M.Sc. DEGREE IN PHYSICS

CHOICE BASED CREDIT SYSTEM

(For S.V. University College of Sciences)

and

NON-CHOICE BASED CREDIT SYSTEM

(For Affiliated Colleges of S.V. University)

(Effective from the Academic Year 2015-2016)

DEPARTMENT OF PHYSICS
SRI VENKATESWARA UNIVERSITY
TIRUPATI – 517 502
FEBRUARY 2015

Total Credits for the Course

I. Core courses		**Credits**	**Total**
a. I Semester	:	24	
b. II Semester	:	24	
c. III Semester	:	16	
d. IV Semester	:	16	
			80

A student may choose an external elective Paper offered by other Departments in place of Core course Analytical Techniques in the III semester.

II. Elective Courses			
a. Internal Elective in III Semester	:	8	
b. Internal/External Elective in IV Semester	:	8	
			16
	Total		96

III. Self Study Courses		
a. Digital Signal Processing	:	4
b. Physics - Philosophy and Society	:	4
c. Application of Statistics to Physics	:	4

Note:

A student may choose any one or more courses from the self study courses either in III Semester or IV semester. The credits awarded to theses courses will be over and above the required 96 credits of the course. The marks awarded in these courses and the results of these courses will not be considered for the award of the degree and the classification of the results.

SRI VENKTESWARA UNIVERSITY:: TIRUPATI
DEPARTMENT OF PHYSICS

(Common for CBCS and non CBCS)

(Revised Scheme of Instruction and Examination, Syllabus etc., with effect from the Academic Years 2015-16 for I and II Semesters and 2016-17 for III and IV Semesters)

M.Sc. PHYSICS

(CHOICE BASED CREDIT SYSTEM)

SCHEME OF INSTRUCTION AND EXAMINATION

Semester	Course code	Title of the Course	Core/ Elective	No. of credits	Internal Assess-ment	Semester End Exams	Total Marks
I	PHY 101	Classical Mechanics and Theory of Relativity	Core	04	30	70	100
	PHY 102	Atomic & Molecular Physics	Core	04	30	70	100
	PHY 103	Solid State Physics	Core	04	30	70	100
	PHY 104	Analog and Digital Electronics	Core	04	30	70	100
	PHY 105	Practical - I (General)	Core	04		80	80
	PHY 106	Practical-II (Electronics)	Core	04		80	80
		Records				20	20
		Viva-voce				20	20
							600
II	PHY 201	Statistical Mechanics	Core	04	30	70	100
	PHY 202	Electromagnetic Theory, Lasers and Modern Optics	Core	04	30	70	100
	PHY 203	Mathematical Physics	Core	04	30	70	100
	PHY 204	Computational Methods and Programming	Core	04	30	70	100
	PHY 205	Practical - I (General)	Core	04		80	80
	PHY 206	Practical - II (Electronics)	Core	04		80	80
		Records				20	20
		Viva-voce				20	20
							600
	PHY 207	Human Values and Professional Ethics - I	Core	04	30	70	100

Semester	Course code	Title of the Course	Core/ Elective	No. of credits	Internal Assess-ment	Semester End Exams	Total Marks
III	PHY 301	Quantum Mechanics – I	Core	04	30	70	100
	PHY 302	Nuclear and Particle Physics	Core	04	30	70	100
	PHY 303	Physics of Semiconductor Devices	Core	04	30	70	100
	PHY 304	Internal Elective -I	IE	04	30	70	100
	PHY 305	Computer Laboratory Practical	Core	04		80	80
	PHY 306	Internal Elective Practical - I	IE	04		80	80
		Records				20	20
		Viva - voce				20	20
	PHY 307	Analytical Methods	EE	04	30	70	100
	PHY 308	Remote Sensing and Applications	EE	04	30	70	100
							600
IV	PHY 401	Quantum Mechanics - II	Core	04	30	70	100
	PHY 402	Analytical Techniques	Core	04	30	70	100
	PHY 403	Advances in Physics	Core	04	30	70	100
	PHY 404	Internal Elective – II	IE	04	30	70	100
	PHY 405	General Practical Laboratory	Core	04		80	80
	PHY 406	Internal Elective Practical –II	IE	04		80	80
		Records				20	20
		Viva – voce				20	20
							600
	PHY 407	Human Values and Professional Ethics - II	Core	04	30	70	100

A candidate may choose any one elective from the list of electives offered by the Department

Sem ester	Course code	Title of the Course	Core/ Elective	No. of credits	Internal Assess-ment	Semester End Exams	Total Marks
IV	PHY 408	Digital Signal Processing	SSC	04	---	100	100
	PHY 409	Applications of Statistics to Physics	SSC	04	---	100	100

I CORE COURSES

COURSE CODE	TITLE
PHY 101	Classical Mechanics and Theory of Relativity
PHY 102	Atomic and Molecular Physics
PHY 103	Solid State Physics
PHY 104	Analog and Digital Electronics
PHY 105	Practical - I (General)
PHY 106	Practical - II (Electronics)
PHY 201	Statistical Mechanics
PHY 202	Electromagnetic Theory, Lasers and Modern Optics
PHY 203	Mathematical Physics
PHY 204	Computational Methods and Programming
PHY 205	Practical – I Laboratory (General)
PHY 206	Practical - II Laboratory (Electronics)
PHY 301	Quantum Mechanics - I
PHY 302	Nuclear and Particle Physics
PHY 303	Physics of Semiconductor Devices
PHY 305	Computer Laboratory Practical
PHY 401	Quantum Mechanics - II
PHY 402	Analytical Techniques
PHY 403	Advances in Physics
PHY 405	General Laboratory Practical
PHY 207	Human Values and Professional Ethics – I
PHY 407	Human Values and Professional Ethics – II

II INTERNAL ELECTIVE COURSES

III EXTERNAL ELECTIVE COURSES (FOR THE STUDENTS OF OTHER DEPARTMENTS)

COURSE CODE	TITLE
PHY 304A	Applied Spectroscopy - I
PHY 304 B	Condensed Matter Physics - I
PHY 304 C	Electronics – Embedded Systems
PHY 304D	Photonics - I
PHY 304 E	Solar Energy – Thermal Aspects
PHY 304 F	Vacuum and Thin Film Technology
PHY 306	Elective Laboratory - I
PHY 404 A	Applied Spectroscopy - II
PHY 404 B	Condensed Matter Physics - II
PHY 404 C	Electronics – Wireless Communication Systems
PHY 404 D	Photonics - II
PHY 404 E	Solar Energy- Photovoltaic Aspects
PHY 404 F	Properties and Applications of Thin Films
PHY 406	Elective Laboratory - II

COURSE CODE	TITLE
PHY 307	Analytical Methods
PHY 308	Remote Sensing and Applications

Note: The Department will offer any one or both External Elective Courses depending on the convenience of the Department and student's strength opted for that course, which will be intimated at the beginning of the semester.

SELF STUDY COURSES (FOR THE SUDENTS OF M. Sc., PHYSICS)

COURSE CODE	TITLE
PHY 407	Digital Signal Processing
PHY 408	Applications of Statistics to Physics
PHY 409	Physics – Philosophy and Society

SRI VENKTESWARA UNIVERSITY:: TIRUPATI
DEPARTMENT OF PHYSICS
TWO YEAR M.Sc. COURSE IN PHYSICS
(Non-Choice Based Credit System with Effect from Academic Year 2015-2016)
(For Affiliated Colleges of S.V. University)
COURSE STRUCTURE AND EXAMINATION SCHEME

Semester	Course code	Title of the Course	Internal Assess-ment	Semester End Exams	Total Marks
I	PHY 101	Classical Mechanics and Theory of Relativity	20	80	100
	PHY 102	Atomic & Molecular Physics	20	80	100
	PHY 103	Solid State Physics	20	80	100
	PHY 104	Analog and Digital Electronics	20	80	100
	PHY 105	Practical - I (General)		80	80
	PHY 106	Practical-II (Electronics)		80	80
		Records		20	20
		Viva-voce		20	20
					600
II	PHY 201	Statistical Mechanics	20	80	100
	PHY 202	Electromagnetic Theory, Lasers and Modern Optics	20	80	100
	PHY 203	Mathematical Physics	20	80	100
	PHY 204	Computational Methods and Programming	20	80	100
	PHY 205	Practical - I (General)		80	80
	PHY 206	Practical- II (Electronics)		80	80
		Records		20	20
		Viva-voce		20	20
					600
	PHY 207	Human Values and Professional Ethics -I	20	80	100

Semester	Course code	Title of the Course	Internal Assess-ment	Semester End Exams	Total Marks
III	PHY 301	Quantum Mechanics – I	20	80	100
	PHY 302	Nuclear and Particle Physics	20	80	100
	PHY 303	Physics of Semiconductor Devices	20	80	100
	PHY 304	Electronics – Embedded Systems	20	80	100
	PHY 305	Practical-I (Computers)		80	80
	PHY 306	Practical- II Electronics		80	80
		Records		20	20
		Viva-voce		20	20
					600
IV	PHY 401	Quantum Mechanics - II	20	80	100
	PHY 402	Analytical Techniques	20	80	100
	PHY 403	Advances in Physics	20	80	100
	PHY 404	Electronics – Wireless Communication systems	20	80	100
	PHY 405	Practical –I (General)		80	80
	PHY 406	Practical –II (Electronics)		80	80
		Records		20	20
		Viva-voce		20	20
					600
	PHY 407	Human Values and Professional Ethics - II	20	80	100

SEMESTER-I

PHY 101: CLASSICAL MECHANICS AND THEORY OF RELATIVITY

UNIT – I: Lagrangian Mechanics and Hamiltonian Mechanics

Newtonian mechanics of one and many particle systems: Conservation laws, Constraints and their classification, Degrees of freedom: Generalized coordinates: Principle of virtual work, D'Alemberts principle, Lagrange's equations of motion.

