANCED PHYSICS AND MICROCONTROLLER

Advanced Physics (Any FIVE)

1. Michelson Interferometer – Wavelength, Separation of wavelengths.
2. Michelson Interferometer – Thickness of mica sheet.
3. Susceptibility by Guoy's method.
4. Ultrasonics – Compressibility of a liquid.
5. Miscibility measurements using ultrasonic diffraction method.
6. Dielectric measurements in Microwave test bench.
7. Iodine absorption spectra.
8. Molecular spectra – A/O band.
9. Molecular spectra – CN bands.
10. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient.

Microcontroller – 8051 (Any TEN)

1. Addition, Subtraction, Multiplication and division of two 8-bit numbers.
2. Sum of a series of 8-bit numbers,
3. Average of N numbers.
4. Factorial of number.
5. Fibonacci series of N terms.
6. Sorting in ascending and descending order – Picking up smallest and largest number.
7. LED interface – Binary up/down counter, BCD up/down counter, Ring and twisted ring counter.
8. Interfacing seven segment displays.
9. Block Transfer.
10. Multi byte Addition / Subtraction.
11. DAC 0800 / 1408 interface and wave form generation.
12. ADC interfacing.
13. Stepper motor interfacing.
14. Temperature controller and Measurements.

Electives

214PMPE01 – SPECTROSCOPY

UNIT 1: Microwave Spectroscopy
Rotational spectra of diatomic molecules – Polyatomic molecules – Linear and symmetric top molecules – Hyperfine structure and quadrapole moment of linear molecules – Experimental techniques – Stark effect.

UNIT 2: Normal Co-ordinate 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, Molecular 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. **Attaur 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.

214PMPE02 - MATERIAL SYNTHESIS AND CHARACTERIZATION

UNIT – I : Nucleation and Growth

The crystalline state - concept of crystal growth – historical review – Importance of crystal growth – crystal growth theory : classical theory – Gibbs – Thomson equation- kinetic theory of nucleation – Energy of formation of a nucleus – kinetics of thin film formation – Film growth – five stages – Ncleation theories – Incorporation of defects and impurities in films – Deposition parameters and grain size – structure of thin films.

UNIT – II: Growth Techniques

Solution growth technique: low temperature solution growth : solution –Solubility – constant temperature bath an crystallizer – seed preparation and mounting – slow cooling and solvent evaporation methods.

Gel growth technique: Principle – various types – structure of gel – Importance of gel – Experimental procedure – Advantage of gel method.

Melt technique: Bridgman technique – czochralski technique – Experimental arrangement – Growth process.

Vapous technique: physical vapour deposition – chemical vapour deposition (CVD) – chemical vapour transport.

Unit – III: Thin Film Deposition Techniques

Thin films – Introduction to vaccum technology –deposition techniques – physical methods – resistive heating , electron beam cun and laser gun evaporation – sputtering : Reactive sputtering radio frequency sputtering – chemical methods – spray pyrolsis – preparation of transport conducting oxides.

Unit – IV: Characterization Technique

X-ray Diffraction (XRD) – power and single crystal – fourier transform infrared analysis – FT –Raman analysis – Elemential dispersive x-ray analysis (EDAX) – scanning electron microscopy (SEM) – UV –VIS Spectrometer Vickers micro hardness – Auger emission spectroscopy. Photolumine scene (PL) – UV –Vis –IR spectrometer- AFM- Hall effect – SIMS – X-ray – photoemission spectroscopy (XPS) – dynamic light scattering – ellipsmety method.

Unit – V: Applicaions

Micro electrochemical systems (MEMS) – optoelectronic devices : LED , LASER and solar cell – polymer films – Fabrication and characterization of thin film transistor, capacitor , resistor , inductor and FET – Sensor – quanum dot – Applications of ferromagnetic and super conducting films : Data storage , Giant magneto resistance (GMR).

Books for study:

1.K.Sangawal , Elementary crystal growth – shan publisher , UK ,1994.
2.P.Santhana Ragavan , P.Ramasamy ,Crystal Growth and processes. KRU publications. Kumbakonam(2000).
8.H.H. Williard , L.L. Merritt.Methods, J.Dean, and F.A. Settle , Instrumental methods of analysis – Sixth Edition. Cbs Publishers & distributors, Delhi (1986).
9.R.W.Berry , P.M.Hall and M.T.Harris, Thin Film Technology , Vn Nosrand (1968).
10.A.Goswami , Thin film Fundamentals , New Age International (P) Ltd. Publishers, New Delhi(1996).

