



Since 1947

PSG College of Arts & Science

An Epitome of Quality Learning

M.Sc. PHYSICS

2017 - 2019

MSc PHYSICS PROGRAMME -SCHEME OF EXAMINATIONS

(For students admitted from 2014-15 & onwards)

Code No.	Subject	Duration (Hrs)	Max. Marks			Credit Points
			CA	CE	Total	
First Semester						
14PHP01	Classical Mechanics	3	25	75	100	4
14PHP02	Mathematical Physics	3	25	75	100	4
14PHP03	Quantum Mechanics - I	3	25	75	100	4
14PHP04	Optical Physics	3	25	75	100	4
-	Practical – I General Physics	-	-	-	-	-
-	Practical – II Electronics	-	-	-	-	-

cond Semester

14PHP05	Nuclear Physics	3	25	75	100	4
14PHP06	Condensed Matter Physics	3	25	75	100	4
14PHP07	Quantum Mechanics II	3	25	75	100	4
14PHP08	Applied Thermodynamics and Statistical Mechanics	3	25	75	100	4
14PHP09	Group Theory & Molecular Spectroscopy (Allied-CH)	3	25	75	100	5
14PHP10	Practical – I General Physics	4	40	60	100	4
14PHP11	Practical – II Electronics	4	40	60	100	4
14SBP01	<u>Skill based subject :</u> Cyber Security	-	100	-	100	2

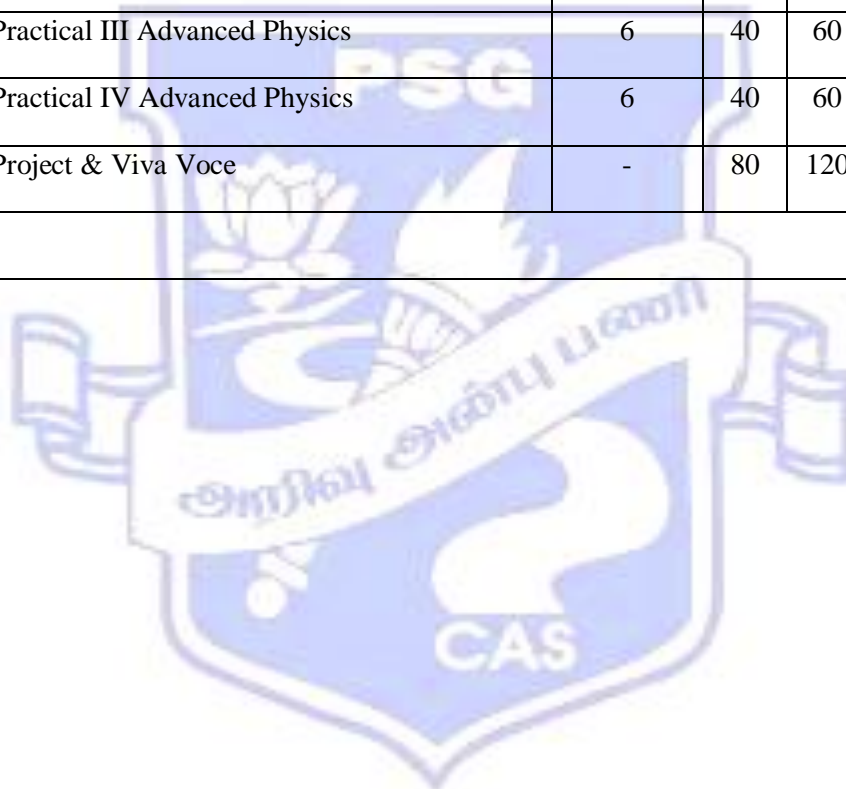
Code No.	Subject	Duration (Hrs)	Max. Marks			Credit Points
			CA	CE	Total	

Third Semester

14PHP12	Photonics and Applications	3	25	75	100	4
14PHP13	Electromagnetic theory	3	25	75	100	4
14PHP14A	<i>Core Elective: I</i> Crystal Growth , Thin Films and Plasma Physics	3	25	75	100	5
14PHP14B	OR Molecular Spectroscopy					
14PHP15A	<i>Cluster IDC - Theory</i> Fuzzy Logic (IDC-MA)					
14PHP15B	OR Statistical Techniques (IDC-ST)	3	25	75	100	2
14PHP15C	OR Web Designing using HTML & Java Script (IDC-CM)					
14PHP16A	<i>Cluster IDC - Practical</i> Fuzzy Logic Practical (IDC-MA)					
14PHP16B	OR Statistical Techniques Practical (IDC-ST)	3	40	60	100	2
14PHP16C	OR Web Designing using HTML & Java Script Practical (IDC-CM)					
-	Practical III Advanced Physics	-	-	-	-	-
-	Practical IV Advanced Physics	-	-	-	-	-

Fourth Semester

14PHP17	Microprocessor and its Applications	3	25	75	100	4
14PHP18	Digital Communications	3	25	75	100	4
14PHP19A	<i>Core Elective: II</i> Applied Solar Energy	3	25	75	100	5
14PHP19B	OR Nano Science and Nanotechnology					
14PHP20	Practical III Advanced Physics	6	40	60	100	4
14PHP21	Practical IV Advanced Physics	6	40	60	100	4
14PHP22	Project & Viva Voce	-	80	120	200	5
TOTAL						90



Since - 1947

UNIT – I (12 Hrs)

LAGRANGIAN FORMULATION: Mechanics of a single particle and a system of particles- Generalized coordinates and constraints – principle of virtual work and D'Alembert's principle – Lagrange's equation for a conservative system – velocity dependent potentials and dissipation function. **VARIATIONAL PRINCIPLE:** Hamilton's principle – Lagrange's equations of motion from this principle – extension of the principle to non-conservative and non-holonomic systems – conservation theorems and symmetry properties. **APPLICATIONS FOR LAGRANGIAN AND VARIATIONAL PRINCIPLE:** simple pendulum, compound pendulum, double pendulum, triple pendulum, dumb bell, Atwood's machine, simple harmonic oscillators, isotropic oscillator, particle moving on the surface of the sphere.

UNIT – II (12 Hrs)

TWO BODY CENTRAL FORCE PROBLEM: Reduction of two body problem to equivalent one body problem – equation of motion and first integrals – equivalent one-dimensional problem – classification of orbits – Virial theorem – application – differential equation for the orbit and integral power law potentials – Kepler's problem – inverse square law of force – scattering in a central force field – transformation of scattering problem to laboratory coordinates.

UNIT – III (12 Hrs)

MECHANICS OF RIGID BODY MOTION: Generalized coordinates for rigid body motion – Euler's integrals – infinitesimal rotations – Coriolis force – application of a free fall of a body on earth's surface and Foucault's pendulum – moments and products of inertia – Euler's equation of motion – force free motion of a symmetrical rigid body – heavy symmetrical top under gravity – fast top and sleeping top conditions.

UNIT – IV (12 Hrs)

HAMILTON FORMULATION: Hamilton's equation of motion – cyclic coordinates and Routh's procedure – conservation theorem – Hamilton's equation of motion from variational principle – principle of least action – canonical transformation – equations of canonical transformation and generating functions – examples of canonical transformations – integral invariance of Poincare-Lagrange and Poisson's brackets – equations of motion in Poisson bracket notation – Jacobi's identity- infinitesimal contact transformations – angular momentum – Poisson bracket relations – Liouville's theorem.