Applications: Inclined plane, Linear harmonic oscillator and simple pendulum, Hamiltonian principle, Lagrange's equation from Hamilton's principle, Hamilton's equation of motion, Applications, Simple pendulum, Compound pendulum. (1-4)

UNIT – II: Canonical Transformations and Hamilton - Jacobi Theory

Canonical Transformations, Generating function and their properties, Condition for transformation to be canonical, Illustration of canonical transformation, Poisson – Brackets, Canonical equations in terms of Poisson, Bracket notation. Lagrange - Brackets and their properties.

Hamiltonian - Jacobi equation, one dimensional harmonic oscillator, Small oscillations and normal modes, Action Angle variables, Kepler problem in action angle variables. (4,5)

UNIT –III: Motion in a Central Force Field

Reduction to the equivalent one body problem, Motion in a central force field, Conditions for closed orbits: Inverse square law of forces, Kepler's laws of planetary motion- Rutherford scattering. (2,3)

Rotations – Space and body fixed axes, Angular momentum and Torque, Eulerian angles – Euler's equations of a rigid body, Motion of symmetrical top, Expression for slow and fast precessions, Larmour precision, Examples of Gyroscope. (1-6)

UNIT –IV: Special Theory of Relativity

Introduction – Postulates of Special Theory of Relativity – Principle of constancy of light – Lorentz transformations. Relativistic Kinematics, Velocity transformations – Transfor-mations for the acceleration of a particle. Relativity Optics: Aberration of the of the light from stars – Doppler effect.

Relativistic Mechanics: Mass of a moving particle – Relativistic dynamics of a single particle – Applications of relativistic dynamics of a single particle, Motion in electric field – Motion in a magnetic field – Experimental verification of the variation of mass with velocity – Bucherer's experiment - Transformation of momentum and force. (7-9)

Books for Reference

1. Classical Mechanics, N.C. Rana and P.S. Joag - Tata Mc-Graw Hill, 1991.
2. Classical Mechanics, H. Goldstein - Addison Wesley, 1980.
3. Classical Mechanics, J.C. Upadyaya - Himalaya Publishing House, 2005.
4. Classical Mechanics, Gupta, Kumar and Sharma - Pragathi Prakashan, 2012.
5. Classical Dynamics of Particles, J.B. Marion Academic Press - Saunders College Publications, 4th edition, 1995.
6. Introduction to Classical Mechanics, R.G. Takwale and P.S. Puranic -Tata McGraw-Hill,1989.
7. Theory of Relativity, W. Pauli - Dover Publications, 1981.
8. Introduction to the Theory of Relativity, P.G. Bergmann – Prentice Hall, 1953.
9. Introductory Relativity, W.G.V. Rosser - CRC Press, 1992.

PHY 102: ATOMIC AND MOLECULAR PHYSICS

UNIT I: Atomic Spectra

Introduction: Hydrogen atom (one electron atom) and the three quantum numbers- Spectra of hydrogen atom- Spectra of alkali elements- Fine structure- Elements with more than one valence electron- Forbidden transitions and selection rules- Space quantization- Stern-Gerlach (S-G) experiment-Coupling schemes- Spectral terms and term symbols, Ground states based on electron configuration - LS coupling - JJ coupling- Hund's rule of multiplicity - Pauli's exclusion principle - Equivalent and non-equivalent electronic systems. Width of spectral lines – Spectrometer - Spectrophotometer – Applications of atomic spectra.

UNIT II: Zeeman and Stark Effects

Introduction: Zeeman effect, Normal and anomalous Zeeman effects, Experimental details, Zeeman effect of hyperfine structure, Magnetic moment of the atom and Lande's 'g'-factor, Zeeman effect in sodium atom, Lande g-formula for LS and JJ couplings - Paschen-Back effect, Complete Paschen-Back effect - Splitting of sodium lines and selection rules, Stark effect, Experimental details, Weak and strong field effects, Width of spectral lines.

UNIT III: Diatomic Molecular Spectroscopy – Rotational Energies

Introduction – Rotational, vibrational, electronic spectra of diatomic molecules –types of molecules – Linear, symmetric top, asymmetric top and spherical top molecules – Rotational spectra of a diatomic molecule as rigid rotator – Energy levels and spectra of non-rigid rotor – Intensity of rotational lines - Rotational spectra of polyatomic molecule – Rotational analysis of electronic spectra- Evaluation of rotational constants - Effect of isotopic substitution on rotational levels – Stark splitting of rotational lines – Stark modulated microwave spectrometer – Applications of rotational spectroscopy - Determination of molecular structure, dipole moment, atomic mass, nuclear quadrupole moment – Microwave oven.

UNIT IV: Diatomic Molecular Spectroscopy – Vibrational Spectra

Introduction – Vibrational spectra of diatomic molecule – Diatomic molecule as simple harmonic oscillator – Anharmonic oscillator – Energy levels and spectrum – Molecule as vibrating rotator – PQR branches – progressions and sequences – Vibrational analysis of electronic spectra - Deslander's table – Evaluation of vibrational constants – Morse potential energy curve – Frank-Condon principle – Intensity distribution in absorption and emission spectra - Effect of isotopic substitution on vibrational bands – IR spectrometer – FTIR spectroscopy – Principle – Interferometer arrangement – advantages - Applications of vibrational spectroscopy: Identification of molecular constituents – Elucidation of molecular structure – Biological applications.

Books for study:

1. Introduction to Atomic Spectra, H.E. White, McGraw-Hill Kogakusha. Ltd., New Delhi.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M.Mc Cash, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 1994.
3. Spectroscopy, Vol. I & III, B.P. Straughan & S. Walker, John Wiley & Sons, Inc., NY,1976.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw - Hill Book Co, 1962.
5. Spectra of Diatomic Molecules, G. Herzberg, D.Van Nostrand Company Inc, New York.
6. Molecular Spectroscopy, J.M. Brown, Oxford Science Pub. Oxford, 1998.
7. Molecular Structure and Spectroscopy, G. Aruldhas, Prentice- Hall of India, Pvt., 2005.
8. Elements of Diatomic Molecular Spectra by H. Dunford – Addison-Wisely, 1957.

PHY 103: SOLID STATE PHYSICS

UNIT – I: Lattice Energies and Lattice Vibrations

Origin of chemical binding in ionic and van der Waals crystals – Elastic properties – Stress and strain – Elastic moduli - Lattice energy calculations for ionic and van der Waals crystals – Lattice vibrations: Mono and diatomic one dimensional infinitely long lattices – Vibrational spectra – Infrared absorption in ionic crystals – Vibrational spectra of finite lattice – Quantization of lattice vibrations – Phonons – Properties – Experimental measurement of dispersion relation.

UNIT – II: Transport Phenomena and Band Theory

Concept of electrical and thermal resistivity – Expression for thermal and electrical conductivities for metals – Lorenz number - Different scattering mechanisms – Matheissens rule- Formulation of Boltzmann transport equation – Relaxation time approximation – Distribution function.

Sommerfeld model – its consequences – electron-lattice interaction (Quantitative only) – Motion of electron in periodic potential – Bloch function - Kroning - Penny model – Formation of energy bands in solids – Concept of effective mass – Brillouin zones – Different schemes of representation of E versus K curves – Distinction between metals, insulators and semiconductors.

UNIT – III: Semiconductor Physics

Intrinsic and extrinsic semiconductors – Expression for position of Fermi levels and carrier concentrations – Variation of Fermi level with temperature – np product – Carrier mobility, conductivity and their variation with temperature – Direct and indirect band gap semiconductors – Differences and examples – Hall effect - Continuity equation – Drift and Diffusion – Einstein relation – Generation, Recombination and life time of non-equilibrium carriers – Heyness-Schockley experiment – Determination of life time, diffusion length of minority charge carriers.

UNIT – IV: Superconductivity

Concept of zero resistance – Magnetic behavior – Distinction between a perfect conductor and superconductor – Meissner effect – Isotope effect – Specific heat behavior – Two-fluid model – Expression for entropy difference between normal and superconducting states – London's equations – Penetration depth – BCS theory –Josephson junctions – SQUIDS and its applications - Applications of superconductors – High T_C superconductors – Preparation – Properties.

Books for Study

1. Solid State Physics, C. Kittel, John Wiley & Sons.
2. Solid State Physics, A.J. Dekkar, Macmillan India Ltd.
3. Elementary Solid State Physics, M. Ali Omar, Addison-Wesley.
4. Solid State Physics, M.A. Wahab, Narosa Publishing House.
5. Solid State Electronic Devices, B.G. Streetman.
6. High T_C Superconductivity, C.N.R. Rao and S.V. Subramanyam.
7. Solid State Physics, S.O. Pillai.
8. Solid State Physics, S.L. Kakani and C. Hemarajan.
9. Electrons in Solids, Richard H. Bube.

