DEPARTMENT OF PHYSICS

H.H.THE RAJAH'S COLLEGE(AUTO)

PUDUKKOTTAI – 622 001

COURSE STRUCTURE

AND

SYLLABI

FOR PG PROGRAMME

CHOICE BASED CREDIT SYSTEM

(2015 – 2016 ONWARDS)

H.H. THE RAJAH'S COLLEGE (AUTONOMOUS), PUDUKKOTTAI

M. Sc. Physics Programme Pattern – CBCS -2015-2016 Onwards

Sl. No.	Sem	Paper	Hrs/week	Credit	Exam hrs.	Marks		
						Internal	External	Total
1	I	Mathematical Physics - I	6	5	3	25	75	100
2	I	Classical Dynamics	6	5	3	25	75	100
	I	General Physics Practical *	4					
	I	Electronics Practical *	4					
3	I	Elective - I : Electronics and Communication	6	5	3	25	75	100
4	II	General Physics Practical *	4	5	4	40	60	100
5	II	Electronics Practical *	4	5	4	40	60	100
6	II	Mathematical Physics - II	6	5	3	25	75	100
7	II	Quantum Mechanics	6	5	3	25	75	100
8	II	Elective - II : Crystal Growth, Thin film and Nano Physics	6	5	3	25	75	100
9	II	EDC: Numerical Methods and C++ Programming	6	5	3	25	75	100
10	III	Statistical Mechanics	6	5	3	25	75	100
11	III	Electromagnetic Theory	6	5	3	25	75	100
12	III	Atomic and Molecular Spectroscopy	6	5	3	25	75	100
13	III	Elective - III; Microprocessor and Microcontroller	6	5	3	25	75	100
	III	Computer, Microprocessor and Microcontroller Practicals*	4					
14	IV	Computer, Microprocessor and Microcontroller Practicals*	4	5	4	40	60	100
15	IV	Nonlinear Dynamics and Relativity	6	5	3	25	75	100
16	IV	Condensed Matter Physics	6	5	3	25	75	100
17	IV	Nuclear and Particle Physics	6	5	3	25	75	100
18	IV	Project Work		5		20	80	100
				90				1800

* Exams will be held at the end of even semester

M. Sc. PHYSICS PROGRAMME

(CBCS Syllabus 2015 – 2016 Onwards)

CC01 : MATHEMATICAL PHYSICS

OBJECTIVE: To master the mathematical methods which are applied in Physics

SUB.CODE: JSPPHA1

UNIT – I: Vector Analysis

The Scalar and Vector fields – Gradient, Divergence - Curl and Laplacian in terms of Orthogonal and curvilinear co-ordinates - Rectangular, cylindrical and spherical co-ordinates – Integration of Vector – Line integrals, surface integrals and volume integrals – Gauss Divergence theorem – Stokes theorem – Greens theorem.

UNIT – II: Matrices and Linear Vector spaces

Orthogonal, Unitary and Hermitian matrices - Characteristics equation of a matrix- Eigenvalues and eigenvector – Cayley – Hamilton theorem – Inverse of a square matrix – Diagonalization – Matrix representation of linear operators.

Linear Vector space – Definition–Linear independence, Basis and Dimension– Scalar product – Orthonormal basis - Gram-Schmidt's orthogonalization process – Schwartz inequality.

UNIT – III: Tensor Analysis

Definition – Co-ordinate transformation – Indicial and summation conventions - Kronecker delta symbol – Scalar, Covariant, Contravariant and invariant tensors – Tensors of higher Ranks – Algebraic operations of tensor - Symmetric and antisymmetric tensor – Conjugate Tensors - Metric tensor – Riemannian Spaces – Christofell's three index symbols – Law of transformation for Christofell's symbols – Examples from Physics.

UNIT – IV: Ordinary Differential Equations

Linear first order differential equations - Linear second order differential equations with constant coefficients – Linear second order differential equations with variable coefficients - Power Series solution around a regular singular point: Frobenius method – Nonlinear differential equations – Solution for anharmonic oscillator problem.

UNIT – V: Partial Differential Equations

Linear Partial differential equations – Separation of variables – Separation of Helmholtz equation in Cartesian , Spherical polar coordinates and in Cylindrical polar coordinates – Laplace's equation in Cartesian, Spherical polar and Cylindrical polar coordinates – Symmetry and separability.

Books for study and Reference:

1. B.D.Gupta, Mathematical Physics, Vikas publishing ltd, India.
2. Satya Prakash, Mathematical Physics, Sultan Chand & Sons, New Delhi.
3. P.K.Chattopadhyay, Mathematical Physics (New Age international, New Delhi, 1990)
4. A.W.Joshi, Matrices and Tensors in Physics (Wiley Eastern, New Delhi, 1995)

CC02 : CLASSICAL DYNAMICS

Objective: To understand the fundamental concepts of macroscopic physics

SUB.CODE: JSPPHB1

UNIT – I: Lagrangian Formulation of Classical Mechanics

Mechanics of a system of particles – Constraints – Principle of virtual work- D'Alembert's principle – Derivation of Lagrange's equation for velocity independent potentials from it – Principle of least action – Derivation of Lagrange's equation from it - Simple applications of Lagrange's equation of equation – Motion of single particle in Cartesian and polar coordinates- Atwoods machine – Cyclic coordinates.