UNIT – V (12 Hrs)

HAMILTON – JACOBI THEORY AND SMALL OSCILLATIONS:

Hamilton-Jacobi equations for Hamilton's principle and characteristic functions – harmonic oscillator problem – separation of variable method – action angle variables – applications – linear harmonic

oscillator and Kepler problem – theory of small oscillations – Eigen value equations – normal modes and normal coordinates – application to triatomic molecule.

BOOKS FOR STUDY:

- 1.H.Goldstein : Classical Mechanics.
- 2.Gupta, S.L.Kumar and Sharma : Classical Mechanics.

REFERENCE BOOKS:

- 1.Gupta & Sathya Prakash : Classical Mechanics.
- 2.Rana & Joag : Classical Mechanics



UNIT - I (12 Hrs)

COMPLEX ANALYSIS: Analytic functions- Cauchy-Riemann equation- Laplace's equation: harmonic functions- line integral in complex plane- Cauchy's theorem- Cauchy's theorem for multiply connected regions- Derivatives of analytic functions- Taylor's series- Maclaurin series- singularities- types of singularities- calculus of residues- Cauchy's residues theorem.

Applications: Concept of equi-potential surfaces. Solution of two dimensional Laplace's equation as applicable to potential between (1) parallel plates (2) coaxial cylinders (3) steady state heat flow equation (4) temperature distribution of a conducting wire surrounded by a thermally conducting cylinder.

UNIT- II (12 Hrs)

INTEGRAL TRANSFORMS: Laplace transform- inverse transform- shifting theorems- transform of derivatives and integrals- convolution theorem- partial fractions- differentiation and integration of transform- transform of Dirac- Delta function. **Applications:** Electrical network- damped and undamped forced vibrations of a mass spring system. Fourier transform- inverse transform- cosine and sine transform- transform of derivatives- convolution theorem- transform of Gaussian function. **Applications:** Solving partial differential equations like (1) heat flow equation (2) wave equation (3) damped and undamped forced vibrations of a harmonic oscillator.

UNIT- III (12 Hrs)

PARTIAL DIFFERENTIAL EQUATIONS: Homogeneous and non homogeneous equations of first and second order partial differential equations- separation of variables techniques- solution by Fourier series- use of double Fourier series. **Applications:** (1) one dimensional wave equation (2) one dimensional heat flow equation (separation of variables and use of Fourier series). (3) two dimensional Laplace's equation in Cartesian coordinate (separation of variables and double Fourier series).

UNIT - IV (12 Hrs)

SPECIAL FUNCTIONS: Power series method for homogeneous linear differential equation with constant coefficients- solution of Legendre, Bessel, Hermite differential equations- generating functions, Rodrigue's formula- orthonormality relations- Sturm-Liouville's problems- orthogonal functions. **Applications:** (1) multipole expansion in electrostatics(Legendre polynomials) (2) partial wave analysis in plane wave expansion in Quantum mechanics(Bessel function) (3) orthogonal properties of the eigen functions of one dimensional harmonic oscillator using generating function.

UNIT- V (12 Hrs)

GROUP THEORY: Definition- subgroups- classes- Lagrange's theorem- homomorphism and isomorphism- symmetry operations on an equilateral triangle and a square- Group representation- irreducible and reducible representation- unitary transformations- Schur's Lemmas- orthogonality theorem- character table. **Applications:** Predicting the number of rotational and vibrational modes of

molecules (1) linear CO₂ molecule (2) non linear H₂O molecule (3) predicting the number of Rotational and Vibrational modes of NH₃.

BOOKS FOR STUDY:

Units 1-4:

1. Erwin Kreyzig, Advanced engineering mathematics, 8th edition, publishers-John Wiley & Sons, Inc, 2005.
2. S.Arumugan, A.Thangapandi Issac and A.Somasundaram, Engineering Mathematics, Vol I-III, first edition-publishers-Scitech publications (India) pvt. Ltd.

Unit 5:

1. Michael; Tinkham, Group theory and Quantum Mechanics-publishers-Tata McGraw-Hill Co. Ltd, TMH edition, 1974.
2. A.W.Joshi, Group theory for physicists Wiley Eastern Limited, 2nd Edition, 1997.

BOOKS FOR REFERENCE:

1. Pipes and Harvill-Applied mathematics for Engineers and physicists. Publishers-McGraw-Hill international bookcompany, 3rd edition, 1984.
2. Butkov; Mathematical physics, 1968.
3. Schaum's outline series, Theory and Problems of Fourier analysis, M.R.Spiegel, 2000.
4. Murray R.Spiegel, Theory and Problems of Fourier Analysis with Applications to Boundary Value Problems, Mchraw Hill book company, 2000.
5. Schaum's outline series, Theory and Problems of Laplace Transforms, Murray R.Spiegel, Mchraw Hill book company, 1989.
6. Introduction to partial Differential Equations, K. Sankara Rao, 2nd Edition, Prentice Hall of India, 2005.
7. Greenberg M.D, Advanced engineering mathematics, publishers-pearson education (Singapore) pvt. Ltd, 2nd edition, 2002.
8. Bell: Special functions for scientists and Engineers, 1968.

UNIT I (12 Hrs)

EQUATION OF MOTION & APPLICATION OF SCHRÖDINGER'S EQUATION State Vectors-Hilbert Space-Dirac Notation-Dynamical Variables as Operators- Change of Basis-Unitary Transformation-Equation of Motion in Schrodinger Picture, Heisenberg Picture & Dirac Picture.

UNIT - II (12 Hrs)

APPROXIMATE METHODS: Time Independent Perturbation Theory in Non-Degenerate Case-Ground State of Helium Atom- Degenerate Case-Stark Effect in Hydrogen-Variation Method its Application to Hydrogen Molecule- WKB Approximation.

UNIT - III (12 Hrs)

TIME DEPENDENT PERTURBATION THEORY: Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation-Transition Probabilities-Selection Rules for Dipole Radiation-Collision-Adiabatic Approximation

UNIT - IV (12 Hrs)

ANGULAR MOMENTUM: Orbital Angular Momentum-Spin Angular Momentum-Total Angular Momentum Operators- Commutation Relations of Total Angular Momentum with Components-Ladder Operators-Commutation Relation of J_z with J_+ and J_- - Eigen Values of J^2 , J_z -Matrix Representation of J^2 , J_z , J_+ and J_- - Addition of Angular Momenta- Clebsch Gordon Coefficients-Properties.

UNIT - V (12 Hrs)

RELATIVISTIC WAVE EQUATION: Klein Gordon Equation, charge- current four vector non-relativistic limits- Dirac equation- Dirac Matrices- Free Particle solution- spin Angular momentum-Significance of negative energy, electron in a magnetic field- Spin magnetic moment- Spin orbit energy covariant form of the Dirac equation- gamma matrices and their properties.

BOOKS FOR STUDY & REFERENCE:

1. Quantum Mechanics-Gupta, Kumar & Sharma 23rd Edition, 2003-2004

2. Quantum Mechanics-Satyaprakash
3. Quantum Mechanics-L.I. Schiff- McGraw Hill, 3rd Edition, 1968
4. Quantum Mechanics-E. Merzbacher-Wiley and Sons, 3rd Edition, 2004
5. Quantum Mechanics-A. Devanathan-Narosa Publishing-New Delhi, 2005
6. A Text Book of Quantum Mechanics-P.M. Mathews & K. Venkatesan-Tata McGraw Hill. 29thReprint, 2002
7. Principles of Quantum Mechanics-R.Shankar, Springer, 2005.