PHY 104: ANALOG AND DIGITAL ELECTRONICS

UNIT – I: Introduction to Electronic Devices

Field Effect Transistor (FET): Structure and working of JFET, Characteristics, and parameters of JFET. Advantages of FET over BJT. FET as switch and Amplifier, Application of FET as voltage variable resistor. Structure of MOSFET, depletion type and enhancement type, MOSFET Characteristics, MOSFET as variable resistor, Concept of CMOS. Structure, working and Characteristics of UJT. Application of UJT as a Relaxation oscillator. (1)

UNIT – II: Operational Amplifiers

Block diagram of a typical Op-Amp, differential Amplifier, Comparator open loop configuration, inverting and non-inverting amplifiers. Op-amp with negative feedback, voltage shunt feedback, effect of feedback on closed loop gain, input resistance, output resistance, CMRR, frequency response slew rate.

Instrumentation- Amplifier, integrator and differentiator. Waveform generators: Square and triangle. Filters: Low pass, High pass and Band pass. (2)

UNIT – III: Digital Electronics

Combinational Logic: Multiplexers, Decoder, Demultiplexer, Data Selector, Multiplexer, Encoder.Sequential Logic: JK Flip – Flop, JK Master Slave Flip–Flops, D Flip-Flop. Shift Registers: Serial in Serial out, Serial in Parallel out, parallel in Serial out, Parallel in Parallel out Registers. Counters: Asynchronous and Synchronous Counters, MOD-3 Counter, MOD-5 Counter. Converters: R - 2R Ladder D/A Converter, Successive Approximation A/D Converter. (3,4)

UNIT – IV: Communication Electronics

Introduction to Modulation (AM & FM), Sampling Theorem, Low pass and Band pass signals, PAM, Channel BW for a PAM signal. Natural sampling, Flat-top sampling. Signal recovery through holding. Quantization of signals, PCM transmission, Quantization of noise, Differential PCM, Delta Modulation, Adaptive Delta modulation CVSD. Signal to noise ratio in PCM and Delta Modulations.

(5)

Text Books

1. Micro Electronics, Milliman and Halkias. TMH Publications.
2. OP-Amps & Linear Integrated Circuits, RamakanthA. Gayakwad, PHI, 2nd Edition, 1991.
3. Digital Systems: Principles and Applications, Ronald J. Tocci, Neal Widmer and Gregory L. Moss, 10th Edition, PHI, 2007.
4. Digital Principles and Applications, A.P. Malvino and Donald P. Leach, Tata Mc Graw-Hill, New Delhi, 1993.
5. Principles of Communication, Taub and Schilling, Mc-Graw Hill Publication.

Reference Books

1. Electronic Devices and Circuit Theory, R. Boylested and L. Nashdsky, PHI, New Delhi, 1991.
2. Micro Electronics, Sedra and Smith.
3. Electronic Principles, Malvino, 6th Ed. TMH.
4. Linear Integrated circuits, Roy Choudhry.
5. Operational amplifiers, Collins.

SEMESTER-II

PHY 201: STATISTICAL MECHANICS

UNIT- I: Ensembles

Phase space – Concept of ensembles – Types of ensembles - Ensemble average - Liouville's Theorem – Micro canonical ensemble: ideal gas – Gibb's paradox – Entropy and probability – Canonical ensemble – Ideal gas in canonical ensemble – Grand canonical ensemble – Ideal gas in grand canonical ensemble – Comparison of various ensembles.

UNIT – II: Partition Functions

Canonical partition function – Molecular partition function – Translational partition function – Rotational partition function – Vibrational partition function – Electronic and Nuclear partition functions – Applications of Rotational partition function – Applications of vibrational partition function to solids.

UNIT – III: Maxwell – Boltzmann and Bose – Einstein Statistics

Maxwell - Boltzmann distribution - Distribution of velocities – Experimental verification - Calculation of mean values – Equipartition theorem. Bose – Einstein distribution, Bose – Einstein condensation, Black body radiation and the Planck's radiation law - Dulong and Petit's law - Einstein and Debye's theories of heat capacities - Liquid helium – Two fluid model of liquid helium II – Super fluid phase of ^{3}He.

UNIT – IV: Fermi – Dirac Statistics & Fluctuations

Fermi - Dirac distribution – Electrons in metals – Thermionic emission – Magnetic susceptibility of free electrons – White dwarfs – Fluctuations in ensembles, Onsagar's one dimensional and reciprocal rotations and their applications to thermoelectric phenomena, Kelvin's first and second equations: One dimensional random walk – Random walk and Brownian motion.

Books for study

1. Statistical Mechanics , B.K. Agarwal, Melvin Eisner,2nd Edition, New Age International (P)Ltd.
2. Statistical Mechanics and properties of Matter by ESR Gopal — Student Edition (Ellis Horwood)
3. Statistical and Thermal Physics , F. Reif—4th Edition, Mc Graw Hill
4. Elementary Statistical Mechanics, C. Kittel, Dover Publications

Books for reference:

1. Statistical Physics, Bhattacharjee
2. Thermal Physics, Kittel and Kremer

PHY 202: ELECTROMAGNETIC THEORY, LASERS AND MODERN OPTICS

UNIT – I: Electromagnetic Theory

Maxwell's equations, The wave equation, Propagation of light in isotropic dielectric medium – Dispersion, Propagation of light in conducting medium-skin depth, Reflection and refraction at the boundary of a dielectric interface – Fresnel's equations, Propagation of light in crystals-Double refraction.

Electromagnetic radiation ; Retarded potentials, Radiation from moving point charge, Radiation from oscillating dipole (electric and magnetic dipoles), Radiation from linear antenna – Radiation resistance, electric quardrupole radiation, Lienard – Wiechert potentials.

UNIT – II: Lasers and Non-Linear Optics

Basic principles of lasers – Spontaneous and stimulated emission – Coherence - Population inversion-Einstein coefficients – Pumping schemes – Threshold condition for laser oscillation – Losses and Q-factor – Ruby laser and GaAs laser – Gas lasers-Argon ion laser, Co_2 laser - Laser applications.

Basic Principles – Origin of optical nonlinearity - Harmonic generation – Second harmonic generation – Phase matching condition – Third harmonic generation – Optical mixing – Parametric generation of light – Parametric light oscillator – Frequency upconversion – Self focusing of light - Guided wave optics - Pulse compression - Optical solutions.

UNIT – III: Holography and Fourier Optics

Introduction to Holography – Basic theory of Holography – Recording and reconstruction of Hologram – Diffuse object illumination – Speckle pattern – Fourier transform Holography – Applications of Holography.

Introduction to Fourier optics– Two dimensional Fourier transforms – Transforms of Dirac-Delta function – Optical applications – linear systems- The convolution integral – convolution theorem-Spectra and correlation – Parsevel's formula – Auto correlation and cross-correlation – Apodization – Array theorem – Fourier methods in diffraction - Fraunhouffer diffraction of single slit, double slit and transmission grating using Fourier method.

UNIT – IV: Fiber Optics

Total internal reflection - Optical fiber modes and configuration – Single mode fibers – Graded index fiber structure – Fiber materials and fabrication – Mechanical properties of fibers – Fiber optic cables – Attenuation – Signal distortion on optical wave guides- Erbium doped fiber amplifiers – Solitons in optical fibers - Block diagram of fiber optic communication system - Applications of optical fibers in communication and medicine.

Text and Reference Books

1. Introduction to Electrodynamics, D.J. Griffiths, 4 th Edition, Prentice-Hall of India, ND, 2013.
2. Electromagnetics, B.B. Laud, 3rd Edition, New Age International Publishers Ltd, N D, 2011.
3. Fundamentals of Electromagnetic theory, 2nd Edition, S.K. Dash and S.R. Khuntia, ND, 2011.
4. Modern Optics by G.R. Fowels, 1989.
5. Laser and their Applications, M.J. Beesly, Taylor and Francis, 1976
6. Lasers and Non-Linear Optics, B.B. Laud, 3rd Edition, New Age International Publishers Ltd, New Delhi, 2011.
7. Optics, E. Hecht, Addison Wiley, 1974.
8. Optical Fiber Communications, Gerel Keiser, McGraw Hill Book, 2000.

PHY 203: MATHEMATICAL PHYSICS

UNIT - I: Special Functions

Beta and Gamma Functions – Definitions and properties – Evaluation of integrals, Legendre, Bessel and Hermite differential equations – Solutions – Generating functions – Orthogonal properties of Legendre, Bessel and Hermite Functions (Proof not necessary) – Recurrence relations – (Proof for Legendre polynomials only)

UNIT - II: Integral Transforms

Fouriers Transforms: Properties of Fourier transforms – Fourier sine and cosine transforms- Power in Fourier series – Modulation theorem, Fourier transform of impulse function, Constants, Unit step function and Periodic (square wave, triangular wave & sawtooth wave) functions.