UNIT – II: Problem of Central forces

Reduction of two body problem to equivalent one body problem- Reduced mass – Equations of motions and first integrals – Classification of orbits – Virial theorem – Differential equation for the orbit – Bertrand's theorem – Kepler theorem – Motion in time in Kepler problem – The Laplace – Runge lenz vector – Scattering in a central force field – Scattering cross section – Scattering problem in laboratory coordinates.

UNIT – III: Rigid body dynamics

Orthogonal transformations – Transformation matrix – Euler angles – Cayley Klein parameters – Finite and infinitesimal rotations – Corolis effect – Inertial tensor and moment of inertia – Principle axis transformation – Euler equations of motion – Motion of heavy symmetric top with one point fixed.

UNIT – IV: Small oscillations

Formulation of the problem –eigenvalue equation and the principal axis transformation –Frequencies of free vibrations and normal coordinates – Free vibrations of a linear tri-atomic molecule – Forced vibrations and the effect of dissipative forces – Damped driven pendulum and the Josephson junction.

UNIT – V: Canonical transformations and Hamilton Jacobi theory

Equations of canonical transformation – examples of canonical transformations – the harmonic oscillator – Poisson brackets and other canonical invariants – Equation of motion in Poisson bracket – Hamilton Jacobi equation for Hamilton's principal function – Harmonic oscillator problem as an example – Hamilton equation for Hamilton's characteristic function – Action angle variables.

Books for Study and Reference:

1. H. Goldstein, C. Poole and John Safko, Classical Mechanics, 3rd Edition, (Pearson Education, New Delhi, 2004).

2. Rana and Joag, Classical Mechanics (Tata McGraw-Hill, New Delhi, 2006).

CC03 : GENERAL PHYSICS PRACTICAL

SUB.CODE: JSPPHC2

ANY 15 EXPERIMENTS

1. Determination of q,n,σ by forming elliptic fringes
2. Determination of q,n,σ by forming hyperbolic fringes
3. Determination of Stefan's constant
4. Identification of Prominent lines by spectrum photograph- Iron Spectrum
5. Identification of Prominent lines by spectrum photograph- Copper Spectrum
6. Determination of e/m by Thomson's method
7. Determination of Planck constant by Photo electric effect
8. Determination of Carrier Concentration and Hall coefficient in semiconductors
9. Determination of Magnetic susceptibility of a liquid by Guoy method
10. Determination of Magnetic susceptibility of a powder Guoy method
11. Determination of Magnetic susceptibility of a thin rod by Guoy method
12. Determination of magnetic susceptibility of liquids by Quincke's method
13. Determination of Charge of an electron by spectrometer
14. Determination of Specific rotary power of a liquid using polarimeter
15. Determination of thermal conductivity by Forbe's method
16. Determination of wavelength of monochromatic source using biprism
17. Determination of wavelength and thickness of a film using Michelson interferometer.
18. Determination of polarization of liquid (benzene) using spectrometer
19. Determination of Rydberg constant using spectrometer
20. Determination of resistivity by Four Probe method
21. Laser Experiments (particle size, diameter of thin wire determination)
22.

CC04 : ELECTRONICS PRACTICAL

ANY 15 EXPERIMENTS **SUB.CODE: JSPPHD2**

1. Design and study of monostable multivibrator (IC 555)
2. Design and study of bistable multivibrator (IC 555)
3. Characteristics of UJT
4. Characteristics of SCR
5. FET Amplifier
6. Construction of dual power supply using ICs (78XX and 79XX)
7. Half and Full adder
8. Half and Full Subtractor
9. K- Map
10. Operational amplifier – Waveform generators
11. Operational amplifier – Active Filters
12. Operational amplifier – Digital to analog conversion by Binary weighted method
13. Operational amplifier - Digital to analog conversion by R-2R ladder method
14. Operational amplifier – Simultaneous equations
15. Frequency divider using IC 555
16. Design and study of Wien's oscillator (Transistor or IC)
17. Design and study of Phase shift oscillator (Transistor or IC)
18. BCD to seven segment display
19. Astable Multivibrator by 555 timer
20. Multiplexer and Demultiplexer
21. One bit comparator
22. Encoder and decoder

EC01 : ELECTRONICS AND COMMUNICATION

Objective: To apply the principles of electronics in the field of communication

SUB.CODE: JSPPHEC1

UNIT – I: Semiconductor Devices and linear integrated circuits

UJT – VI characteristics – Relaxation Oscillators – Tunnel diode – Characteristics and application – SCR-DIAC – TRIAC.

Operational amplifiers – Characteristics – Elementary applications – Digital to analog conversion using op-amps- Binary weighted resistor method – R-2R ladder method – Analog to digital conversion – Successive approximation method and counter methods - IC 555 timer - Multivibrators with 555 (Astable and Monostable).