Books for reference:

1.J.C.Brice , Crystal Growth Process , John wiley publications , NewYork (1996).
2.L I Maissel and R clang , Hand book of thin films Technology , Mc Graw – Hill (1970).
3.J.L. Vossen and W.kern ,Thin films process , Academic press ,1978.
4.M.Ohring , The materials science of Thin Films, Academic press , 1992.
5.M.William and D.Steve , Instrumental Methods of analysis (CBS publishers) Newdelhi. (1986).

214PMPE03 - MEDICAL PHYSICS

Unit – I

Bioelectric Signals – Electrodes – Surface, Needle and Micro Electrodes – Biosensors – Pulse Sensors.

Unit – II

Transducers: Thermistors : Photo electric type – transducer – photo voltaic cells – Photo emissive cells – Diode – Detectors – Optical fibers.

Unit – III

Blood Pressure measurements: Sphygmomanometer Measurement of heart rate – Basic Principles of EGC – Basic Principles of Electroneurography (ENG) – basic Principles of MRI.

Unit – IV

Basic of X-ray – Production of X-ray – X-ray Image – Applications of X-ray Examinations – Basic Principles of X-ray Tomography.

Unit – V

Endoscopes – Thermography – Liquid Crystal thermography – Microwave thermography – Basic Principles of ultrasonography – Laser – Uses of Lasers in Medicine.

Books for study:

1. Biomedical Instrumentation – Dr. M. Arumugam, Anuratha Agencies Publishers (2002).
2. Bio-Medical Electronics & Instrumentation – Prof. S.K.Venkata Ram – Galgotia Publications Pvt. Ltd.

Books for reference:

1. Handbook of Biomedical Instrumentations, TMG, New Delhi (2005) – R.S.Khandpur.

314PMPE01 - MICRO CONTROLLER AND INTEGRATED TECHNIQUES

UNIT 1: 8051 Serial Communication
8051 connection to R8 2320 – Serial Communication programming – Operating modes – serial port control register – Generating baud rats – Programming 8051 for serial data transfer – Doubling the Baud Rate.

UNIT 2: 8051 Microcontroller Hardware
Introduction – Features of 8051 – 8051 Microcontroller Hardware : Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input/Output pins, Ports and Circuits – External data memory and program memory : External program memory, External data memory.

UNIT 3: 8051 Instruction Set and Assembly Language Programming
Addressing modes – Data moving (Data transfer) instructions : Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions : byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions : Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions : Jump and Call program range, Jump, Call and subroutines – Programming.

UNIT 4: Interrupt Programming
8051 Interrupts – Interrupt vector table – Enabling and disabling an interrupt – Timer interrupts and programming – Programming external hardware interrupts – Serial communication interrupts and programming – Interrupt priority in the 8051 : Nested interrupts , Software triggering of interrupt.

UNIT 5: Interfacing to External World
Interfacing keyboard : Simple keyboard interface, Matrix keyboard interface – Interfacing displays : Interfacing seven segment LED displays, Interfacing LCD display – Interfacing DAC to 8051 – Interfacing ADC to 8051 – Interfacing sensors – Interfacing stepper motor – Temperature controlled.

Books for study:
1. A. P. Godse and D. A. Godse, "Microprocessors & its Applications", Technical Publications, Pune.
2. 2. Kenneth Ayala, " The 8051 Microcontroller", Third Edition, Delmar Cengage Learning,2005
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay, "The 8051 Microcontroller and Embedded Systems" , Second Edition, Pearson Education 2008.
4. W. A. Triebel and Avatar Singh, The 8086/8088 Microprocessors – Programming. Software, Hardware and Application, Prentice Hall of India, New Delhi, (Unit 2)

Books for reference:
1. Douglas V. Hall : - Microprocessors and Interfacing programming and Hardware (Tata Mc Graw Hill) (Unit 1)
2. B, Brey, 1995, Intel Microprocessors 8086/8088, 80186,80286,80486,80486, Architechture, Programming and Interfacing
3. Yu – Cheng and Glenn A. Gibson, The 8086/ 8088 family Architecture, Programming and Design, Prentice-Hall of India
4. Muhammed Ali Mazidi and Janice Gillespie Mazidi, 2004, The 8051 Microcontroller and Embedded systems, Fourth Indian Reprint, Pearson Education

314PMPE02 - LASERS AND APPLICATIONS

Unit I: Introduction
Review of elementary quantum physics, Schrodinger equation, Properties of Laser Beams-monochromativity, temporal and spatial coherence , Directionality, Brightness, Radiation Trapping Superradiance, Superfluorescence, Amplified Spontaneous Emission, Non-radiative delay. Absorption, spontaneous emission and stimulated emission processes, relation between Einstein's A and B coefficients, population inversion, pumping, gain, optical cavities.