Laplace Transforms: Definition and notation – Properties of Laplace transforms – Laplace transforms of Dirac delta function and periodic functions (Square wave, sawtooth wave and triangular wave) – Inverse Laplace transforms – properties – Solution of linear differential equations with constant coefficients - Applications to LCR circuits, Operational amplifiers and resonance of simple pendulum.

UNIT - III: Partial Differentiations and Tensors

Partial Differentiations: Laplace equation – Method of separation of variables – Application of Laplace equation to two dimensional steady state of heat flow in a thin rectangular plate and a long cylinder. Wave equation in two dimensions – Application to the vibration of a rectangular membrane and circular membrane.

Tensors: Definition – Contravariant, Covariant and Mixed tensors – Dummy suffix notation- Addition, subtraction, contraction, inner product, outer product, symmetric and anti-symmetric tensors - Application of Tensor theory to strain, thermal expansion and piezoelectricity.

UNIT – IV: Complex Variables

Functions – Complex differentiation - Analytic function - Cauchy – Reimann equations –Derivatives of elementary functions – Singular points and classification. Complex integration - Cauchy's theorem – Integrals of special functions – Cauchy's integral formula – Taylor's and Lorentz theorem (statements only) – Residues, calculations of residues - Residue theorem – evaluation of definite integrals.

Reference Books

1. Functions for Scientists and Engineers, W.W. Bell, Van Nostrand Co., London (1968).
2. Fourier Analysis, Hsu P. Jewi, Unitech Division.
3. Laplace Transforms, Murray Spiegle, Schaum's outline series, McGraw Hill, New York.
4. Applied Mathematics for Engineers, Pipes and Harval, III Edition, McGraw Hill Books Co.
5. Vector Analysis & Introduction to Tensor Analysis, M. R. Spiegel, Schaum's Series 1959.
6. Physical Properties of Crystals, J.F. Nye, Schaum's Series, Oxford Univ. Press, 1957.
7. Theory and Properties of Complex Variables, S. Lipschutz, Schaum's Series, Mc Graw Hill.
8. Mathematical Physics, H.K. Das and Ramaverma, S. Chand & Co. Ltd., New Delhi (2011).
9. Mathematical Physics, B. Bhattacharyya, New Central Book Agency Pvt. Ltd., (2010).

PHY 204: COMPUTATIONAL METHODS AND PROGRAMMING

UNIT – I: (a) Fundamentals of C language

C character set – Identifiers and keywords – Constants – Variables – Data types – Declarations of variables – Declaration of storage class – Defining symbolic constants – Assignment statement. Operators : Arithmetic operators – Relational operators – Logic operators – Assignment operators – Increment and decrement operators – Conditional operators.

(b) Expressions and I/O statements: Arithmetic expressions – Precedence of arithmetic operators – Type converters in expressions – Mathematical (library) functions – Data input and output - Getchar and putchar functions – Scanf – Printf – Simple programs.

(c) Control statements: If-Else statement – Switch statement – The ?operator – GO TO – While , Do-while, FOR statements – BREAK and CONTINUE statements.

UNIT – II: (a) Arrays

One dimensional and two dimensional arrays – Initialization – Type declaration – Inputting and outputting of data for arrays – Programs of matrices addition, subtraction and multiplication.

(b) User Define functions: The form of C functions – Return values and their types – Calling a function – Category of functions. Nesting of functions.Recursion.ANSI C functions – Function declaration. Scope and life time of variables in functions.

(c) Pointers: Accessing the address of variable. Declaration and Initialization of pointer variables. Accessing the value of the variable through its pointer. Pointer Expressions- Pointers and arrays – Pointers and structures.

UNIT – III: Linear, non-linear equations and curve fitting

(a) Solution of Algebraic and transcendental equations – Bisection, Falsi position and Newton-Rhapson methods – Basic principles – Formulae – Algorithms.

(b) Simultaneous equations: Solutions of simultaneous linear equations – Gauss elimination and Gauss-Seidel iterative methods - Basic principles – Formulae – Algorithms

(c) Curve fitting – Least square fitting – Linear and quadratic equations.

UNIT – IV: (a) Interpolations: Concept of linear interpolation – Finite differences – Newton's and Lagrange's interpolation formulae –Principles and Algorithms

(b) Numerical differentiation and integration: Numerical differentiation – algorithm for evaluation of first order derivatives using formulae based on Taylor's series – Numerical integration – Trapezoidal and Simpson's 1/3 rule – Formulae – Algorithms.

(c) Numerical solution of ordinary differential equations: Euler, method, fourth order Runga-Kutta Method.

Books for reference

1. Programming with 'C', Byron Gottfried, Tata McGraw Hill.
2. Programming in 'C', Balaguruswamy.
3. Numerical Methods, E. Balaguruswamy, Tata McGraw Hill.
4. Computer oriented numerical methods, Rajaraman.
5. Let Us C, Yeswanth Kanetkar.

PHY 207: Human Values and Professional Ethics – I

Chapter I: Definition and Nature of Ethics – Is relation to Religion, Politics, Business, Law, Medicine and Environment. Need and Importance of Professional Ethics – Goals – Ethical Values in Various Professions.

Chapter II: Nature of Values – Good and Bad, Ends and Means, Actual and Potential Values, Objective and Subjective Values, Analysis of Basic Moral Concepts – Right, Ought, Duty, Obligation, Justice, Responsibility and Freedom, Good Behavior and Respect for Elders, Character and Conduct.

Chapter III: Individual and Society: Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non Possesion) and Aparigraha (Non-stealing). Purusharthas (Cardinal virtues) - Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desires), Moksha (Liberation).

Chapter IV: Bhagavd Gita – (a) Niskama Karma, (b) Buddhism – The Four Nobel Truths – Arya astanga marga, (c) Jainism - Mahavratas and Anuvratas. Values Embedded in Various Religions, Religious Tolerence, Gandhian Ethics.

Chapter V: Crime and Theories of Punishment – (a) Reformative, Retributive and Deterrent, (b) Views on Manu and Yajnavalkya.

Books for study:

1. Johns S Mackenjie: A Manual of ethics
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D. Irwin Inc.
3. Management Ethics – Integrity at work by Joseph A. Petrick and John F. Quinn, Response Books, New Delhi.
4. "Ethics in Management" by S.A. Shelekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed) G.C. Haughton.
10. Sasruta Samhita: Tr. KavirajKunjanlal, KunjanlalBrishagratha, Chowkamba Sanskrit Series, Vol I,II and III, Varanasi, Vol I PP, 16-20, 21-32 and 74-77 only.
11. Charaka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series Office. Varanasi I, II, III Vol I PP 183-191.
12. Ethics, Theory and Contemporary Issues. Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed.,) John H. Piet and Ayodya Prasad, Cosmo Publications.
15. Text Book for Intermediate First Year Ethics and Human Values, Board of Intermediate Eduction – Telugu Academy, Hyderabad.
16. I.C. Sharma Ethical Philosophy of India. Nagin& Co Julundhar.

SEMESTER-III

PHY 301: QUANTUM MECHANICS – I

UNIT - I: Formulation and Simple Problems

Wave particle duality – Wave functions in coordinate and momentum representation- Postulates of quantum mechanics -Linear vector space: Hilbert space - Dirac's Bra and Ket notations- Hermitian operators and their properties- Matrix representation of an operator- Unitary operators- Unitary transformation - The Kronicker Delta and Dirac delta functions

Eigen values and Eigen functions for finite potential well and step barrier – Quantum mechanical tunneling

UNIT - II: Quantum Dynamics and Simple Problems

Equations of motion - Schrodinger Picture- Heisenberg Picture- Interaction Picture- Equivalence of various Pictures- . Poisson and Commutation brackets- Their Properties

Eigen values and Eigen functions for Simple harmonic oscillator- Polynomial method and abstract operator method in one dimension- Eigen values and Eigen functions for a free particle and particle in a box in three dimensions.

UNIT - III: Approximate Methods

Time independent perturbation theory for non-degenerate levels: Perturbed harmonic oscillator, Normal Helium atom, Stark effect of the plane rotator. First order perturbation theory for degenerate levels: First order Stark effecting in hydrogen atom; Time dependent perturbation theory: Transition to continuum (Fermi Golden rule).

WKB approximation – Turning points and connecting formulae: Application to potential barrier. Variational methods.

UNIT - IV: Scattering Theory

Introduction: classical theory of scattering - Quantum theory of scattering - Method of partial wave analysis - Scattering by a perfectly rigid sphere - Greens function in scattering theory - Born approximation - Validity of Born approximation - optical theorem.

Reference Books

1. Quantum Mechanics: S. L.Kakani and H.M.Chandalia.SultanChandandSonsFirst Edition
2. Advanced Quantum Mechanics : B.S. Rajput, Pragatiprakasan.
3. Quantum Mechanics: V.K. Thankappan, Wiley Eastern Limited
4. A Textbook of Quantum Mechanics : P.M. Mathews and K. Venkatesan, Tata Mc GrawHill Publishing Company.
5. Quantum Mechanics: S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma Jai Prakash Nath and Company.
6. An introduction to QuantumMechanics, P.T. Mathews c Graw Hill Publishing Company.