UNIT - I (12 Hrs)

FOURIER OPTICS: Introduction to diffraction—general aspects. Fraunhofer and Fresnel diffraction. Scalar diffraction theory, Helmholtz equation and Greens theorem approach to Fresnel and Fraunhofer diffraction, the Huygens principle. Fourier transform in Fraunhofer diffraction. Fresnel transform, Fresnel diffraction such as square aperture, sinusoidal amplitude grating. Fractional Fourier transform. Fourier transform properties of lenses.

UNIT - II (12 Hrs)

PHYSICAL OPTICS: Interference with multiple reflections – Method of complex amplitude – Fabry Perot interferometer – Chromatic resolving power – Comparison of wavelength with interferometer – Interference filters – Fraunhofer diffraction – single, double and N slits- Polarization of Light – production, detection and analysis of plane, elliptically and circularly polarized light – Fresnel and index ellipsoids – uniaxial and biaxial crystals- conical refraction – Interference with polarized light- electro and magneto optic effects.

UNIT - III (10 Hrs)

FIBRE OPTICS: Introduction – Optical fibre- Numerical aperture – Coherent bundle- fibre optic communication system – pulse dispersion in step index fibres – Graded index fibres – material dispersion – single mode fibres- fibre optic sensors – Holography – Gabor and Upatnik holography – construction and reconstruction- Applications.

UNIT - IV (13 Hrs)

NON LINEAR OPTICS: Nonlinear optical susceptibility, wave equation description of nonlinear optical interactions – Sum frequency generation, Difference frequency generation, Second Harmonic generation, Phase matching condition - Quantum mechanical theory of nonlinear optical susceptibility - Second harmonic generation, parametric processes, 3rd order nonlinear optics, Kerr type nonlinearities, 4-wave mixing, self focusing collapse, optical breakdown, two beam coupling, electro optics and photorefractive effects.

UNIT – V (13 Hrs)

NANO OPTICS : Nanoscale optical microscopy – far field illumination and detection, near field illumination and far-field detection, far field illumination and near field detection, energy transfer microscopy. Near –field optical probes- Probe –sample distance control. Light emission and optical interactions in nanoscale environments- multipole expansion, radiating electric dipole, spontaneous decay, delocalized excitations, Quantum emitters, dipole emission near planar interfaces, Light in periodic structures: Photonic crystals and resonators, Surface plasmons. Meta materials.

BOOKS FOR STUDY:

UNIT I Introduction to Fourier Optics, J. W. Goodman, McGraw-Hill. Third Edition, 2004

UNIT II & III A text book of Optics – A.Ghatak TMH edition

UNIT IV Nonlinear optics, second Edition, Robert W Boyd, Academic Press (2003)

UNIT V Principles of Nano-optics, L Novotny & B Hecht, Cambridge Univ. Press (2006)



UNIT – I (11 Hrs)

BASIC PROPERTIES OF NUCLEUS: Nuclear size, angular momentum, magnetic dipole moment, electric quadrupole moment – Experimental determination - parity - Nuclear mass – mass spectrometer – binding energy – Weizasckar’s semi empirical mass formula – Nuclear stability – mass parabolas – shell model of the nucleus – shell structures – predictions of shell model .

UNIT – II (10 Hrs)

RADIOACTIVITY: Potential well – Alpha decay – Gamow’s theory of alpha decay – Geiger – Nuttall law – Beta ray spectrum – Neutrino hypothesis – Fermi’s theory of Beta theory – Kurie plot – Coulomb effect on beta decay – Fermi and GT selection rules – Non-conservation of parity in beta decay Gamma decay – Internal conversion – Nuclear isomerism – Multipole radiations – Angular momentum and parity of nuclear levels.

UNIT – III (11 Hrs)

THE TWO BODY SYSTEMS AND NUCLEAR FORCES: General properties of nuclear forces – Charge independence and spin dependence of nuclear forces – Exchange forces – Yukawa’s theory – Theory of ground state of deuteron – predictions about the n-p interaction – photodisintegration of deuteron – nuclear scattering cross sections – low energy n-p scattering – phase shift analysis, scattering length and effective range – Determination of the phase shift – partial wave analysis of n-p scattering – Born approximation.

UNIT – IV (10 Hrs)

NUCLEAR REACTIONS AND NUCLEAR ENERGY: General feature of cross sections – inverse reaction and detailed balance – The compound Nucleus – energy levels – Excitation energy of the compound nucleus – Resonance reaction – Briet – Wigner and level formula – Liquid drop model of the nucleus – nuclear fission – Features of nuclear reactor design – Neutron diffusion equation – Super and subcritical reactors..

UNIT – V (10 Hrs)

ELEMENTARY PARTICLES: Classification of elementary particles – Decay modes – General idea of strong weak and electromagnetic interactions – Conservation law – Strangeness – Gellman – Nishigama relation – Electro-weak interaction – Higg’s mechanism– SU_2 , SU_3 symmetry – Quark model.

BOOKS FOR SYUDY:

1. D. C. Tayal - Nuclear Physics
2. Duff - Elementary Particles

REFERENCE BOOKS:

1. Srivatsava : Basic Nuclear Physics
2. Segre : Nuclei and Particles
3. Evans : Atomic Physics
4. Preston : Nuclear structure

5. Cohen : Nuclear Physics
6. Sacks : Nuclear Theory
7. Lamarsh : Reactor Theory
8. Griffiths : Elementary Particles.



Since - 1947

UNIT – I (11 Hrs)

CRYSTAL STRUCTURE, DIFFRACTION AND CRYSTAL BINDING: Unit cells and Bravais lattices – Simple crystal structure – Diffraction of X-rays according to Laue and Bragg –Relative comparison of X-ray diffraction with diffraction of electrons and neutrons- Reciprocal lattice and Brillouin zone. Different type of crystal binding – Ionic, covalent molecular or Vander wall's metallic and Hydrogen bonding –Born's theory -Born Haber cycle - London interaction – Leonard Jones potential.

UNIT – II (10 Hrs)

FREE ELECTRON THEORY AND BAND THEORY: Free electron gas – electrical conductivity – Fermi surface – Effects of Fermi surface –failure of free electron model. Bloch theorem – Kronig Penney potential- calculations of energy bands -The hole – electrical conductivity, cyclotron resonance and Hall effect– experimental methods in the determination of Band structure namely, Soft X-ray emission, cyclotron resonance and optical U-V techniques

UNIT- III (10 Hrs)

CRYSTAL IMPERFECTION AND SUPER CONDUCTIVITY: Types of imperfection – Vacancies – Diffusion – Dislocation and Mechanical Strength of Metals – Ionic Conductivity – color centers. Super conductivity – Type I and II Super Conductors – Isotope effect – Tunneling and Josephson effect – Theory of super conductivity – Electrostatics of Super Conductors.

UNIT – IV (11 Hrs)

LATTICE VIBRATIONS, DIELECTRICS AND OPTICAL PROPERTIES OF SOLIDS: Specific heat ; models of Einstein and Debye - The phonon – Lattice curves (monoatomic and diatomic lattices). The Dielectric constant and polarizability –Types of Polarizability – Inter band transition in solids – Piezo –electricity – Ferro electricity – Ferro electric domains.

UNIT – V (10 Hrs)

MAGNETISM AND MAGNETIC RESONANCES: Classification of Materials – Langevin Dia Magnetism – Para Magnetism – Anti-ferromagnetism and ferromagnetism – Ferromagnetic domains – Nuclear Magnetic Resonance –Para and ferromagnetic resonance.