UNIT – II: Antennas and Microwaves

Antennas – Equivalent circuit – Thin linear antenna – Nonresonant antenna – Loop antenna – Radiation fields – Polarization – Isotropic radiator – Power gain – Effective parameters of an antenna – Dipole arrayed VHF, UHF and Microwave antennas.

Microwave generation and application – Klystron – Traveling wave tubes – Microwave propagation through wave guides – HO1 and EO1 modes – Attenuators – Crystal detection – Measurement of SWR- Radar equations – Detection and ranging – Transmitters and receivers.

UNIT – III: Communication System

Modulation – Modulation index – Directory modulated FM transmitters – FM detectors – Pulse modulation – Time division multiplexing – pulse time modulation – Pulse code modulation – Delta modulation – Quantization noise – Threshold effect.

UNIT – IV: Optic fiber communication

Introduction of Optic fiber communication – Electromagnetic wave propagation in step index fiber and graded index fiber – Single mode fibers – Types of single mode fiber – Fabrication of fibers , Couplers and passive components- Fiber parameter – Source and detectors – Optic fiber communication systems.

UNIT – V: Color television

Essential of color television – Perception – Three color theory – Luminescence – Hue saturation – TV Camera – VIDICON – Luminescence signal – TV Display Tubes– Single transmission – Modulation of color different signals – PAL of color TV systems- PAL color receiver – Block diagram – Merits and Demerits.

Books for study and Reference

1. Roy Choudhary, Linear integrated circuits,
2. R.R Gulathi, Monochrome and color television, Wily Eastern New Delhi. (1995)
3. Gowar , Optical Communication – Prentice Hall of India Ltd., New Delhi (1990).
4. Roddy Coolen

CC05 : MATHEMATICAL PHYSICS - II

OBJECTIVE: To master the mathematical methods which are applied in Physics

SUB.CODE: JSPPHE2P

UNIT- I: Complex variables

Functions of complex variables – Differentiability – Cauchy – Riemann conditions – Integrals of complex functions – Cauchy's integral theorem and integral formula – Taylor's and Laurent's Series – Residues and singularities – Cauchy's residue theorem – Liouville's theorem – Evaluation of Definite integrals.

UNIT - II: Fourier series, Fourier, Laplace and Integral transforms

Fourier series – Dirichlet's conditions – sine and cosine series – Fourier integrals – Fourier transforms – Convolution theorem – Application to heat and wave equations – Laplace transform – solution of ordinary differential equations – Convolution theorem.

UNIT - III: Green's Functions and Integral Equations

Green's functions – properties – Methods of solutions in one dimension – Applications – Linear integral equations – Fredhelm and Volterra type – Neumann series – Eigen function expansion – Applications.

UNIT - IV: Special Functions

Gamma and Beta functions – Sturm – Liouville problem – Series solution – Legendre, associated Legendre, Bessel, Laugerre and Hermite differential equations and their solutions – Rodrigue formula – Generating functions – Orthogonality relations – Important recurrence relations.

UNIT -V: Group Theory

Basic definitions – Multiplication table – Subgroups, cosets and classes – Direct product groups – point groups and space groups – representation theory – Homomorphism & Isomorphism – Reducible and irreducible representations – Schur's lemma – The great orthogonalitiy Theorem – Character table – C3V and D3 as examples – Elementary ideas of rotation groups.

Books for study and reference:

1. B.D.Gupta, Mathematical Physics, Vikas publishing ltd, India.
2. Sathyaprakash, Mathematical Physics, Sultan Chand & Sons, New Delhi.
3. P.K.Chattopadhyay, Mathematical Physics (New Age international, New Delhi, 1990)
4. A.W.Joshi, Elements of Group Theory for Physicists, Wiley Eastern Ltd., New Delhi(1971).
5. E.Kreyszig, Advanced Engineering Mathematics, 8th edition. Wiley, NY, 1999.
6.W.W.Bell, Special Functions for Scientists and Engineers(Van Nostrand,New York, 1968).

CC06: QUANTUM MECHANICS

Objective: To understand the physics of mesoscopic systems

SUB.CODE: JSPPHF2P

UNIT – I: Basic Concepts

Inadequacy of classical mechanics concepts – Planck's postulate – De Broglie matter waves – Schrödinger equation – Hermitian operators and their properties – Commutator relation – Expectation values – Correspondence principle – Ehrenfest theorem - Hilbert space - Fundamental postulates of wave mechanics-Uncertainty principle – Schroedinger and Heisenberg pictures.

UNIT – II: Exactly Solvable Eigen value Problem (Bound states)

Harmonic Oscillator: Energy Eigen values and Eigen functions – Abstract operator method – Ladder operators – Eigen values – Eigen functions – Angular momentum operators – Rigid rotator – Particle in a central potential – Radial wave equation – Hydrogen atom – Energy eigenfunctions and eigenvalues.