Unit-II: Pumping process:
Optical pumping and pumping efficiency - Electrical pumping and pumping efficiency. Passive Optical Resonators, Rate Equations, Three -level Laser, Four-level Laser, Methods of Q- switching: Electro optical shutter, mechanical shutter, Acousto - optic Q-switches, Mode locking.

Unit-III: Main components of Laser
Main components of Laser, principle of Laser action, introduction to general lasers and their types. Three and four level Lasers, CW and Pulsed Lasers, atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and measurement. Spatial Frequency Filtering – Holography – Applications of holography – HNDT (Holographic Non-Destructive Testing) holographic storage – optical disk storage – Laser speckle and speckle meteorology – SNDT (Speckle Non-Destructive Testing).

Unit - IV: Lasers in Science
Saturation spectroscopy – excited state spectroscopy – nonlinear spectroscopy – time domain and its applications – stimulated Raman Emission – Laser fusion – Isotope separation – Medical applications, photo-chemical applications. Multiphoton photo-electric effects, Two-photon, Three-photon and Multiphoton Processes Raman Scattering, Stimulated Raman Effect.

Unit-V: Lasers in industry
Materials processing – drilling, cutting, welding – alloying – glazing – oblation – laser chemical vapour deposition (LCVD) – laser thermal deposition – hardening, annealing – Laser Tracking – Lidar.

Book for study:
1. K. Thyagarajan and A.K. Ghatak, Lasers Theory and Applications, Mcmillan (1981).
2. K. Koebner (ed.), Industrial Applications of Lasers, Wiley (1984).
3. J.T. Cuxon and D.E. Parker, Industrial Lasers and their Applications, Prentice Hall (1985).
4. B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd. (1984).
5. F.C. Appard, Fiber Optics Handbook, McGraw-Hill (1989).

Books for reference:
1. K.R. Nambiar, "Laser Principles, Types and Application" New Age International.
2. S. A. Ahmad, "Laser concepts and Applications" New Age International.
3. B.B. Laud , Lasers and Non-linear Optics (New Age International, New Delhi,2007)

414PMPE01 - X-RAY CRYSTALLOGRAPHY AND BIO PHYSICS

UNIT –I : X-ray and crystals

Origin of X-rays – conventional generators-construction and geometry sealed tube- rotating anode generator-choice of radiation-Synchrotron radiation - Lattice planes-Miller indices - X-ray diffraction - Crystal systems and symmetry – unit cell – space lattices- non primitive lattices – point groups–space groups – analysis of space group symbols - Crystallization – growing crystals – choosing a crystals – crystal mounting- alignment – measurement of crystal properties.

Data collection techniques for single crystals

Laue method- single crystal diffraction cameras: rotation and Oscillation method – Ewald construction . Single crystal diffractometers: Instrument geometry-crystal in a diffracting position – Data collection strategy: determination of unit cell –orientation matrix - Intensity Data collection - Unique data –equivalent reflections –selection of data.

UNIT-II : Data Reduction

Integration of intensity - Lorenz and Polarization corrections – absorption – deterioration or radiation damage-scaling – Interpretation of Intensity.

Structure factors and Fourier syntheses

Structure factor – Friedel's Law – exponential and vector form – generalized structure factor – Fourier synthesis –Fast Fourier transform – Anomalous scattering and its effects. Calculation of structure factors and Fourier syntheses.

Phase Problem

Methods of solving Phase Problem: Direct methods – Patterson methods –Heavy atom methods.

UNIT III: Refinement of crystal structures

Weighting – Refinement by Fourier syntheses – Locating Hydrogen atoms identification of atom types – least squares – goodness –of-fit –least square and matrices-correlation coefficients- Relationship between Fourier and Least squares – Practical consideration in least squares methods - Random and systematic errors **-** Molecular geometry - absolute configuration – thermal motion.

UNIT-IV: Cell: Its organelles and molecules

Basic structure of prokaryotic and eukaryotic cells–mitochondiria and the generation of ATP– Chemical composition of living systems – molecular components of cell – chemical structure of carbohydrate–Lipids-proteins– Nuclic acids–hetro macro molecules.