BOOKS FOR STUDY:

1. A.J.Dekkar : Solid State physics
2. M.A.Omar : Elementary solid state physics
3. Gupta S.L. & V.Kumar : Solid state physics

REFERENCE BOOKS:

1. C.Kittel : Introduction to solid state physics

2. R.K.Puri, V.K.Babbar – Solid State Physics.
3. P.K.Palanisamy – Solid State Physics-Sci Tech Public (I)Ltd. Fourth edition 2004



Since - 1947

UNIT - I (10 Hrs)

SCATTERING THEORY: Scattering Amplitude-Expression in terms of Green's Function-Born Approximation and its Validity- Partial Wave Analysis-Phase Shifts-Scattering by Coulomb and Yukawa Potential

UNIT - II (10 Hrs)

APPLICATION TO ATOMIC STRUCTURE: Central Field Approximation-Thomas Fermi Model-Hartree's Self Consistent Model-Hartree Fock Equation-Alkali Atoms-Doublet Separation- Intensities-Complex Atoms-Coupling Schemes

UNIT - III (11 Hrs)

APPLICATION TO MOLECULAR STRUCTURE: Hydrogen Molecule Ion-Hydrogen Molecule-Heitler London Method-Covalent Bond-Spin Orbit Interaction as Correction to Central Field Approximation- Hartree Fock Self Consistent Field Method for Molecules-Hybridisation.

UNIT - IV (10 Hrs)

THEORY OF RADIATION (SEMI CLASSICAL TREATMENT): Einstein's Coefficients-Spontaneous and Induced Emission of Radiation from Semi Classical Theory- Radiation Field as an Assembly of Oscillators-Interaction with Atoms-Emission and Absorption Rates- Density Matrix and its Applications

UNIT -V (11 Hrs)

QUANTUM FIELD THEORY: Quantization of Wave Fields- Classical Lagrangian Equation-Classical Hamiltonian Equation-Field Quantization of the Non-Relativistic Schroedinger Equation-Creation, Destruction and Number Operators-Anti Commutation Relations-Quantization of Electromagnetic Field Energy and Momentum.

BOOKS FOR STUDY & REFERENCE:

1. A Text Book of Quantum Mechanics-P.M. Mathews & K. Venkatesan-Tata McGraw Hill 29th Reprint 2002
2. Quantum Mechanics-Gupta, Kumar & Sharma, 23rd Edition, 2003-2004
3. Quantum Mechanics-Satyaprakash

4. Introduction to Quantum Mechanics-A.K. Chandra-Tata McGraw Hill
5. Quantum Mechanics-Merzbacher-John Wiley & Sons3rd Edition,2004
6. Quantum Mechanics-Devanathan-Narosa Publishing-New Delhi, 2005
7. Quantum Mechanics-Aruldas, 2002
8. Quantum Mechanics-A.K. Ghatak and S. Loganathan-McMillan India 4th Edition, 1999
9. Quantum Mechanics-Messiah (North Holland)1970
10. Quantum Mechanics-L.I. Schiff- McGraw Hill 3rd Edition, 1968
11. Principles of Quantum Mechanics-R.Shankar, Springer, 2005



14PHP08 APPLIED THERMODYNAMICS AND STATISTICAL MECHANICS
Semester: II/52Hrs

UNIT I (10 Hrs)

Basic idea of statistical ensembles and of probabilities. Probabilities of micro- and macro- states; characteristics of probability function, mean, variance and standard deviation; sharpness of the probability distribution of a macroscopic variable; correlation of two random variables.

UNIT II (11 Hrs)

MICROCANONICAL ENSEMBLE: probabilities of microscopic states in an isolated system at equilibrium; example of equilibration in the system of spins; thermal equilibrium of two arbitrary systems; definition of temperature; entropy in microcanonical ensemble; additivity of entropy; the postulate of entropy increase in an isolated system (second Law of Thermodynamics); the direction of heat flow. Canonical ensemble: Boltzmann Distribution; partition function; microscopic state probabilities; average energy of a system in thermal equilibrium.

UNIT III (11 Hrs)

THERMODYNAMIC EQUILIBRIUM AND THERMODYNAMIC PROCESSES: characteristic time scales; reversible and irreversible processes; quasi-stationary process; examples of quasi-stationary heat transfer and of work. Heat and Work in thermodynamics; First Law of Thermodynamics; differential relations between thermodynamic quantities; Maxwell relations; enthalpy; heat capacity; intensive and extensive quantities; entropy, pressure and heat capacity of a classical ideal monoatomic gas.

UNIT IV (10 Hrs)

HEAT CAPACITY OF SOLIDS: Dulong-Petit law; classical treatment of the problem; deviations from Dulong-Petit law; Einstein theory of heat capacity; Einstein temperature; Debye theory; Debye temperature; phonons; heat capacity of diatomic gas. Grand Canonical ensemble: chemical potential; Gibbs Distribution; grand partition function; grand thermodynamic potential and its relation to grand partition function.

UNIT V (10 Hrs)

HEAT ENGINES: perpetuum mobile of first and second type; Kelvin-Planck and Clausius formulations of second law of Thermodynamics; PV-diagram of processes in a heat engine; efficiency of a heat engine; isothermal, isobaric, isochoric and adiabatic processes; Carnot cycle; refrigerators.

BOOK FOR STUDY AND REFERENCES:

1. C. Kittel and H. Kroemer, Thermal Physics, WH Freeman & Co, USA.
2. F. Reif F, Fundamentals of Statistical and Thermal Physics, McGraw-Hill, NY, 1965, QC 175.R43

14PHP09

Group Theory and

Semester: II

Molecular Spectroscopy-IDC (50Hrs)

UNIT-I

Group Theory

(10 Hrs)

Symmetry operations and Symmetry elements – Group multiplication table – sub groups and class – reducible and irreducible representation – Great orthogonality theorem – construction of character table.

UNIT-II

Group Theory in molecular vibrations

(10 Hrs)

Normal modes of vibration – activity and inactivity of IR and Raman frequencies (XY_2 bent symmetrical and XY_3 pyramidal) – construction of character table XY_2 bent symmetrical type molecules .

UNIT-III

(10 Hrs)

IR Spectroscopy

Theory and principle – Instrumentation (single beam) – sampling methods – Interpretation of IR spectrum of some functional group vibrations – FTIR spectroscopy – ATR Technique – FTIR micro spectroscopy.

UNIT IV

Raman Spectroscopy

(10 Hrs)

Principle and theory – Instrumentation (single beam) – Degree of depolarization – surface enhanced Raman spectroscopy.

Applications of IR and Raman Spectroscopy

(10 Hrs)

Molecular structural determination of XY_2 (C_{2v}), XY_3 (C_{3v}) type molecule – construction of G matrix elements – FG matrix method – Force field calculations.

UNIT-V

UV Visible Spectroscopy

(10 Hrs)

Absorption laws- Formation of absorption bands – theory – electronic excitations – types of transitions – Transition probability – Chromophores and auxochromes – absorption and intensity shifts – Types of adsorption bands – solvent effects – conjugated systems –

extended conjugation – aromatic systems – Woodward Fisher rules for calculating adsorption maximum in dienes – enones and aromatic systems –Fischer Kuhn rules for calculating adsorption maximum in polyenes – Instrumentation – applications of UV-visible spectroscopy to organic compounds.

NMR Spectroscopy

Theory – chemical shifts. Factors influencing chemical shift –inductive effect, anisotropic effect, ring current and solvent effects. Spin- spin coupling. – Geminal, vicinal, cis, trans and aromatic coupling. Relaxation process. Conversion of non first order spectra to first order spectra –Increase in field strength, spin decoupling and chemical shift reagents.