UNIT – III Approximation Methods for Stationary States

Time independent perturbation theory – Non Degenerate case - Degenerate case – Time dependent perturbation – Harmonic perturbation – Sudden Approximation – Fermi's golden rule – Stark effect – Two electron atoms – Variation method – Ground state energy estimation for helium atom – Upper bound theorem – Hydrogen molecule – WKB approximation – Connection formula – Quantization condition – WKB solution of the radial wave equation.

UNIT – IV Scattering theory and Angular momentum

Differential and total cross section – Scattering amplitude – Born approximation – Validity – Eikonal approximation – Partial wave analysis – Asymptotic form and Phase shift – Ramsauer – Townsend effect.

Angular momentum – matrix representation of spin angular momentum – Pauli's spin matrices – Commutation relations – Eigen values – Addition of angular momentum – Spin matrices – Clebsch Gordan coefficients – Tables of C-G coefficients – Identical particles with spin – Wigner Eckart theorem.

UNIT – V Relativistic Wave Equation

Klein Gordan equation Charge and Current densities Hydrogen like atoms – Non relativistic limit – Dirac equation – Position probability density – Dirac matrices – Spin of Dirac particle – Significance of negative energy states – Relativistic electron in a central potential – Electron in a magnetic field – Spin magnetic moment.

Books for study and Reference

1. P.M. Mathews and K. Venkatesan, A Text book of Quantum mechanics TMH
2. Ghatak and Loganathan, Quantum mechanics , TMH
3. L.I Schiff, Quantum mechanics, Wiley

EC02: CRYSTAL GROWTH, THIN FILMS AND NANO PHYSICS

Objective : To understand the methods of synthesizing new materials

SUB.CODE: JSPPHEC2

Unit - I: Crystal Growth

Introduction – Crystal Growth and its importance – Nucleation – Theories of nucleation-Classical theory of nucleation – Spherical and Cylindrical Shape of nucleus – Hetrogeneous nucleation - Solution – Solubility and Super solubility - Methods of crystalization - Slow cooling – Slow evaporation- Gel Growth – Experimental procedure – U-tube and Straight tube methods-Melt Growth techniques: Bridgmann, Czochrolski – Kyropoulous methods.

Unit - II: Thin Films

Introduction – Nucleation theories and comparision – Film deposition parameters – Grain size – film structure – film deposition by different processes – Dielectric properties – Optical properties – Transport properties –Annealing effect –Effect of frequency and temperature – Conductivity –Resisitivity –Activation energy.

Unit - III: Introduction to Nano particles:

Introduction – Historical perspective of Nano Particle – Classifications of Nano materials – Nano rodes – Nano particles – Nano material preparation – Plasma arching – Chemical vapour deposition – Solgel electrodeposition – Ballmilling techniques.

Unit - IV: Nano Crystals

Synthesis of metal nano particles and structures – Background on Quantum semiconductors – Background on reverse miceller solution – synthesis of Cadmium fluoride nano crystals – Cadmium sulfide nano crystals – Characteristics: Magnetism in particle of reduced size dimension – Variation of magnetism with size – magnetic behaviour, Specific heat, melting point of small particles.

Unit - V: Carbon nano tubes and Applications

Fabrication – structure – Electrical, Vibrational and Mechanical properties of Carbon nano tubes – General Applications: Colourants and Pigments – DNA array devices – Drug delivery systems.

Books for Study and Reference:

1. C. Kittel, Introduction to Solid State Physics, Wiley, 1996
2. P. Ramasamy and P. Santhana Raghavan, Crystal Growth Processes and Methods
3. C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley India Ltd. 2007
4. K. J. Klaabunde, Nanomaterials in Chemistry, Wiley India Ltd, 2001
5. J. DeJongh, Physics and Chemistry of Metal Cluster Compounds, Kluwer Academic Publisher, 1994.

EDC : NUMERICAL METHODS AND C ++ PROGRAMMING

Objective : To learn and understand the numerical methods which can be applied to solve many problems by using computers in the field of Physics

SUB.CODE: JSPPHED1

Unit – I : Numerical Methods

Newton Raphson method of root finding – Simpson 1/3 and Trapezoidal integration rules – Newton forward and backward difference formulae for derivatives – Gauss Elimination method for simultaneous equations – Runge Kutta II and IV order methods for solving Differential equations – Gregory – Newton forward and backward interpolation formula.

Unit II: Object oriented Programming

Basic concepts of Object Oriented Programming – Structure of C++ Program - Tokens, Key words – Identifiers and constants – Basic Data types -User Defined Data types - Derived data types – Symbolic constants – Declaration of Variables – Dynamic Initialization of variables – operators in C++ - Scope resolution operator – Manipulators.

Unit III: **Expressions and Function**

Expressions and their types – Special assignment expressions – Implicit conversions – Control structures.

Functions in C++ – the main () function – function prototyping – inline functions – default arguments – constant arguments – function overloading – math library functions.

Unit IV: Class and objects

Specifying a Class – defining a member function – making an outside function inline – Nesting of member function – Private member function – Arrays with in a class – Friend function – Static member function – Arrays of objects – Objects as function arguments.