Molecular interactions: Molecular forces–forces hold macro molecules together– intermolecular weak forces-van der waals-inductive force-dispersion force-Lenard-Jones potential-hydrogen bond – hydrophobic forces-acid, bases and pH, pK, pl and buffering.

UNIT-V: Macromolecular Structure

Nucleic acid structure–conformation of monomers and polymers–double helical structure of DNA–polymorphism of DNA–DNA super coiling – structure of transfer RNA. Protein structure–amino acids–primary structure–peptide bond–secondary structure – α-helix and β- sheet-tertiary and quaternary structure – Virus structure.

Books for study:

1. X-ray Structure Determination (2nd Edition) - Stout and Jensen – John Wiley Publications.
3. Practical Protein Crystallography- Duncan E. McRee- Academic Press Publications.
4. Elements of X-ray crystallography – Leonid V.Azaroff- McGraw-Hill Publications.
5.Biophysics An Introduction – Rodney M. J. Cotterill; John Wiley Publication.
6. Biophysics – Vasantha Pattabhi and N.Gautham; Narosa Publishing House.
7. Biophysics – Roland Glacer; Pringer Publications.
8. Elementary Biophysics An Introduction – P. K. Srivastava ; Narosa Publishing House.

Books for reference:

1. Fundamentals of Crystallography –(2nd Edition)- C. Giacovazzo- Oxford Press.
2. Structure Determination by X-ray Crystallography (2nd Edition) - Ladd and Palmer.
3.Molecular Biophysics –Structure in motion- M. Duane; Oxford University Press.
4. Introduction to Molecular Biophysics – J. A. Tuszynski and M.Kurzynski; CRC Press Publications.
5. Principles of Physical Biochemistry- K.E. Van Holde, N.C. John and P.S. Ho Prentice Hall Publications.
6. Biophysics – M. V. Volkenshtein ; Mir Publications , Moscow.

414PMPE02 - NANO SCIENCE AND APPLICATIONS

UNIT I : Basics of Nanotechnology

Background to Nanotechnology – scientific revolutions – types of nanotechnology and nano machines – atomic structure molecules & phases – molecular and atomic size – surfaces and dimensional space – top down and bottom Nanoscale formation

UNIT II : Nanocrystals

Synthesis of metal Nan particles and structures – Background on quantum semiconductors – Background on reverse Miceller Solution – Synthesis of semiconductors – Cadmium telluroid nano crystals – Cadmium sulfide nano crystals – Silver sulfide nano crystals
– Nano manipulator – Nano tweezes – Nanodots.

UNIT III: Nano Tubes

Types of nanotubes – formation of nanotubes – methods and reactants – arcing in the presence of cobalt – laser methods – ball milling – chemical vapour deposition methods – properties of nano tubes – plasma arcing – electro deposition – pyrolytic synthesis – Zeolites and templated powders layered silicates.

UNIT IV: Characterization of Nanomaterials

Scanning Electron Microscope : Theory – Instrumental setup and its application – Low KV SEM and its application – Low temperature SEM and its application – working of electron probe micro analysis and its application in elemental analysis – EDX spectra Important material systems – optical process in semiconductors – optical process in quantum wells – semi conducting optoelectronic devices – organic optoelectronic devices (qualitative).

Unit V : Applications of Nanotechnology

Structural and Mechanical materials – Nan electronics – opto electronic devices – LED – Applications – Colorants and Pigments – Nano – Lithography – Nanobiotechnology – DNA – Chips, DNA array devices, drug delivery systems.

Books for study:

1. Nanotechnology: Basic science and emerging technologies – Mick Wilson, Kamali Kannagara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press (2005).
2. Amorphous and Nanocrystalline Materials: Preparation, Properties, and Applications, A.Inoue, K.Hashimoto(Eds.,) (2000).
3. Quantum Heterostructures : Microelectronics and Optoelectronics, Vladimir Mitin
4. Smart Electronic Materials (Fundamentals and applications), Jasprit Singh
5. Nanostructures and Nanomaterials (Synthesis, Properties and Applications), Guozhong Cao.
6. Nanoelectronics and Information technology Edited by Rainer Weser.

Books for reference:

1. Introduction to Nanotechnology, Charles P. Poole, Frank J. Owens, Wiley – Interscience (2003).
2. Fundamentals of Surface and Thin Film Analysis, Leonard C.Feldman and James W.Mayer.
3. Nanocomposite science and technology, Pulickel M. Ajayan, Linda S. Schadler, Paul V. Braun, Wiley – VCH Verag, Weiheim (2003).