PHY 302: NUCLEAR AND PARTICLE PHYSICS

UNIT – I: Nuclear Forces and Reactions

Nuclear Forces: Characteristics of nuclear forces – Ground state of Deuteron – Proton – Proton scattering – Neutron – Proton scattering – Meson theory of nuclear forces – Bethe-Weizacker semi-empirical binding energy equation and its applications.

Nuclear Reactions: Types of nuclear reactions – Compound nuclear reactions – Direct reactions - Nuclear cross section – Resonance theory – Briet Wigner formula.

UNIT – II: Nuclear Accelerators

Introduction – Ions sources – Classification of accelerators - Electrostatic accelerators – Cockcroft-Walton accelerator, Van de Graff accelerator and Tandem accelerators - Linear accelerators – Drift tube and Wave guide accelerators – Low energy circular accelerators – Cyclotron and Betatron – High energy circular accelerators – Synchrotron and Microtron.

UNIT – III: Nuclear Reactors

Nuclear fission reactions – Types of fission - Distribution of fission products – Neutron emission on fission – Spontaneous fission – Nuclear fission and thermonuclear reactions – Hydrogen bomb.

Nuclear fusion reactions - Nuclear chain reactions – Four factor formula – The critical size of a reactor – General aspects of reactor design – Classification of reactors – Research reactors and Power reactors.

UNIT – IV: Elementary particles

Discovery and classification of elementary particles – Types of interactions – Conservation laws – Iso-spin, parity, charge conjugation – Time reversal – CPT theorem – Properties of leptons, mesons and baryons – Elementary particle symmetries (SU_2 and SU_3 symmetries) – Quark model – Search for Higg's particle – Elementary ideas.

Reference Books

1. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
2. Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int.1997.
3. Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co. (1994).
4. Nuclear Physics, D.C. Tayal, Himalaya Pub. (1997).
5. Atomic and Nuclear Physics, R.C. Sharma, K. Nath & Co., Meerut.
6. Nuclei and Particles, E. Segre.
7. Introduction to Nuclear Physics, H.A. Enge, Addison Wesley (1975).
8. Introduction to Nuclear Physics, K.S. Krane.

PHY 303: PHYSICS OF SEMICONDUCTOR DEVICES

UNIT - I: Junctions and Interfaces

p-n Junctions: Description of p-n Junction action – Junction in equilibrium- application of bias – energy band diagrams. Abrupt junction – calculation of the built-in voltage - electric field and potential distributions – Expression for Depletion layer capacitance, Static I-V characteristics of p-n junction diodes: Ideal diode model- Derivation of ideal diode equation. Real diodes – Carrier generation – recombination in the junction depletion region, I-V characteristics of Real Diodes.

Electrical breakdown in p-n junctions: Zener and Avalanche breakdown in p-n junctions, Distinction between the Zener and Avalanche breakdown, Applications of breakdown diodes. Metal-Semiconductor interfaces, Ohmic and Schottky contacts.

UNIT- II: Junction Diodes

Tunnel diode- I-V characteristics, Schottky barrier diode - operation and applications. Varactor diode, Gunn diode, IMPATT diode, TRAPATT diode, BARITT diode - basic principle, operation and its applications. Solar cell – Structure - Principle of operation – Solar cell parameters – Light Emitting Diodes (LEDs), Semiconductor lasers – principle of operation and applications.

UNIT - III: Junction Transistors

Bipolar junction transistors: Principle of operation- Analysis of the ideal diffusion transistor – Calculation of terminal currents, DC parameters. Ebers-Moll Equations – Four regions of operation of a bipolar transistor. Real transistors - carrier recombination in the Emitter-Base junction depletion region – Effect of collector bias variation, avalanche multiplication in the collector – base junction and base resistance.

Junction field-effect transistors: JFET Principle of operation, Static I-V Characteristics of the idealized model.

MOS transistors and charge-coupled devices: MOS capacitor – Surface field effect – Energy band diagrams of an MOS capacitor for different bias conditions. C-V characteristics of the MOS capacitors. Basic Structures and the operating principle of MOSFET, I-V characteristics of an ideal MOSFET, Charge Coupled Devices (CCD)- principle of operation.

UNIT – IV: Power Devices and Semiconductor Technology

Technology of Semiconductor Devices: Crystal growth and Wafer preparation, Methods of p-n junction formation, Growth and deposition of dielectric layers, Planar technology, Masking and lithography, Pattern definition, Metal deposition techniques.

Power rectifiers and Thyristors: Power rectifiers, Thyristors, Some special thyristor structures, Bidirectional thyristors, Field-controlled thyristor.

Books for Study

1. Introduction to Semiconductor Materials and Devices, M.S. Tyagi, John Wiley & Sons (Asia) Pvt. Ltd., Singapore, 2000.
2. Microwave Devices and Circuits, Samuel and Y. Lao, Prentice-Hall of India, 1999.
3. Microwave and Radar Engineering, M. Kulkarni, UMESH Publications, New Delhi, 1999.

Reference Books

1. Physics of Semiconductor Devices , S.M. Sze, 3rd Edition , Oct.2006, John Wiley.
2. Solid State Electronic Devices, B.G. Streetman, PHI, New Delhi.

PHY 304 A: APPLIED SPECTROSCOPY- I

UNIT I: Molecular Spectroscopy

Introduction – Rotational structure of electronic bands of diatomic molecules – Fortrat diagram – General relations – Combination relations for $^1\Sigma$ - $^1\Sigma$ and $^1\Sigma$ – $^1\pi$ bands– Evaluation of rotational constants with reference to above transition.Isotope effect in electronic spectra of diatomic molecules – Vibrational effect and rotational effect. Potential energy curves and dissociation energy, and pre-dissociation energy. Vibrations of polyatomic molecules: CO_2 and H_2O).

UNIT- II: Raman Spectroscopy

Introduction – Theory of Raman Scattering – Rotational Raman Spectra – Vibrational Raman Spectra – Mutual Exclusion Principle – Laser Raman Spectroscopy – Sample Handling Techniques – Polarization of Raman Scattered Light – Single Crystal Raman Spectra – Raman Investigation of Phase Transitions – Resonance Raman Scattering – Structure Determination using FTIR and Raman Spectroscopy . Fourier Transform (FT) Raman Spectroscopy and its additional advantages over the conventional Raman Spectroscopy, Significance of confocal Raman spectrometer, Surface enhanced Raman Scattering-Coherent Anti-Stokes Raman Spectroscopy.

UNIT – III: Spectrophotometry

Introduction – Beer's law – Absorptivity – UV and visible absorption – Instrumentation – Essential parts of spectrophotometer – Gratings and prisms – Radiant energy sources – Filters – Photosensitive detectors – Barrier layer cells – Photo emissive cells – Photomultiplier tubes – Relationship between absorption in the visible and UV region and molecular structure – IR Spectrophotometry – Fourier Transform Infrared (FTIR) Spectrometer – Molecular structure – Qualitative and Quantitative analysis – Importance of photography in the spectrochemical analysis.

UNIT - IV: Fluorescence and Phosphorescence Spectroscopy

Introduction – Normal and Resonance Fluorescence – Intensities of Transitions – Non-radiative decay of fluorescent molecules – Phosphorescence and the nature of the triplet state – Population of the triplet state – Delayed Fluorescence – Excitation spectra – Experimental methods – Emission lifetime measurements – Time resolved emission spectroscopy – Applications of Fluorescence and Phosphorescence.

Text Books

1. Molecular spectra and Molecular structure Vol. I, G. Herzberg, 2nd Ed, Van. Nostrand.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata Mc Graw-Hill, 1983.
3. Spectroscopy Straughan and Walker (vol. 2 & 3, John Wiley & Sons, 1976.
4. Molecular Structure and Spectroscopy BY G. Aruldhas, Printice-Hall Pvt. Ltd. 2001.
5. Instrumental Methods of Analysis Willard, Merritt, Dean & Settle, CBS Pub, 2001.
6. Spectrochemical Analysis, L.H. Ahrens and S.R. Taylor,Addison – Wesley, London.

Reference Books

1. Elements of Spectroscopy, Gupta, Kumar and Sharma.
2. Elements of Diatomic Molecular Spectra, H. Dunford.
3. Problems in Spectroscopy, S.V.J. Lakshman.
4. Basic Principles of Spectroscopy, R. Chang.
5. Principles of Fluorescence Spectroscopy, Joseph R.Lakowicz - Plenum Press, 1983.
6. Molecular Spectroscopy, N.C. Crabb and P.W.B. King.
7. Light Scattering in Solids, M Cardona, G Guntherodt - 1975 - Springer-Verlag.
8. Noble Lecture of Sir C.V. Raman.

PHY 304 B: CONDENSED MATTER PHYSICS - I

UNIT - I: Crystal Growth and Imperfections in Crystals

Crystal growth: Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystal growth techniques – Melt growth: Bridgman, Czochralski techniques.

Imperfections: Classification of imperfections – Point defects – Schottky and Frenkel defects - Expressions for equilibrium defect concentrations – Colourcentres –Production of colour centres – Line defects – Dislocations – Edge and Screw dislocations – Burger vector – Estimation of dislocation densities – Mechanism of creep – Experimental determination of creep activation energy.