Unit V: Constructors, Destructors and File handling

Constructors – Parameterized constructors – Copy constructor – Dynamic constructors – Destructors.

Inheritance: Single inheritance – Multiple inheritance – multi level inheritance – Hierarchical inheritance – Hybrid inheritance.

Working with files – Classes for file steam operation – Opening and Closing a file – text file operation – error handling during file operation.

Books for Study and Reference:

1. E. Balagurusamy, Object oriented Programming with C++
2. Bjarne Stroutstrup, The C++ Programming Language
3. Grady Booch, Object Oriented Analysis and design.
4. M.K. Venkataraman, Numerical methods in Science & Engineering (The National Publishing co; Madras, 1993).
5. Bohn Hubbard, *Schaum's outline Series: Programming with C++, 2nd Ed.* (Tata McGraw-Hill, New Delhi, 2006)

CC07 : STATISTICAL MECHANICS

Objective : To reckon the statistical concepts and Physics in the dealing of many particle systems

SUB.CODE: JSPPHG3

UNIT – I Review of the Laws of Thermodynamics and Their Consequence

Energy and first Law of Thermodynamics – Heat content and Heat Capacity – Specific heat – Entropy – Second Law of Thermodynamics – Thermodynamic potential and the Reciprocity relation – Maxwell's relation – Deduction – Properties of Thermodynamics relation – Gibb's Helmholtz relation – Nernst Heat theorem of third law – Phase-Gibb's Phase rule – Chemical potential.

UNIT – II Kinetic Theory

Equilibrium state of dilute gas: Binary collisions – Boltzmann transport equation and its validity Boltzmann's H-theorem and its analysis – Maxwell-Boltzmann distribution – Method of most probable distribution.

Transport Phenomena: Mean free path – Conservation laws – Zero and first order approximation – Viscous hydrodynamics – Navier-Stoke's equation – Examples in hydrodynamics.

UNIT – III Elementary Statistical Mechanics

Micro and Macro states – Statistical equilibrium – Phase space - Partition function – Free energy – Relation between partition function and thermodynamic quantities - Ensembles – Micro canonical ensemble – Partition function and its associated thermodynamic quantities – Canonical ensemble – Partition function and its associated thermodynamic quantities - Grand canonical ensemble – Partition function and its associated thermodynamic quantities - Liouville's theorem – Maxwell-Boltzmann statistics and distribution law.

UNIT – IV Statistical Mechanics of ideal Bose gas

Bose-Einstein– Distribution law - Black body radiation and Planck's law – Phonons – Partition function for a harmonic oscillator – Specific heat of Solids– Einstein's theory – Debye's theory – Specific heat of diatomic molecules – Ideal Bose gas – Energy, Pressure and Thermal properties – Bose-Einstein condensation – Liquid helium.

UNIT – V Statistical Mechanics of ideal Fermi gas

Fermi-Dirac statistics and distribution law – Ideal Fermi gas – Properties – Gas degeneracy- Electron gas – Free electron model and Thermoinic emission – Pauli paramagnetism – Random walk problem – Brownian Motion – Diffusion Equation- Quantum mechanical ensemble theory – Density matrix and Partition function.

Books for study and Reference:

1. F.Reif, Statistical and Thermal Physics, McGraw Hill, International Edition, Singopore,
2. B.R.Agarwal and N.Eisnor, Statistical Mechanics, Wiley Eastern Ltd, NewDelhi.
3. R.Huang, Statistical Mechanics, Wiley Eastern Ltd, New Delhi (1983)
4. C.KIttel, Thermal Physics, 2nd Ed

CC08 : ELECTROMAGNETIC THEORY

Objective: To know the associated effects of stationary and moving charges and charge distributions by using different methods

SUB.CODE: JSPPHH3

Unit I : Electrostatics:

Coloumb's law – The electric field – Continuous charge distribution – Gauss's law – the curl of E – electric potential – Poisson and Laplace equation – the potential of the localized charge distribution – Electrostatic boundary conditions – the work done to more charge – energy of a point charge distribution – continuous charge distribution – the classic image problem – the induced surface charge – force and energy – Multipole expansion – Approximate potentials at large distances.

Unit II: Magnetostatics

The Lorentz force law – Magnetic field – Magnetic forces – Biot-savat law – steady current – the magnetic field of steady current – straight line current – the divergence and curl of B – Application of Amperee's law – comparison of electrostatics and magnetostatics - magnetic vector potential – magnetic boundary – Multi pole expansion of vector potential – Ampere's law in magnetized materials – Magnetic susceptibility and permeability.

Unit III: Electromagnetic Induction:

Faraday's laws – induced electric field – Induction (Neumann's formula) – Energy in a magnetic field – Maxwell's Equations:- Electrodynamics before Maxwell's – Displacement current – Maxwell's equation in a matter – boundary conditions – Conservation laws:- Continuity equation - Poynting theorem – Potential field:- Scalar and vector potentials - Gauge transformations – Coulomb and Lorentz Gauge – Retarded potential.