414PMPE03 - ADVANCED MATERIALS

UNIT I NANOSTRUCTURAL MATERIALS

Magnetism in particles of reduced size and dimensions - variations of magnetic moment with size - magnetism in clusters of non magnetic solids - magnetic behaviour of small particles - diluted magnetic semiconductors (DMS) - Fe- DMS and IV -VI Mn DMS and their applications - intermetallic compounds - binary and ternaries and their magnetic properties.

UNIT II COMPOSITE MATERIALS

Metal matrix composites- polymer matrix composites - ceramic matrix composites - reinforcements - whisker reinforced ceramics - carbon-carbon composites - design of composite materials - hybrid composites - angled plied composites- unidirectional fiber composites - discontinuous fiber composites - applications of composites in electrical components and nuclear industry.

UNIT III LIGHT WEIGHT HIGH STRENGTH MATERIALS

Properties and structure of Titanium - alloying elements- manufacture of titanium wrought products - mechanical properties and microstructure correlation - □,□ and □+□ alloys, aerospace and medical applications - yttrium based iron-chromium aluminum alloy- mechanical alloying process of MA 956 alloy - MAODS super alloys - high temperature and medical applications

UNIT IV OPTO ELECTRONIC MATERIALS

Injection luminescence and LEDs - LED materials - LED construction - double heterojunction LED and related materials - edge emitter and super luminescent LED materials-liquid crystals-properties and structure-liquid crystal displays-comparison between LED and LC displays-optical amplifier - erbium doped silica fiber.

UNIT V ENGINEERING MATERIALS

Electrets - properties and applications - metallic glasses - properties and applications - SMART materials - piezoelectric, magnetostrictive, electrostrictive materials - shape memory alloys - rheological fluids - CCD device materials and applications - single crystalline solar cells - amorphous silica solar cells -thin film polycrystalline solar cells -surface acoustic wave and sonar transducer materials and applications.

REFERENCES:

1. Hand book of Nanophase Materials - edited by Avery N.Goldstain Marcel Dekker Inc, NewYork, 1997.
2. Science and Technology of Nanostructured Magnetic Materials, Ed. George C.Hadjipanayis and Gary A.Prinz, NATO ASI series, Plenum Press, New York,1991.
3. Composite Materials, S.C.Sharma, Narosa Publishing House, New Dellhi,2000.
4. Heat Treatment Structure and properties of non-ferrous, Charlie Brooks .R, American society for metals, U.S.A, 1984.
5. Optical Fiber Communications - John M.Senior, Prentice-Hall of India private Ltd., New Delhi, 1998.
6. Microelectronic Materials - C.R.M.Grovenor, Adam Hilger, Bristol and Philadelphia,1989.

414PMPE04 - ENERGY PHYSICS

Unit I **Introduction to energy sources:** Energy sources and their availability – prospects of renewable energy sources.
Solar radiation and its measurements: Solar constant – solar radiation at the Earth's surface – solar radiation Geometry – solar radiation measurements – solar radiation data – estimation of average solar radiation – solar radiation of tilted surfaces.

Unit II **Solar cells :** Solar cells for direct conversion of solar energy to electric powers – Solar cell parameter – Solar cell electrical characteristics – Efficiency – Single crystal silicon solar cells – Polycrystalline silicon solar cells – cadmium sulphide solar cells.

Unit III **Applications of solar energy:** Solar water heating – space heating and space cooling – solar photo voltaics – agricultural and industrial process heat – solar distillation – solar pumping – solar furnace – solar cooking – solar green house.

Unit IV **Wind Energy :** Base principles of wind energy conversion wind data and energy estimation – Base components of wind energy conversion systems (WECS) types of wind machines – Generating systems – schemes for electric generation – generator control – load control – applications of wind energy.

Unit V Energy from Biomass: Biomass conversion Technologies – wet and Dry process – Photosynthesis.

Biogas generation: Introduction – basic process and energetic – Advantages of anaerobic digestion – factors affecting bio digestion and generation of gas. **Classification of Biogas plants:** Continuous and batch type – the done and drum types of Bio gas plants – biogas from wastes fuel properties of biogas utilization of biogas.

Books for study and Reference

1. Kreith and Kreider, Principles of solar Engineering, Mc Graw Hill Pub.,
2. A.B.Meinel and A.P.Meinel, Applied Solar Energy.
3. M.P.Agarwal, Solar Energy, S.Chand & Co.,
4. S.P.Sukhatme, Solar Energy, TMH.
5. G.D.Rai, Non-conventional Energy sources, Khauna Publications, Delhi.