UNIT- II: Dielectrics and Ferroelectrics

Dielectrics: Introduction – Dipole moment – various types of polarization – Electronic, ionic and orientational polarization **–** Langevin's theory – Lorentz field – Clausius-Mosotti equation – Measurement of dielectric constant – Applications of dielectrics.

Ferroelectrics: Piezo-, Pyro- and ferroelectric crystals– Spontaneous polarization – Classification and properties of ferroelectrics - Ferroelectric domains – Oxygen ion displacement theory – Applications of ferroelectrics.

UNIT- III: Ferromagnetism and Anti-ferromagnetism

Ferromagnetism: Introduction – Weiss molecular field theory – Temperature dependence of spontaneous magnetization – Heisenberg model – Exchange interaction – Ferromagnetic domains – Magnetic bubbles – Bloch wall – Thickness and energy – Ferromagnetic spin waves – Magnons – Dispersion relations.

Anti-ferromagnetism: Introduction – Two sub lattice model of anti-ferromagnetism – Ferri magnetism - Ferrites – Structure – Applications – Multiferroics.

UNIT-IV: Photoconductivity and Luminescence

Excitons: Weakly bound and tightly bound – Photoconductivity – Simple model – Influence of traps – Space charge effects – Determination of photoconductivity. Luminescence – Various types– Thermoluminescence, Electroluminescence, Photoluminescence, Cathodoluminescence and Chemiluminescence - Excitation and emission – Decay mechanisms – Applications.

Reference Books

1. Introduction to Solid State Physics, Charles Kittel VII edition, John Wiley & Sons.
2. Solid State Physics, A.J. Dekker, McMillan Publications.
3. Material Science and Engineering, V. Raghavan, PHI, New Delhi.
4. Crystal Growth, B.R. Pamplin, Pergmon Press.
5. Crystal Growth from High Temperature Solutions, D. Elwell and H.J. Scheel,Academic Press.
6. Solid State Physics, M.A. Wahab, Narosa Publishing House.
7. Fundamentals of Solid State Physics, Saxena, Gupta, Saxena, Pragathi Publications, Meerut.
8. Solid State Physics, R.L. Singhal, Kedar Nath Ram Nath & Co. Pub.

PHYS 304 C: ELECTRONICS - EMBEDDED SYSTEMS

Unit - I: Introduction to Embedded Systems

Embedded systems in today's world – examples of Embedded systems – Microprocessors and Microcontrollers – Microchip and PIC microcontroller – Introduction to PIC microcontrollers using the 12 series.

Architecture of 16F84A – Memory organization – in 16F84A – Timing generation – Power-up and Reset functions in 16F84A.

Unit - II: Hardware Details of 16F84A

Parallel ports : Basic idea – Technical challenge – connecting to the parallel port – Parallel ports of PIC16F84A – Clock oscillator – Power supply – Interrupts – Timers and counters – watch dog timer – Sleep mode.

Unit - III: Assembler and Assembler Programs

Basic idea – PIC 16 series instruction set and ALU – Assemblers and Assembler format – creating simple programs – Adopting a development environment – Building structured programs – Flow control : Branching and Subroutines – Generating time delays and intervals – Logical instruction – Arithmetic instructions.

Unit - IV: PIC Microcontroller PIC 16F873A

Block diagram and CPU – Memory and memory maps – Interrupts – Oscillator, Reset and Power supply – Parallel ports.

PIC 16F87XA Timer 0 and Timer 1 – 16F87XA Timer 2, Comparator and PR2 register – capture/Compare/PWM (CCP) Module – Pulse width modulation – ADC module.

Interface: LED displays – Liquid crystal displays.

Books for Study

1. Designing Embedded Systems with PIC Microcontrollers: Principles and Applications by Tim Wilmshurst, First Edition, 2007, Newnes – Elsevier – Publishers.

Reference Books

1. Microcontrollers: Theory and Applications, Ajay V. Deshmukh, , Tata Mc Graw- Hill, New Delhi, 2005.
2. Designing with PIC Microcontrollers, John B. Peatman, Pearson Education, Inc., 1998.

PHY 304 D: PHOTONICS –I

UNIT - I: Laser systems

General description, Laser structure, Single mode laser theory, Excitation mechanism and working of: CO_2, Nitrogen, Argon ion, Excimer, X-ray, Free-electron, Dye, Nd:YAG, Alexanderite and Ti:sapphire lasers, Diode pumped solid state laser, Optical parametric oscilater (OPO) lasers. Optical amplifiers-Semiconductor optical amplifiers, Erbium doped waveguide optical amplifiers, Raman amplifiers, Fiber Lasers. Laser applications-Lasers in Isotope separation, Laser interferometry and speckle metrology, Velocity measurements.

UNIT - II: Properties of laser Radiation

Introduction, Laser linewidth, Laser frequency stabilization, Beam divergence, Beam coherence, Brightness, Focusing properties of laser radiation, Q-switching, Methods of Q-switching: Rotating-mirror method, Electro-optic Q-switching, Acoustic-optic Q-switching and Passive Q-switching, Modelocking, Methods of mode locking: Active and passive mode locking techniques, Frequency doubling and Phase conjugation

UNIT - III: Opto-electronic Devices

Introduction, P-N junction diode, Carrier recombination and diffusion in P-N junction, Injection efficiency, Internal quantum efficiency, Hetero-junction, Double hetero-junction, Quantum well, Quantum dot and Super lattices; LED materials, Device configuration and efficiency, Light extraction from LEDs, LED structures-single heterostructures, double heterostructures, Device performances and applications, Quantum well lasers; Photodiode and Avalanche photodiodes (APDs), Laser diodes-Amplification, Feed back and oscillation, Power and efficiency, Spectral and spatial characteristics.

UNIT – IV: **Modulation of Light**

Introduction, Birefringence, Electro-optic effect, Pockels and Kerr effects, Electro-optic phasemodulation, Electro-optic amplitude modulation, Electro-optic modulators:scanning and switching, Acousto-optic effect, Acousto-optic modulation, Raman-Nath and Bragg modulators : deflectors and spectrum analyzer, Magneto-optic effect, Faraday rotator as an optical isolator. Advantages of optical modulation.

Text and reference books

1. Lasers: Principles and applications by J.Wilson And J.F.B.Hawkes, Prentice, Hall of India, New Delhi, 1996.
2. Laser fundamentals, W.T.Silfvast, Foundation books, New Delhi, 1999.
3. Semi conductor opto electronics devices, P. Bhattacharya, Prentice – Hall of India, New Delhi, 1995.
4. Optical fiber communications, John M. Senior, Prentice-Hall of India, New Delhi, 2001
5. Optoelectronics: An Introduction, J.Wilson And J.F.B.Hawkes, Prentice-Hall of India, New Delhi, 1996.
6. Electro-Optical devices, M.A. Karim, Boston, Pws-Kent Publishers, 1990

PHY 304 E: SOLAR ENERGY – THERMAL ASPECTS

UNIT - I: Solar and Thermal Radiation- Basics

Spectral distribution of Extra-terrestrial radiation – Solar Constant-Concept of Zenith Angle and Air-Mass. Standard Time, Local Apparent Time, Equation of Time. Definitions of Declination, Hour Angle, Solar and Surface Azimuth Angles. Direct, Diffuse and Total Solar Radiations - Intensity Measurements- Thermoelectric Pyranometer, Thermoelectric Pyrheliometer and Angstrom Pyrheliometer.

Reflection, Absorption and Transmission of solar radiation through single and multiple covers-Transmittance-Absorptance product. Kirchoff's law-Relationship among absorptance, emittance and reflectance. Spectrally Selective Surfaces-Methods of obtaining selectivity -Direct measurement of solar absorptance and thermal emittance of a selective surface.

UNIT - II: Flat-Plate Collectors

General description of a flat-plate collector- Liquid heating type flat-plate collector-Energy balance equation and efficiency. Temperature distribution in the flat-plate collectors-Collector over-all heat-loss coefficient- Definitions of fin efficiency - Collector efficiency factor, Collector heat-removal factor and Collector flow-factor. Standard method of testing the thermal performance of liquid heating type flat-plate collector. Evacuated tubular collectors.

UNIT - III: Concentrating Collectors and Thermal Energy Storage

Types of Concentrating Collectors - Non-imaging and imaging concentrators-single axis and two-axis tracking – Definitions of Aperture, Rim-angle, Concentration ratio and Acceptance angle. Thermal performance of Linear Parabolic Trough Concentrator with an uncovered receiver.

Thermal Energy Storage - Sensible heat storage- liquid and pebble-bed storage, Latent Heat storage and Thermochemical storage.

UNIT - IV: Solar Thermal Energy Applications

Principles of Solar Water Heating System- Natural and Forced Circulation types-sizing of domestic water system. Solar space heating systems-active heating system-liquid heating type - Passive space heating and cooling concepts. Solar vapour absorption type and vapour compression type cooling systems. Solar Cookers, Solar Desalinators. Solar Air Heaters - Different configurations-Solar Driers - Principle of working – Solar thermal power generation.