Unit IV: Electromagnetic waves:

Plane wave in a non-conducting media – linear and circular polarization – Energy flux in a plane wave – Radiation pressure and momentum – plane wave in a conducting medium – Reflection and refraction of electromagnetic waves at a plane interface between dielectrics – Frequency dispersion characteristics of dielectrics – Conductor and Plasma.

Unit V: Wave Guide and Radiating System

Propagation of waves between conducting planes – waves in Guides of Arbitrary cross-section (Cylindrical) – wave Guides of Rectangular cross-section – Coaxial wave guide – Dielectric wave Guide – Resonant cavities – Field and radiation of a localized oscillating source – Electric dipole field and Radiation – Magnetic dipole and electric dipole field – Center-fed linear antenna.

Books for Study and references:

1. David J. Griffiths, Introduction to Electrodynamics (Prentice-Hall of India, New Delhi, 1995).
2. J.D. Jackson, Classical Electrodynamics (Wiley Eastern, 1988).
3. E.C. Jordon and K.G. Balmain, Electromagnetic waves and Radiating systems, 2nd Edn (Prentice-Hall of India, New Delhi, 1995).
4. B.B. Laud, Elctromagnetics (New Age International Publishers).
5. John R. Reitz, Fredrick, J. Milford and Robert, W. Christy, Foundations of electromagnetic Theory.

CC09 : ATOMIC AND MOLECULAR PHYSICS

Objective: To unveil the important facts of matter at microscopic scale and their behaviours

SUB.CODE: JSPPHI3

UNIT - I: Atomic spectra

Quantum states of electron in atoms – Hydrogen atom spectrum – Electron spin – Stern Gerlach experiment – Spin-orbit interaction – Lande interval rule – Two electron systems, LS-JJ coupling schemes – Fine structure – Spectroscopic terms and selection rules – Hyperfine structure,

Exchange symmetry of wave functions – Pauli's exclusion principle – Periodic table – Alkali type spectra – Equivalent electrons – Hund's rule.

UNIT - II: Atoms in External Fields and Molecular approximations

Zeeman and Paschen Back effect of one and two electron systems – Selection rules – Stark effect – Inner shell vacancy – X-ray- Auger transitions – Compton Effect.

Molecules: Covalent, ionic and Vanderwall's interactions – Born Oppenheimer approximation – Heitler-London and molecular orbital theories of H – Bonding and anti bonding – Mos-Huckel's molecular approximation – application to butadiene and benzene.

UNIT - III: Microwave and IR Spectroscopy

Rotational spectra of diatomic molecules – Intensity of spectral lines – Effect of isotopic substitution – the non-rigid rotator – Rotational spectra of poly atomic molecules – linear, symmetric top and asymmetric top molecules – Experimental techniques – Vibrating diatomic molecule – Diatomic vibrating rotator – Linear and symmetric top molecules – Analysis by infrared techniques – characteristic and group frequencies.

UNIT - IV: Raman Spectroscopy and Electronic Spectroscopy of Molecules

Raman Effect – Polarizability theory – Pure rotational Raman's spectrum: vibrational Raman spectrum diatomic molecules – Structure determination form Raman & IR spectrometer experimental Techniques.

Electronic spectra of diatomic molecules – intensity of spectral lines – The Franck-Condon principle – Dissociation energy and dissociation products - Rotational fine structure of electronic vibration transitions – Predissociation.

UNIT - V: Masers and Lasers

Spontaneous and stimulated emission – Ammonia maser – Interaction of radiation with atomic systems – Einsteins's coefficients – Population inversion inversion – Laser threshold condition – Rate equations for 3 and 4 level lasers – Laser resonators – Ruby Laser – He-Ne laser – CO_2 laser, Semiconductor laser – laser applications.

Books for study and reference:

1. C,N.Banwell, Fundamentals of Molecular Spectroscopy, TMH
2. A. Beiser, Concepts of Modern Physics, TMH
3. B. P. Stranghan and S. Walker, Spectroscopy Vol. 1, Chapman and Hall 1976
4. Manas Chanda, Atomic Structure and Chemical Bond, TMH

EC03 : MICROPROCESSOR AND MICROCONTROLLER

SUB.CODE: JSPPHEC3

Unit – I: Microprocessor Architecture (8085) and Instruction Set

Microprocessor architecture 8085 – data instruction cycle – timing diagram – Instruction set – data transfer group – arithmetic group – logic group – branch control group – I/O and machine controlled group – addressing modes – direct –indirect – register – relative – indexed modes – status flags.

Unit – II: Microprocessor Programming

Software programs – debugging – modular programming – structured programming – macros – micro programming – assembly language programming – addition – subtraction – multiplication – division – BCD arithmetic –searching an array for a given number – smallest and largest numbers from a list – arranging a list of numbers in ascending and descending order – finding the square root of a number – multibyte addition and subtraction.