414PMPE05 - ULTRASONICS AND APPLICATIONS

UNIT I ULTRASONIC TRANSDUCERS

Piezoelectric and magnetostrictive transducers - equivalent circuits - Efficiency - Transducer mounting - Mechanical and Electronics, linear and sector transducers - variable frequency systems.

UNIT II ABSORPTION OF ULTRASONIC RADIATION

Classical absorption due to viscosity - Absorption due to thermal conductivity - Relaxation process - Evaluation of dispersion and absorption curves – structural relaxation - relation between collision frequency and relaxation time – Ultrasonic attenuation in solids.

UNIT III ULTRASONIC PROPAGATION IN SOLIDS AND LIQUIDS

Propagation of Ultrasonic waves in solids - Plane wave propagation – Relation between velocity of sound and Elastic properties - Adiabatic and Isothermal elastic constants - Ultrasonic propagation in liquids - Internal pressure and free volume calculations.

UNIT IV DETERMINATION OF VELOCITY OF PROPAGATION OF ULTRASOUND

Transit time method - Pulse Echo methods - Acoustic Interferometry - Measurements at high pressure and high temperature - Transducer coupling materials.

UNIT V APPLICATION OF ULTRASONICS

Industrial applications - Medical Applications - Acoustic microscope – Acoustic hologram - ultrasonic transaxial tomography.

REFERENCES:

1. G.L.Gooberman, Ultrasonics - Theory and Applications, - The English Universities Press Ltd., London, 1968.
2. Schreiber, Anderson and Soga, Elastic Constants and Their Measurement, Mc Graw Hill Book Co., New Delhi, 1973.
3. R.A.Lerski (Editor), Practical Ultrasound, IRL Press, Oxford,1988.
4. Robert T.Beyer and Stephen V. Letcher, Physical Ultrasonics, Academic Press, London, 1969.
5. J.P.Woodcock, Ultrasonics, Adam Hilger Ltd., U.K., 1979.
6. W.J.McGonnagle, Nondestructive Testing Methods, McGraw Hill Book Co., New York, 1961.

414PMPE06 - GEOPHYSICS

UNIT – I ORIGIN OF EARTH

Petrology – Evolution and composition of earth – Major subdivisions of earth's Sphere – Atmosphere – Hydrosphere – Lithosphere – Interior of earth – Composition of earth crust - Relative abundance of earth's crust,

UNIT – II GEOMAGNETISM

Origin of earth's magnetism – elements of earth's magnetic field – inclination, declanation and dib- earth's magnetic field – Diurnal, annual and secular variations – magnetosphere.

UNIT – III EISMOLOGY

Basic principles of elasticity and wave motion – primary wave (P-waves) and elasticity wave (S-wave) – density within the earth – pressure distribution – variation of 'g' and elastic constants - earth quakes – Elementary ideas about Ritter's scale.

UNIT – IV GEO – THERMAL EFFECT

Fundamentals concept of Thermal conductivity – heat flow measurement of on ground level and ocean – heat flow gravity variation – temperature of the primitive earth – inner core – melting point – adiabatic temperature gradient.

UNIT – V GRAVIMETRY:

Fundamental concepts of gravitational filed – gravitational anomalies – use of gravitational anomalies in geophysical prospecting – petroleum and mineral survey – factors affecting gravitational field due to magnetic stroms and cosmic ray showers - Mammond and Faller method of absolute gravity measurement – princible and working.

BOOKS FOR REFERENCES AND STUDY

1. Pedology – Concept and applications – J.SEHGAL Kalyani publishers, 4863/2B, Bharat Ram Rode , 24, Daryaganj, New Delhi – 110 002
2. Introduction to, geophysics (mantle, core and crust)- George G. Garland, W.B.Saunder's company – Philadelphia – London and Toranto.
3. Physics and Geology – Jacobbs ,Russel and Wilson – International Students Edition, Tata McGraw Hill , New Delhi.
4. Rock Magnetism – Nagata – McGraw Hill Publications, New Delhi
5. Geology – Debrin – McGraw Hill Publications , New Delhi.
6. Physics and Geology n- A.J.Aitken – tata McGraw Hill – Publications, New Delhi.
7. Bio – graphy of the earth (Its past , present and future) – George Gamove - Macmillon company Ltd , Canada

Registrar