Books for study

1. Solar Thermal Energy Engineering, J.A. Duffie and W.A. Beckman, John Wiley & Sons,1990.
2. Solar Energy Utilization, G.D. Rai, Khanna Publishers.
3. Solar Energy-Fundamentals and Applications, J.P.Garg & J Prakash, Tata McGraw Hill Pub 2000.
4. Solar Energy-Fundamentals, Design, Modelling&Applications,GN Tiwari, Narosa Pub. 2005.
5. Solar Energy- Principles of Thermal Collection and Storage, S.P. Sukhatme, Tata McGraw Hill Pub., 1999.

Reference Books

1. Principles of Solar Energy Engineering, Kreith and Kreider.
2. Handbook of Solar Energy Technology, Part A & Part B, Chemisnoff and Dickinson.
3. Treatise on Solar Energy, Vol. 1, H.P. Garg, John Wiley.
4. Applied Solar Energy, Meinel and Meinel.

PHY 304 F: VACUUM AND THIN FILM TECHNOLOGY

UNIT - I: Production and Measurement of Vacuum

Vacuum pumps: Fundamentals of kinetic theory applicable to vacuum technology- Mechanical Pumps: Rotary pump, Roots pump: Dry Pumps- Turbo molecular pump – Diffusion pump – Sorption pump – Cryogenic pump – Sputter ion pump. (1,2)

Vacuum Gauges: Thermal conductivity (Pirani) gauge- McLeod gauge – Ionization gauges: Penning gauge, Hot cathode ionization gauge – Bayard –Alpert gauge – Partial pressure measurements gauges: Magnetic deflection mass spectrometer – Quadruple mass spectrometer

UNIT - II: Construction and Operation of Vacuum Systems

Valves for medium and high vacuum – Devices for transmitting motion – Working vessel – Pump combinations – Design of vacuum systems - Leaks and leak detection.

Vacuum application: Vacuum metallurgy, Space simulators, Freeze drying – Vacuum in electrical applications (Drying, Impregnation, circuit breakers). (1,2,3)

UNIT - III: Preparation of Thin Films

Physical Methods: Vacuum evaporation:– Thickness distribution of evaporated films (Point and Ring sources) - Resistive heating, Electron beam evaporation, Co-evaporation Pulsed laser ablation – Epitaxial thin deposition: Close-space vapour transport (CSVT) and molecular beam epitaxy. Sputtering: Glow discharge, DC and RF sputtering, Reactive sputtering and magnetron sputtering.

Chemical methods: Electroplating – Spray pyrolysis – Chemical vapour deposition (CVD), Plasma enhanced chemical vapour deposition (PECVD) and Metal organic chemical vapor deposition (MOCVD) . (3,4,5)

UNIT - IV: Growth and Thickness Measurements of Thin Films

Growth of thin films: Condensation, Nucleation and growth of thin films – Langmuir Frenkel theory of condensation – Theories of thin film nucleation – Capillarity theory – Statistical or Atomistic theory – Comparison of the nucleation theories – The four stages film growth – Incorporation of defects during growth.

Thickness measurement: Multiple beam interferometer (MBI) methods – Quartz crystal thickness monitor, Stylus profiler. (3,4,6)

Books for Study

1. Vacuum Technology, A. Roth, North-Holland, 1986.
2. Vacuum Science and Technology, V. Vasudeva Rao, T.B. Ghosh and K.L. Chopra, Allied Publications, 1998.
3. Handbook of Thin Film Technology, L.I. Maissel and R.L. Glang, Mc Graw Hill Book Co., 1970.
4. Thin Film Phenomena, K.L. Chopra, Mc Graw Hill Book Co., New York, 1969.
5. Vacuum Deposition onto Webs, Films and Foils, Charles A. Bishop, Elsevier, London, 2011.
6. The Materials Science of Thin Films, M. Ohring, Academic Press, New York, 1992.
7. The User's Guide to Vacuum Technology, J.F .O'Henlon, John Wiley & Sons, 2003.

EXTERNAL ELETIVE

PHY 307: ANALYTICAL METHODS

UNIT-I: MICROSCOPIC AND SPECTROSCOPIC TECHNIQUES

Optical microscopy: Bright field microscopy, Dark field microscopy, Phase contrast microscopy and its applications. Fluorescence microscopy and Polarizing microscopy. Electron microscopy: Transmission electron microscopy, Scanning electron microscopy, Preparation of the Specimen for Electron Microscopy, Confocal microscope, Video- microscopy and digital imaging scanning – Tunneling microscopy.

FTIR and Laser Raman spectrometers. Applications of group frequencies for the structural studies of biological molecules.

UNIT-II: PHYSICO-CHEMICAL TECHNIQUES

Light scattering: macro molecular scattering, particle scattering factor, experimental setup, Zimm's plot, applications to a few systems. Electrophoresis, Osmotic pressure, Viscosity, Ultra centrifuge, Sedimentation velocity and sedimentation equilibrium- Determination of molecular weight –Small angle X-ray scattering, Rotational diffusion –Flow birefringence measurements.

UNIT-III: THERMODYNAMICS AND BIO-MECHANICS

Introduction, Strriated Muscles: Contractile proteins. Mechanical properties of Muscles: Contraction Mechanism, Role Ca^{2+} ions. Biomechanics of Cardiovascular System: Blood pressure, Electrical activity during the Heartbeat, Electrocardiography**.** Mechanical properties of Muscles: Contraction Mechanism, Role Ca^{2+} ions. Biomechanics of Cardiovascular System: Blood pressure, Electrical activity during the Heartbeat, Electrocardiography**.**

UNIT-IV: RADIATION BIOPHYSICS

Types of radiations. Interaction between radiation and matter: Directly ionizing radiation, Indirectly Ionising radiation. Dose and Dose rate. Dosimetry. Description and interpretation of radiation action: Dose effects graphs and target theory, Direct and Indirect radiation action. Radioactive isotopes. Biological effects of radiation. Radiation Protection and Therapy.

Books for Study

1. Essential of Biophysics, P. Narayanan, New Age International Ltd., New Delhi (2000).
2. Biophysics, W. Hoppe, W. Lohmann, H. Ziegler, Springer-Verlag, Berlin (1983).
3. Biophysics, V. Pattabhi and N. Gautham, Narosa Pub. House, New Delhi (2002).
4. Quantum Mechanics of Molecular Conformation, B. Pullman, John Wiley & Sons,NY(1975).
5. Biophysical Chemistry, Upadhyay and Upadhayanath, Himalaya Publish House (2008).

PHY 308: REMOTE SENSING AND APPLICATIONS

UNIT – I: Photography and Photogrammetry

Fundamentals of Aerial photography systems. Basic principles of Aerial photos, Types of Aerial Photos, scale, Ground coverage, Photographic resolution, Radiometric characteristics.

Fundamentals of Photogrammetry : Geometry of Aerial photos. Relief and Tilt displacements – measurement of heights and determination of slopes. Concepts of stereophotogrammetry.

UNIT – II: Remote Sensing

Principles and basic concepts of remote sensing, physics of remote sensing. Effects of Atmosphere, Principles and Geometry of scanners, CCD arrays and platforms. Rainfall estimation techniques, cyclone analysis techniques & synoptic weather analysis using visible, Near Infrared.

UNIT – III: Laser and Microwave remote sensing

Principles and basic concepts of microwave sensing – SLAR, SAR, Geometric characteristics, spatial resolution, Radar Grammetry.

Ground data collection for interpretation and analysis Principles of Image interpretation – Types of Imagery, their formation and characteristics, elements of interpretation techniques of visual interpretation.

UNIT – IV: Digital Image Processing

Digital Image, Digital Image data formats, Band sequential; Band Interleaved and its characteristics. Image processing systems considerations and characteristics – Image enhancements techqnieques – Image reduction and magnification, contrast enhancements, rationing, spatial filtering, edge enhancements.

Reference Books

1. Text Book of Photogrammetry, Rampal, K.K. Oxford & IBM, 1982.
2. Remote Sensing: Methods and Applications, Hard R. Michael, John Wiley, 1987.

SEMESTER-IV
PHY 401: QUANTUM MECHANICS-II

UNIT- I: Identical Particles and Molecules

Identical particles- Indistinguish ability of Identical particles- Construction of Symmetric and Anti-symmetric wave functions for two and three particle systems - Pauli's Exclusion Principle- Hydrogen molecule- Spin-orbit interaction- Ortho and Para hydrogen- Spin statistics connection.

UNIT - II: Angular Momentum

Introduction: Definition of angular momentum operator - Commutation rules for angular momentum - Eigen values and Eigen functions of L_z and L^2 - Angular momentum in general - Allowed values of angular momentum J - Eigen values of J_+ and J_- angular momentum matrices - Addition of angular momeeta and Clebsh -- Gorden co-efficients: Clebsh – Gorden co-efficient for $J_1=J_2=1/2$ and $J_1=1$, $J_2=1/2$ - spin angular momentum and Pauli's spin matrices.

UNIT - III: Relativistic Quantum Theory

Klein – Gorden Equation – Probability Current Density – Inadequacies of K.G. Equation – Dirac's Relativistic Equation for a Free Particle - Dirac`s Matrices – Dirac`s Equation in Co-variant form – Plane wave solution – Negative Energy States – Spin Angular Momentum -Existence.