Unit – III: Interfacing and Applications

Interfacing memory and I/O devices – IC mapped I/O – memory mapper I/O – Types of interfacing devices – 8255 I/O ports and programming – Programmable interrupt controller – Stepper motor interfacing – Applications – Temperature measurements digital clock – Music generator – Data acquisition.

Unit – IV: Microcontroller (8051) Architecture

8051 Architecture – Microcontroller hardware – Program and data memory – External memory – Counter – Timers – Serial data I/O – Interrupts.

Unit – V: Microcontroller (8051) Instructions and Simple Programs

Addressing modes – Instructions – Data transfer instructions – Logical, arithmetic, jump and call instructions – Bit manipulation – Addition – Sum of N numbers, Multibyte addition – Subtraction – Multiplication – Division – Biggest and smallest numbers.

Books for study and reference:

1. B. Ram, Fundamentals of Microprocessors and micro computers (Dhanpat Rai and sons, New Delhi, 1995).
2. R. Goankar, Microprocessor Architecture Programming and Applications (Wiley Easter Ltd.,)
3. Kenneth J. Ayala, The 8051 Microcontroller, Architecture, Programming and Applications (Thompson, Delmer, Learning (ISE), New Delhi, 2004).

CC10: COMPUTER , MICROPROCESSOR, MICROCONTROLLER PRACTICALS

SUB.CODE: JSPPHM4P

ANY 15 EXPERIMENTS(5 from each section)

C++

1. Newton Raphson method
2. Simpson and Trapezoidal integration rules
3. Gauss Elimination method
4. Runge Kutta II and IV order methods
5. Newtons Forward and backward formulae
6. Bifurcation diagram of logistic map
7. Duffing Oscillator trajectory plot

MICROPROCESSOR

1. Addition, subtraction, multiplication and divison (8 bit)
2. 16 bit addition and 1's and two's complement subtraction(8 and 16 bit)
3. Conversion : Decimal to Octal and Decimal to hexadecimal
4. Searching for a number from a given list
5. Ascending and descending order
6. Stepper motor interface
7. Temperature measurement interface

MICROCONTROLLER

1. Addition, subtraction, multiplication and division
2. Fibonacci series
3. Factorial of a number
4. Square root of a number
5. Gray code to 8 bit binary number conversion
6. Ascending and descending order
7. Conversion : Decimal to Octal and Decimal to hexadecimal

CC11: NONLINEAR DYNAMICS AND RELATIVITY

Objective: To understand the integrable and nonintegrable physical systems' interesting behaviours in addition to the theory of relativity

SUB.CODE: JSPPHJ4

UNIT – I: Non linear system and Bifurcation

Linear and nonlinear systems, autonomous and non autonomous systems – Equilibrium points – Classification for two dimensional case – Limit cycle motion – Periodic attractor – Poincare Bendixson theorem – Bifurcations - Saddle node, Pitchfork, Transcritical and Hopf Bifurcations.

UNIT – II: Chaos in Discrete and Continuous Dynamical Systems

Logistic map – Equilibrium points and their stability – Period doubling phenomenon – Onset of chaos – Lyapunov exponent – Bifurcation diagram of logistic map - Henon map – Period doubling – Self similar structure – Duffing Oscillator – Bifurcation Scenario – Period doubling route to chaos – Intermittency transition – Quasi periodic route to chaos.

UNIT – III: Choas in Non linear Electronic circuits and Hamiltonian chaos

.Linear and Non linear circuit elements – Non linear circuits – Chua's diode – Bifurcations and chaos – MLC circuit – Experimental Realization – Stability analysis – Experimental and Numerical studies.

Henon – Heiles system – Equilibrium points – Poincare surface of section – Periodically driven undamped Duffing Oscillator – Standard map – Linear stability and invariant curves – Numerical analysis – Regular and Chaotic motions – Kolmogorov – Arnold -Moser theorem.

UNIT – IV: Waves and solitons

Linear waves – Linear non dispersive wave propagation – Linear dispersive wave propagation – Fourier transform and solution of initial value problem- Wave packet and dispersion – Cnoidal and Solitary waves – Solitons – KDV equation – Fermi Pasta Ulam Paradox – Hirota bilinearization method – Lax pair – Inverse Scattering transform method for KdV equation.

UNIT – V: Relativity

Basic Postulates of Relativity – Lorentz transformations – Velocity addition and Thomas precession – Vectors and the metric tensor- Relativistic Kinematics of collisions and many particle systems – Relativistic angular momentum – Lagrangian formulation of relativistic mechanics – Relativistic One dimensional Harmonic oscillator – Introduction to General theory of relativity.

Books for Study

M. Lakshmanan and S. Rajasekar, Non Linear Dynamics , Springer Verlag, (2003)(For unit I – IV)

H. Goldstein, C. Poole and John Safko, Classical Mechanics, 3rd Edition, (Pearson Education, New Delhi, 2004(For unit V).

CC12: CONDENSED MATTER PHYSICS

Objective: To learn the basics of solid state of matter and the associated theories.