Text Book

1. Symmetry and Spectroscopy of molecules, K. Veera Reddy, New Age International Ltd. Publishers, 1998.



ANY 15 EXPERIMENTS*

1. F.P Etalon – Thickness of air film.
2. L.G. Plate – Thickness and resolving power.
3. Arc Spectra – copper/ Iron.
4. Arc Spectra – Alloy.
5. Elastic constants of the material– Elliptical fringes.
6. Elastic constants of the material– Hyperbolic fringes.
7. Biprism on optic bench – wavelength determination.
8. Angle of biprism by optic bench.
9. Determination of Stefan’s constant.
10. Forbe’s Apparatus – Thermal conductivity.
11. Thermistor characteristics and band gap measurements.
12. Solar spectrum – Rydberg’s constant.
13. B.H.Curve – using CRO
14. Determination of wavelength of laser source – transmission grating
15. Determination of wavelength of laser source – reflection grating
16. Refractive index of liquids using laser.
17. Measurement of direct, diffused and total components of solar radiations.
18. Determination of Figure of merit- F1 of solar collector by stagnation test.
19. Performance analysis of solar absorber coatings.
20. Polarisation of light and verification of Malu’s Law.
21. Measurement of Temporal and Spatial coherence of Laser Source.

*Subject to the availability of classes, equipments, etc.,

ANY 15 EXPERIMENTS

1. Design and study of an astable multivibrator.
2. Design and study of a monostable multivibrator.
3. Design and study of a bistable multivibrator.
4. Design and study of a Schmitt trigger.
5. Characteristics of UJT.
6. Design and study of FET amplifier.
7. Construction and study of scaling circuits.
8. Construction and study of counters with direct feedback.
9. Construction and study of counters with inverse feedback
10. Construction and study of up/down counter using 74190.
11. Construction and study of 4bit binary adder and subtractor.
12. Construction and study of wave form generators – OPAMP 741.
13. Construction and study of current to voltage converter-OPAMP741.
14. Construction and study of voltage to frequency converter- OPAMP741.
15. Construction and study of BUTTERWORTH filters- low pass-high pass filters –etc - OPAMP741.
16. Construction and study of Schmitt trigger – OPAMP741.
17. Construction and study of D/A converter – OPAMP741.
18. Study of A/D converter.
19. Application of PLL.
20. Modulator and Demodulator circuits.

* If feasible EDA tools will be used during teaching the practical and in the examination.

UNIT- I (12 Hrs)

Interaction of radiation with matter: absorption ,spontaneous emission and stimulated emission – Einstein’s coefficients – relation connecting them – principle of laser action – properties of laser beams(qualitative explanations only) – coherence – temporal and spatial coherence monochromaticity – directionality – brightness - conditions for laser oscillations – Laser safety..

UNIT- II (12 Hrs)

Pumping process – optical pumping – electrical pumping – pumping efficiency – resonators: various types of resonators – theory and design of spherical resonators – condition for stability – types of stable configurations – laser mirrors: metallic, crystalline and dielectric multilayer mirrors – rate equations – three level and four level lasers – quality factor – switching and mode locking of lasers – active and passive methods of mode locking.

UNIT- III (12 Hrs)

TYPES OF LASERS: Solid state lasers: ruby laser – Nd-YAG laser – Neutral atom laser – He-Ne laser – ion laser Ar^+ laser – metal vapor laser – He-Cd laser He-Se laser – Excimer laser – N_2 laser – semiconductor laser – Ga As laser – CO_2 laser – dye laser

UNIT -IV (12 Hrs)

APPLICATIONS: Holography – Holographic computer memories – Nuclear fusion – industry medicine – laser tracking – Measurement of distance – Interferometric methods-Beam modulation telemetry- Pulse echo techniques (LIDAR)

UNIT -V (12 Hrs)

LUMINESCENCE AND DISPLAY DEVICES: Luminescence: Photoluminescence – cathode luminescence – CRT – electro luminescence –Radioactive recombination process: interband transitions – impurity center recombination – excitation recombination – LED materials LED construction – response times of LED’s – LED drive circuitry – Liquid crystal display – Numeric displays.

BOOKS FOR STUDY:

- 1.Orazio Svelto – Principles of Lasers (Plenum press)
- 2.Thyagarajan And Ghatak – Lasers – Theory and Applications (Macmillan India Ltd)
- 3.J.Wilson And J.F.B.Hawkes – Optoelectronics an introduction (Printice-Hall of India Pvt.Ltd)
- 4.Ross – LASERS

14PHP13 ELECTROMAGNETIC THEORY Semester: III/60Hrs
UNIT-I (12Hrs)

ELECTROSTATIC FIELDS IN A VACCUM: The equations of Poisson and of Laplace – Conductors – Calculation of the Electric Field produced by a simple Charge distribution. – The Electric Dipole – The Linear Electric Quadrupole – Electric Multipoles.

DIELECTRIC MATERIALS: The electric Polarization – Electric Field at an exterior point - Electric Field at an interior point – The local field – The electric Susceptibility – The Divergence of E. The electric displacement – D – Calculation of Electric fields involving Dielectrics – The Clausius – Mossotti Equation

UNIT – II (12 Hrs)

POLAR DIELECTRICS: Frequency dependence, anisotropy and distribution in the presence of dielectrics – Forces on conductors in the presence of dielectrics.

STEADY CURRENT AND NON MAGNETIC MATERIALS: Magnetic forces – Magnetic induction B. The Biot – Savart law – The divergence of a point charge moving in a magnetic field – The divergence of the magnetic induction B – The vector potential – The curl of the magnetic induction B – Ampere’s circuital law

UNIT – III (12 Hrs)

MAGNETIC FIELDS: The Faraday’s induction law – The induced electricfield intensity E In terms of the vector potential A – Induced electromotance in a moving system- Inductance and induced electromotance.

MAXWELL’S EQUATIONS: The conservation of electric charge – The potentials V and A – The Lorentz condition – The divergence of E and the non homogeneous wave equation for V - the non homogeneous wave equation for A – The curl of B – Maxwell’s equations

UNIT IV (12 Hrs)

PROPAGATION OF ELECTROMAGNETIC WAVES I : Plane waves in infinite media: Plane electromagnetic waves in free space – The E and H vectors in homogeneous, Isotropic, linear and stationary media

PROPAGATION OF ELECTROMAGNETIC WAVES II : Propagation of plane electromagnetic waves in non conductors - Propagation of plane electromagnetic waves in conducting media - Propagation of plane electromagnetic waves in good conductors.

UNIT V (12 Hrs)

GUIDED ELECTROMAGNETIC WAVES: Propagation in straight line –TE and TM Waves – TEM Waves – Boundary conditions- The coaxial line – The hollow rectangular wave guide- The TE Waves- Internal Reflections – Energy Transmission – Attenuation.

RADIATION OF ELECTROMAGNETIC WAVES: Electric dipole radiation – The scalar potential – The vector potential A and the magnetic field intensity – The electric field intensity E – The average pointing vector and the radiated power – The electric and magnetic lines of force – The $K\lambda$ surface.

BOOK FOR STUDY:

1. Electromagnetic Fields and Waves – Paul Lorrain & Dale R. Corson – CBS Publ. New Delhi- II Edition.

BOOK FOR REFERENCE:

1. Introduction to Electrodynamics-David J.Griffiths I-Edition, Prentice-Hall of India Private Ltd. New Delhi.



CORE ELECTIVE - I

14PHP14A

CRYSTAL GROWTH, THIN FILMS AND PLASMA PHYSICS Semester: III/60 Hrs

UNIT – I (12 Hrs)

THEORIES OF CRYSTAL GROWTH: Nucleation Concept- Kinds of nucleation – Classical theory of nucleation -Surface energy theory – Diffusion theory – Bravis and Kossel theory – Stranski’s treatment – two dimensional nucleation theory – surface diffusion of growth theory – Temkin model – Methods of Finding Growth rate. –BCF Theory of Crystal Growth

UNIT – II (11 Hrs)

CRYSTAL GROWTH EXPERIMENTAL TECHNIQUES:

Growth from Melt:

Bridgman Method – Kyropoulos Method – Czochralski Method – Verneuil Method – Zone Melting Method.

Growth From Vapor:

Physical Vapor Deposition- Chemical Vapor Transport- Open and Closed System-Physical, thermo-chemical factors affecting growth process.

Growth From Solutions:

Solubility- Preparation of Solution- Saturation and Super Saturation- Measurement and Expression of Super Saturation- Slow Coating Method- Mason- Jar Method.

UNIT – III (11 Hrs)

METHODS OF PREPARATION: Thermal evaporation – General Considerations – Evaporation Methods – Sputtering – Sputtering Process – Sputtering Variants – Chemical Methods – Electrode less deposition – Basics of Thin Film Growth.

UNIT – IV (12 Hrs)

THICKNESS MEASUREMENTS AND APPLICATIONS: Electrical Methods – Microbalance Monitors – Mechanical Methods – Radiation Absorption and Radiation Emission Methods – Optical Interference Methods. Thin Film Optical devices – Antireflection Coating – Interference filters – Thin Film Resistors and Capacitors – Tribological Coating

UNIT – V (14 Hrs)

PLASMA PHYSICS: Plasma state - occurrence in nature – Definition of Plasma – concept of temperature – Debye Shielding – The Plasma parameters – Criteria for Plasma – Classification of Plasmas - Thermal and Non-thermal Plasmas – Applications of Plasma physics (Basic) - Magnetohydrodynamic generator (MHD) – Basic theory of MHD – Principle of working– Plasma diode.

BOOKS FOR STUDY AND REFERENCES:

1. A.Goswami-Thin Film Techniques, New Age International Pvt Ltd Publishers (December 1, 2008)
2. K.L.Chopra-Thin Film Phenomena,Mc Graw Hill Pub.
3. K. Sangwal- Elementary Crystal Growth, Saan Pub. UK,1994

4. P.Santhana Ragavan & P.Ramasamy -Crystal Growth and Process, KRV Pub. Kumbakonam, 2000.
5. J.C.Brice-Crystal Growth Process, John Criley Pub., NewYork,1986.]
6. L.I.Maissel and R.Glang-Hand Book of Thin film Technology, Mc Graw Hill Pub.,1970.
7. B.R.Pumplin- Progress in Crystal Growth Characterization Program on press Ltd.UK,1982
8. Milton Ohuing - Material Science of Thin films - Academic press [II- edition], 1991.
9. Frenchie F chen : introduction to plasma and controlled Fusion vol . plasma physics (Plenum press)
10. Nocholas A Krail and Alvin W Trivelpiece – Principles of plasma physics (McGraw Hillkoggusha Ltd).
11. Plasma physics- plasma state of matter – S.N.Sen, Pragati Prakashan, meerut



Since - 1947

CORE ELECTIVE - I

14PHP14B MOLECULAR SPECTROSCOPY Semester: III/60 Hrs

UNIT – I (10 Hrs)

IR SPECTROSCOPY: Introduction – Theory of IR Absorption spectroscopy and energy levels. Instrumentation – modes of vibration of atoms in polyatomic molecules. IR positions of various bond-vibrations – Applications of IR spectroscopy – Basic Principles of F-T. IR spectroscopy – FTIR spectroscopy.

UNIT – II (11 Hrs)

RAMAN SPECTROSCOPY: Introduction – Mechanism of Raman effect – classical theory of Raman effect – effect of vibration – effect of rotation – Quantum theory of Raman effect – pure rotational Raman spectra – vibrational – Rotational Raman spectra – Experimental techniques and applications – Laser Raman Spectroscopy.-Laser Surface Enhancement resonance Spectroscopy.(LSERS)

UNIT – III (11 Hrs)

RESONANCE SPECTROSCOPY:

NMR SPECTROSCOPY: Theory of Nuclear magnetic resonance, Conditions for resonance – the Bloch equation relaxation process - The experimental technique – single and double coil methods – chemical shifts – Applications of NMR - Crystal field splittings.

ESR SPECTROSCOPY: Basic principles of ESR – Experimental technique – ESR spectrometer - Hyperfine structure – relaxation phenomena – Applications.

UNIT – IV (10 Hrs)

NQR SPECTROSCOPY: General principle of NQR - Experimental detection of NQR Frequencies – Interpretation and Chemical explanation of NQR spectroscopy.

MICROWAVE SPECTROSCOPY: Introduction – Experimental methods – Theory of microwave spectra of linear symmetric top molecules – Hyperfine structure – quadrupole moment – Satk modulation spectrometer. Inversion spectrum of the Ammonia

UNIT – V (10 HOURS)

MOLECULAR MECHANICS: Introduction – theory – formulation – bond – Stretching – Angle bonding – Torsional angles – Van der Waals – electrostatics – Cross terms – Heats of formation – parameterization – Evaluation of Heats of Formation and strain energies.

MOSSBAUER SPECTROSCOPY: Principles and theory of Mossbauer effect – Mossbauer Instrumentation – Important chemical applications – Magnetic properties of Fe-doped materials.

BOOKS FOR STUDY:

1. Cotton: Group Theory-For UNIT I

2. Gurdeep Chatwal Et.al: Instrumental methods of chemical Analysis- For UNITS II, III,IV and V.
3. Introduction to molecular spectroscopy- Banwell

REFERENCE BOOKS:

1. Chang: Principles of spectroscopy
2. Wilson Etal : Molecular vibrations
3. Stranghan and Walker – Spectroscopy vol. II
4. J.Philip Bowen and N.L.Allinger – Molecular Mechanics: The Art and Science of Parameterization.



CLUSTER – IDC THEORY

14MAP12B/14STP16B/

14CMP22C

PHYSICS FOR MATHEMATICAL SCIENCES (THEORY)

(for MSc Mathematics, MSc Statistics and MSc Computer Science)

Semester: III/39 Hrs

UNIT-I (8 Hrs)

Newton's laws of motion, Using Newton's second law: Dynamics of particle, Application of Newton's third law, Muzzle velocity of the bullet,

UNIT II (8 Hrs)

Spherical polar coordinates, dynamics of circular motion. Momentum, impulse, collisions.

UNIT III (7 Hrs)

Molecular speeds, Heat capacities of gases, Planck and Wein's laws. Numerical solution to Schrödinger's wave equation.

UNIT-IV (8 Hrs)

Ideal gas equation, Van-der-Waals equation, Black body radiation, Molecular properties of matter, Kinetic molecular model of an ideal gas.

UNIT- V (8 Hrs)

'de-Broglie – Bohr' model of atom, Bohr's theory of atomic structure, Lorentz force, Use of matrix in symmetry operation.

BOOKS FOR STUDY & REFERENCE:

1. University Physics by Young and Freedmann Addison Wiley Pub Co (2005)
2. MathCAD for introductory Physics by Denis Donnelly, Siena College
3. The MathCAD 2001i Handbook (Programming Series) by D. Kiryanov
4. Solving Dynamics Problems with MathCAD by Brian Harper
5. Solving static's Problems with MathCAD by J.L.Mariam.