SUB.CODE: JSPPHK4

UNIT – I Crystal Diffraction and Reciprocal Lattice

Bragg law – Diffraction experiments – Laue method – Rotating crystal method – Powder method – Derivation of Scattered wave amplitude by Fourier analysis – Reciprocal lattice vectors – Condition for diffraction – Brillouin zones – Reciprocal lattice to simple cubic, face centered cubic and body centered cubic lattice – Fourier analysis of the basis – Structure factor – atomic form factor – Temperature dependence on spectral lines.

UNIT – II Crystal Binding and Lattice Vibrations

Van der Waals - London interaction Madelung energy and Madelung constant – Evaluations – covalent metal and hydrogen bonded crystals.

Vibrations of Monatomic lattices – Lattice with two atoms per primitive cell – Quantization of lattice vibration – Phonon momentum.

UNIT – III Energy Momentum and Semiconductor Crystals

Nearly free electron model – Bloch functions – Kronig penny model – Wave equation electron in a periodic potential – number of orbitals in band – Metals and insulators – Band gap – Equation of conductors – Effective mass of holes – Intrinsic carrier concentration – Thermoelectric effect in semi conductors – Schottcky Barrier – Gunn – Effect Oscillators.

UNIT – IV Fermi Surfaces and Metals

Construction of Fermi surface – Electron orbits, hole orbits – Calculations of Energy bands – Tight binding method for energy bonds – Wigner Seitz method – Pseudo potential – Experimental methods – Quantization of orbits is a Magnetic field – De Haas – van Alpen effect – Electrical conductivity and ohms law – Motion of electrons in magnetic fields – Hall effect – Thermal conductivity of metals.

UNIT – V Super Conductivity

Occurrence – Meissner effect – Heat capacity Thermodynamics of super conducting transition – London equation –Coherence length and London penetration depth – BCS theory of super conductivity – Flux quantization in a superconducting ring – type-I and type-II super conductors – Josephson super conductor tunneling – AC and DC Josephson effects - SQUID.

Books for Study and Reference

1. C.Kittel, Introduction to Solid State Physics
2. S.O. Pillai, Solid State Physics.

CC13 : NUCLEAR AND PARTICLE PHYSICS

Objective: To understand the classification of subatomic particles and their properties along with their influences

SUB.CODE: JSPPHL4

UNIT I Basic Nuclear properties

Nuclear size, shape, mass-charge distribution – spin and parity –Binding energy- semi empirical mass formula – nuclear stability- mass parabola –Nuclear forces: nature of nuclear force – ground state of deuteron – magnetic dipole moment of deuteron – proton – neutron scattering at low energies- scattering length, phase shift – proton –proton scattering at low energies – properties of nuclear forces- spin dependent – charge symmetry- charge independence- repulsion at short distances – exchange forces – meson theory.

UNIT II Radioactive Decays

Alpha emission- Geiger Nuttal law – Gamow theory – Neutrino hypothesis- Fermi theory of β decay – selection rules- Non conservation of parity- Gamma emission – selection rules- transition probability – internal conversion- nuclear isomerism- detection of nuclear radiations-interaction of charged particle with matter – basic principles of particle detectors – ionization chamber – proportional counter- G.M. counter – solid state detectors – scintillation and semiconductor detectors

UNIT III Nuclear Reactions

Conservation laws for nuclear reactions- reaction energetics- Q-value –relativistic and non – relativistic Q value – nuclear cross section- charged particle induced nuclear reaction – neutron induced nuclear reaction – reciprocity theorem – Breit Weigner formula –resonance theory – optical model theory of nuclear reactions.

UNIT IV Accelerators and Reactors

Cyclotron – synchrocyclotron- Betatron- synchrotron- linear accelerators – nuclear fission and fusion: Characteristics of fission mass distribution of fragments- radioactive decay process- fission cross section – Energy in fission – Bohr- Wheeler's theory of nuclear fission – fission reactors – thermal reactors- homogeneous reactors – heterogeneous reactors – basic fusion process- characteristics of fusion- Solar fusion – controlled fusion – reactors – cold fusion.

UNIT V Elementary Particles

Classification of fundamental forces and elementary particles-basic conservation laws- additional conversation laws: Baryonic, Leptonic, Strangeness and iso- spin charges/ quantum numbers – Gell- Mann-Nishijima formula – multiples- invariance under time reversal(T) , charge conjugate (C) and parity (P) – TCP theorem – parity non- conservation in weak interaction – CP violation – Eight fold and super multiples SU(3) symmetry and quark model

Books for Study and Reference:

1. S.B.Patel, Nuclear Physics, John Wiley, New York, 1987.
2. B.L.Cohen , Concepts of Nuclear Physics, Tata McGraw Hill, New Delhi, 1988.
3. H.S.Hans, Nuclear Physics: Experimental and Theoretical, New Age international Publishers, NewDelhi, 2001.
4. D.Griffths, Introduction to Elementary Particle Physics, Wiley International Edition, New York, 1987.
5. M.L.Pandya and R.P.S.Yadav, KedarNath Ram Nath Publishers, Meerut, 1989.