CLUSTER – IDC PRACTICAL

14MAP13B/14STP17B/ PHYSICS FOR MATHEMATICAL SCIENCES (PRACTICAL)

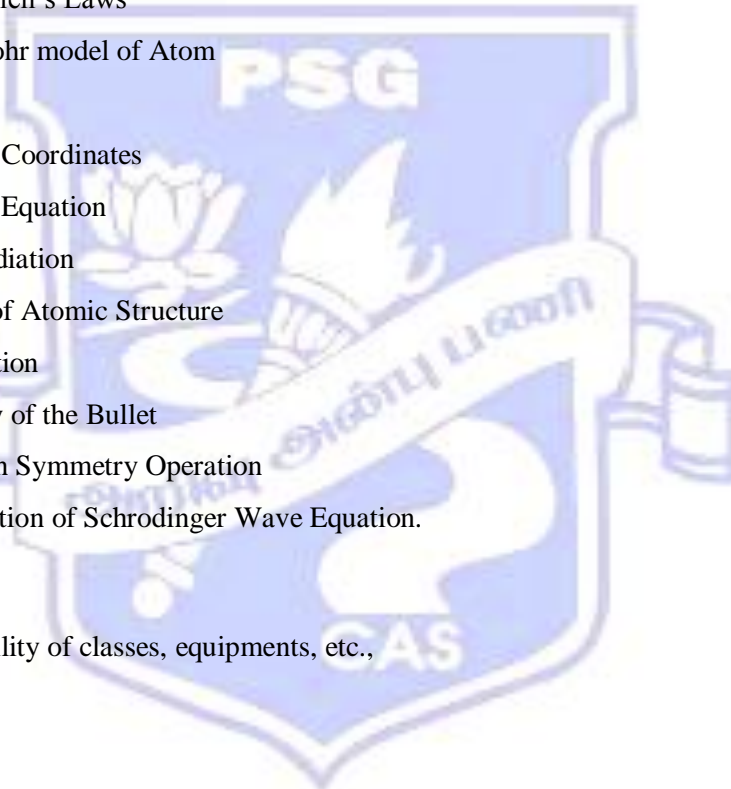
14CMP23C (for MSc Mathematics, MSc Statistics and MSc Computer Science)

Semester III

ANY 8 EXPERIMENTS

1. Planck's and Wien's Laws
2. De-Broglie - Bohr model of Atom
3. Lorentz Force
4. Spherical Polar Coordinates
5. Van-der-Waals Equation
6. Black Body Radiation
7. Bohr's Theory of Atomic Structure
8. Ideal Gas Equation
9. Muzzle velocity of the Bullet
10. Use of Matrix in Symmetry Operation
11. Numerical Solution of Schrodinger Wave Equation.

* Subject to the availability of classes, equipments, etc.,



Since - 1947

UNIT – I (12 Hrs)

MICRO COMPUTERS, MICRO PROCESSOR AND ASSEMBLY LANGUAGE:

Digital computers – computer languages – from large computers to single – chip microcomputers. Microprocessor Architecture and its operations – Memory – input and output (I/O) Devices – Examples of a microcomputer system – Review: Logic Devices for interfacing.

8085 MICRO PROCESSOR ARCHITECTURE AND MEMORY INTERFACING: The 8085 MPU – Example of a Microcomputer – Memory – input and output displays – How does an 8085 – Based Single Board Micro computer work.

UNIT – II (12 Hrs)

INTRODUCTION I/O 8085 ASSEMBLY LANGUAGE PROGRAMMING: The 8085 programming model – instruction classification – instruction format – How to write, Assemble and Execute a simple program – Overview of the 8085 instruction set. Data Transfer (copy) operations – Arithmetic operations – Logic operations – Branch operations – Writing assembly language programs – Debugging a program.

PROGRAMMING TECHNIQUES WITH ADDITIONAL INSTRUCTIONS: Programming techniques; Looping, counting and indexing – Additional Data transfer and 16-bit Arithmetic instructions – Arithmetic operations Related to Memory – Logic operations: rotate – Logic operations; Compare – dynamic Debugging.

UNIT - III (12 Hrs)

COUNTERS AND TIME DELAYS: Counter and Time delays – illustrations five program; Hexadecimal counter - Illustrative program: Generating pulse wave forms – Debugging counter and Time – Delay programs.

INTERFACING DATA CONVERTERS: Digital-to- Analog (D/A) converters – Analog-to-Digital (A/D) converters.

PROGRAMMABLE INTERFACE DEVICES: Basic concepts in programmable devices – The 8155/8156 and 8355/8755 multi purpose programmable devices – The 8276 programmable key board /display interface.

UNIT – IV (12 Hrs)

GENERAL – PURPOSE PROGRAMMABLE PERIPHERAL DEVICES: The 8255A programmable peripheral interface – illustration: interfacing keyboard and seven – segment display – illustration: Bi-directional data transfer between two micro computers – The 8254(8253) programmable interval timer – The 8259A programmable interrupt controller – Direct memory access (DMA) and the 8257 DMA controller.

UNIT – V (12 Hrs)

SERIAL I/O AND DATA COMMUNICATION: Basic concepts in serial I/O – Software – controlled Asynchronous Serial I/O – The 8085 – Serial I/O Lines SOD and SID – Hardware – controlled serial I/O using programmable chips.

MICRO PROCESSOR APPLICATIONS: Designing scanned displays – interfacing a matrix keyboard – Memory design – 8085 – MPU Design – Designing a system : Single – Board Micro computer – STEFFER motor controller- TRAFFIC Light signal controller.

BOOKS FOR STUDY:

1. Ramesh.S.Gaonkar – Microprocessor Architecture Programming and Application

BOOKS FOR REFERENCE:

1. A.P.Mathur: Introduction to Microprocessor.

2. L.A. Leventhal: Introduction to Microprocessor Hardware, Software, programming.



Since - 1947

UNIT - I (12 Hrs)

SINGLE SIDEBAND COMMUNICATION SYSTEMS: Single sideband systems - mathematical analysis of suppressed carrier AM- ring and FET push pull balanced modulators - single side band transmitters and BFO receivers - ISB.

UNIT - II (12 Hrs)

ANGLE MODULATION: Angle modulation - mathematical analysis - phase deviation and modulation index - frequency deviation and percent modulation - deviation ratio - commercial broadcast band FM - Direct FM and P M modulators using varactor diode - frequency up conversion – phase locked loop direct FM transmitter - Armstrong indirect FM transmitter - FM receiver block diagram - FM de modulation using PLL only -limiter circuits - FM vs PM.

UNIT - III (12 Hrs)

DIGITAL MODULATION, TRANSMISSION, MULTIPLEXING: Introduction to digital modulation, ASK, FSK, PSK modulation principle only - high speed Modems - dual four level converters. Digital transmission - pulse modulation - PAM-TDM-PWM-PPM-FDMPCM.(Concept only)

UNIT - IV (12 Hrs)

CELLULAR TELEPHONE COMMUNICATIONS: Cellular telephone concepts- Mobile telephone service evolution of cellular telephone-cellular telephone-frequency reuse interference- cell splitting, sectoring, segmentation and dualization cellular system topology-roaming and handoffs-cellular telephone network components. Second generation cellular telephone systems – digital cellular telephone - global system for mobile communications.

UNIT - V (12 Hrs)

NETWORKING CONCEPTS: Networking concepts and terminologies-Network security-Network protocols- Broadband ISDN and ATM Networks-Ethernet, Internet, Wi-Fi

BOOK(S) FOR STUDY:

1. Wayne Tomasi ,Electronic Communications Systems, (Fundamentals through advanced) Fifth Edition, Pearson Education, Inc 2006.
2. Robert J Schoenbeck-Electronic Communications, Prentice Hall of India, New Delhi, 2002.

CORE ELECTIVE-II

14PHP19A

APPLIED SOLAR ENERGY

Semester: IV/ 60 Hrs

UNIT I (12 Hrs)

IMPORTANCE OF SOLAR ENERGY: Energy Sectors- Classification of energy resources-consumption trend-Advantages and disadvantages of conventional energy sources. World energy status-Energy Scenario in India- relevance of solar energy- advantages. Structure of the sun – solar constant – EM spectrum – solar radiation – outside the earth's atmosphere and at the earth's surface.

SOLAR ENERGY MEASURING EQUIPMENTS: Pyrheliometer, pyrnometer, sunshine recorder – solar radiation data – estimation of average solar radiation – estimation of direct and diffused radiation.

UNIT II (12 Hrs)

FLAT PLATE COLLECTORS: Physical principle of solar thermal conversion – general description of FPC's – Thermal losses and efficiency of FPC – Types of solar water heaters – description of solar water heaters and their installation details – series and parallel arrays – selective absorber coatings – effect of dust and shading – selection of materials for FPC's

UNIT III (12 Hrs)

CONCENTRATING COLLECTORS AND SOLAR STILLs: The solar disc and theoretical solar images – solar concentrators and receiver geometries – orientation and sun tracking systems – materials for concentrating collectors and construction of reflectors – solar distillation – theory and description of a basin type solar still.

UNIT IV (12 Hrs)

SOLAR DRIERS AND PHOTOVOLTAICS: Types of air heaters – applications – heating and drying of agricultural products – types of driers in use – psychrometric chart and its use in crop drying. Photovoltaic principles – pn junction fabrication – power output and conversion efficiencies – advantages and disadvantages of photovoltaic solar energy conversion – $\text{Cu}_2\text{S}/\text{CdS}$ solar cells.

UNIT V (12 Hrs)

Solar pumping – solar components – design options – solar cooking – design, principle and construction of a box type solar cooker – application of solar energy in space – satellite solar power station concept. Solar passive space heating- space cooling-Solar green house.

BOOKS FOR STUDY:

1.G.D.Rai – Solar Energy Utilization. (Khanna Publishers)

REFERENCE BOOKS:

1. Kreith And Kreider – Principles of solar engineering (Mc Graw Hill Publishers)
2. A.B.Meinal & A.P.Meinal Applied solar energy.
3. Backus – Solar cells.5.Seminar Proceedings of Industrial applications of solar energy 1978 National Productivity council.
4. B.H. KHAN – Non-conventional Energy Resources, Tata Mc Graw-Hill Publishing Company Ltd, 2006.
5. Sukathme - Solar energy

CORE ELECTIVE-II

14PHP19B NANOSCIENCE AND NANOTECHNOLOGY Semester IV/60 Hrs

UNIT I (12 Hrs)

BACKGROUND AND TYPES OF NANOMATERIALS: Historical perspective of nanomaterials - scientific revolution – emergence of Nanotechnology – challenges in Nanotechnology – types of nanomaterials - one dimensional (1D) - two dimensional(2D) - three dimensional (3D) nanostructured materials - Quantum dots - Quantum wire.

UNIT II (12 Hrs)

SYNTHESIS OF NANO MATERIALS: Ball Milling – Electrodeposition - Spray Pyrolysis – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering – Molecular Beam Epitaxy (MBE), Sol-Gel Process – Reverse Micelles and Micro emulsions - Chemical Vapor Deposition (CVD).

UNIT III (12 Hrs)

CHARACTERIZATION OF NANOMATERIALS: X-ray diffraction - Debye-Scherrer formula – Electron microscopes: scanning electron microscope (SEM) – transmission electron microscope (TEM); atomic force microscope (AFM) – scanning tunneling microscope (STM) – Working Principle, Instrumentation and Application - Photoluminescence (PL) Spectroscopy.

UNIT IV (12 Hrs)

NANOMATERIALS AND THEIR PROPERTIES: Carbon Nanotubes (CNT) - metals (Au, Ag) - metal oxides (TiO₂, CeO₂, ZnO) - semiconductors (Si, Ge, CdS, ZnSe) – ceramics and composites - size dependent properties - mechanical, physical, thermal and chemical properties.

UNIT V (12 Hrs)

APPLICATIONS OF NANOMATERIALS: Molecular electronics and nanoelectronics – single electron devices - CNT based transistor and Field Emission Display - membrane based water purification – drug delivery system - nanobiotechnology.

BOOK FOR STUDY:

1. A Hand book on Nanotechnology – A.G. Brecket, 1st Edition 2008, Dominant publishers and distributors, New Delhi.

BOOKS FOR REFERENCE:

1. Nanocrystals: Synthesis, Properties and Applications, C.N.R.Rao, P.J. Thomas and G.U. Kulkarni, Springer (2007).
2. Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Guozhong Gao, Imperial College Press (2004).



ANY 18 EXPERIMENTS

1. ALO Bands Determination of molecular constants
2. Spectro chemical analysis of an alloy.
3. CN bands Determination of molecular constants.
4. Absorption spectrum.
5. e/m magnetron method.
6. X-ray powder photograph and X-ray photograph of a single crystal.
7. Susceptibility by Guoy method.
8. Hall Effect.
9. Voltage regulator power supply using CA3085/12-0-12.
10. UJT relaxation oscillator.
11. Production and measurement of high vacuum.
12. Michelson's Interferometer – Thickness of mica sheet (λ and $\Delta\lambda$).
13. Lecher wire.
14. XRD pattern analysis.
15. I-V characteristics of given thin film/bulk material.
16. Annealing of thin film samples.
17. e/m Thomson's method.
18. e/m by Zee man effect.
19. Susceptibility by Quinke's method.
20. Determination of Planck's constant.
21. Resistivities of semiconductors by Four probe method.
22. Construction and study of simple transmitter.
23. Thickness measurement of thin films-MBI Technique.
24. Dielectric constants of solid and liquid – RF oscillator.
25. Ultrasonic diffraction.-Compressibility.
26. Crystal growth – determination of dimensions of the crystal.
27. Various steps of cleaning (glass) substrate.
28. SCR Characteristics.

* Subject to the availability of classes, equipments, etc.,

ANY 18 EXPERIMENTS*

1. Light dependent resistors – characteristics.
2. Solar cell characteristics
3. Determine the spot size of the laser source by knife edge method.
4. Lloyd's single mirror experiment- wave length – Na source.
5. Birefringence studies of crystals.
6. Thickness of wire – optic bench.
7. Voltage regulator using LM 723C.
8. Construction and study of FSK modulator.
9. Newton's rings with the combination of convex and a concave lenses.
10. Charge of the electron-spectrometer.
11. Numerical Aperture and energy losses measurements of optical fiber kit.
12. Controlled rectifier – construction – study of characteristics.
13. Resolving power of a prism and a grating.
14. Polarizability of the liquids-hollow prism- spectrometer.
15. G.M counter- characteristics-absorption co efficient.
16. Thin prism and Bi prism- refractive index- spectrometer.
17. Wave length determination- Bi prism-spectrometer.
18. Variation of viscosity with temperature.
19. Hydrothermal synthesis of nano particles

* Subject to the availability of classes, equipments, etc.,