UNIT - IV: Quantization of Wave Fields

Concept of Field - Method of Canonical Quantization: Lagrangian Formulation of Field, Hamilton Formulation of Field - Second Quantization – Field equation - Quantization of Non-relativistic Schroedinger equation – Commutation and Anti-commutation Relations, The N-representation - System of Fermions and Bosons – Creation and Annihilation.

Reference Books:

1. QuantumMechanics:S.L.Kakaniand H.M. Chandalia SultanChandandSonsFirst Edition
2. Advanced Quantum Mechanics : B.S. Rajput, Pragatiprakasan
3. Quantum Mechanics : V.K. Thankappan, Wiley Eastern Limited
4. A Textbook of Quantum Mechanics : P.M. Mathews and K. Venkatesan,Tata Mc Graw Hill Publishing Company
5. Quantum Mechanics : S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma, Jai Prakash Nath and Company
6. An Introduction to Quantum Mechanics, P.T. Mathews Mc Graw Hill Publishing Company

PHY 402: ANALYTICAL TECHNIQUES

UNIT- I: Diffraction Methods for Structure Analysis

Crystal systems: Symmetry elements, Concept of point groups and space groups. Reciprocal Lattice: Geometrical construction, Relation between direct – Reciprocal Lattice X- ray diffraction, Bragg's law, Laue methods, Powder X-ray Diffractometer– Focusing circle geometry-Determination of lattice constant of a cubic and tetragonal structures using d-spacings, Single crystal X-ray Diffractometer-Electron diffraction and Neutron diffraction: Basic principles and applications.

UNIT - II: Electron Spin Resonance and Mossbauer Spectroscopy

Electron spin resonance spectroscopy: Magnetic moment of an electron, two states of an electron in a magnetic field, ESR theory- Spin-spin interaction, Spin-lattice interaction - Hyperfine interaction-g factor, Line widths and Intensities, Relaxation effects, Experimental methods and applications.

Mossbauer spectroscopy: Introduction-Mossbauer effect, Recoilless emission and absorption, Mossbauer spectrum, Hyperfine interactions, Experimental methods and applications.

UNIT – III: NMR and NQR Techniques

Introduction to NMR: Nuclear spin and magnetic moment, Quantum description of NMR, theory of NMR, chemical shift, Spin-lattice (T_1), spin-spin (T_2) couplings, Bloch equations, Theory of relaxation mechanisms for spin ½ nuclei, Proton NMR, Carbon-13 NMR and NMR applications.

Basic concepts of NQR spectra: Half integral and integral spins, Instrumentation, Super regenerative oscillator, CW oscillator, Pulse RF detection and applications.

UNIT – IV: Advanced Spectroscopic and Microscopic Techniques

Basic principles, Instrumentation and applications of X ray fluorescence spectroscopy, Photoelectron spectroscopy, Photoemission spectroscopy and X-ray photoelectron spectroscopy.

Basic principles, Instrumentation and applications of Scanning electron microscopy, Transmission electron microscopy, Atomic force microscopy, Energy dispersive spectroscopy, Differential scanning calorimetry and Thermo gravimetric analysis.

Books for study

1. Elements of X-ray Diffraction, B.D. Cullity.
2. Methods of Surface Analysis, Techniques and Applications, J.M. Walls Cambridge University Press, 1990.
3. Neutron Diffraction, G.E. Bacon, Oxford University Press, London, 1962.
4. Electron Diffraction, T.B. Rymer, Methnen, London, 1970.
5. X-ray Structure Determination, H. Stout and LH. Jenson, Macmillan, London, 1968.
6. An Introduction to Electron Paramagnetic Resonance, M. Bersohn, J.C. Baird, Benjamin Inc., London, 1966.
7. Instrumental Methods of Analysis, Willard Merritt, Dean Settle, CBS publishers, New Delhi, 1986
8. Spectroscopy, B.P. Straughan and S. Walker, John Wiley & Sons Inc., New York,1976.
9. Spectroscopy, G. Chatwal and S. Anand, Himalaya Pub., 2002.
10. Spectroscopy, B.K. Sharma, Goel Publishers House, Meerut, 1975.
11. NMR Spectroscopy, R.K. Harris, Longman Sci. Tech, 1983.

PHY 403: ADVANCES IN PHYSICS

UNIT – I: Nano Technology

Introduction to Nanomaterials – Zero, One and Two Dimensional Nanostructures - Quantum confinement - Density of states and Dependence of dimensionality – Properties of Nanomaterials – Carbon Nanotubes, Fullerenes.

Synthesis of Nanomaterials – Physical Techniques: Ball Milling – Plasma Arc Deposition – Inert Gas Condensation – Pulsed Laser Deposition – Molecular Beam Epitaxy.

Chemical Techniques:Hydrothermal synthesis– Sol-Gel Process – Chemical Vapour Deposition. Applications: Single Electron Transistor – Solar Cells – Light Emitting Diodes – Nano-filtration.

UNIT – II: Micro and Nano devices

Microelectromechanical systems (MEMS): Introduction to MEMS, Basic MEM structure. Applications of MEMS: Pressure sensors, Accelerometers, Inertial sensors, Mass flow sensors.

Nanodevices: Quantum well and quantum dot devices: Infrared Detectors-Quantum Dot Lasers. Carbon nanotube emitters - Photoelectrical cells - Plasmons propagation in wave guides.

UNIT – III: 8051 Microcontrollers

Microcontrollers and Embedded Processors: Introduction, 8051 Internal Architecture, Register Structure, I/O pins, Memory Organization, 8051 Addressing modes. 8051 Assembly Language Programming Tools. 8051 Instruction set: Data Transfer Instructions, Arithmetic instructions, Logical instructions, Boolean Variable Manipulation Instructions-Bit Addressability, Single-Bit instructions, Program Branching instructions-Jump, Loop, and Call instructions, Rotate Instructions, Stack Pointer.

UNIT - IV: Remote Sensing

Definition of remote sensing; introduction to concepts and systems; Electromagnetic radiation; electromagnetic spectrum; image characteristics; remote sensing systems; remote sensing platform; Sources of remote sensing information; Advantages of remote sensing. Application of Remote sensing in Environmental Management, Natural resource management – forest resources, water resources, land resources and mineral resources.

References Books

1. Nano structures and Nanomaterials: Synthesis, Properties and Application By Guozliong Cao, Imperial College Press, 2004.
2. Introduction to Nanotechnology, Charles P. Poole, Jr & Frank J. Owens, Wiley India, 2006.
3. An Introduction to Microelectromechanical Systems Engineering, Nadim Maluf.
4. Nanomaterials Synthesis Properties and Applications, Alen. S. Edelstein and Robert C. Cammarata, 1998.
5. The 8051 Microcontroller and Embedded systems, Mahammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, Pvt. Ltd., 2000.
6. Floyd F. Sabins Jr., Remote Sensing Principles and interpretation, W.H. Freeman and Company, 2nd Ed., New York, 1987.
7. T.M. Lillesand & R.W. Kiefer, Remote Sensing and Image Interpretation, John Wiley & Sons, New York, 1994.
7. An Introduction to GIS by Ian Heywood et al., Addison Wesley, Longmont Limited, England.

PHY 404 A: APPLIED SPECTROSCOPY – II

UNIT - I: Solid State Spectroscopy I – Transition Metal Ions

Introduction – Crystal fields and ligand fields-Concept of ligand field – Scope of ligand field theory – 'd' and other orbitals (s,p,f) – Quantitative basis of crystal fields – Crystal field theory – Octahedral crystal field potential on the d-wave functions – The evaluation of 10 Dq - Effect of weak field on S, P, D and F terms.

Term energy level diagrams – Correlation diagram for d^2 configuration in octahedral coordination – Tanabe-Sugano diagrams for d^2 configuration in octahedral field.

UNIT - II: Solid State Spectroscopy II – Rare Earth Ions

Introduction – Spectroscopic characteristics of rare earths activated crystals – Intensity of absorption and emission bands – Oscillator strengths – Intra-configurational f-f transitions –Selection rules – Electric and Magnetic dipole transitions – Judd-Ofelt theory and evaluation of Judd-Ofelt parameters – Radiative transition probabilities of excited states of rare earth ions – branching ratios, stimulated emission cross-sections – Non-radiative process – Energy transfer – Possible mechanisms of energy transfer – Resonance energy transfer – Process of IR to visible upconversion – Applications of rare earth doped luminescent materials.

UNIT – III: High Resolution Spectroscopy

Introduction – Light detectors – Single photon counting technique – Phase sensitive detectors – Laser optogalvanic spectroscopy – Matrix isolation spectroscopy – Laser cooling and its applications.

UNIT- IV: Two Photon Spectroscopy

Introduction – Two photon absorption spectroscopy – Selection rules – Expression for the two photon absorption cross section – Photo acoustic spectroscopy – Experimental methodology and applications to Physics, Chemistry, Biology and Medicine.

Books for Study

1. Introduction to ligand fields, B. N. Figgis (Intersci. Pub. New York, 1966.
2. Laser Crystals, A.A. Kaminskii, Springer-Verlag, New York, 1981.
3. Laser and Excited states of Rare Earths, R. Reisfeld and C.K. Jorgnesen, Springer-Verlag, New York, 1977.
4. Optical Properties of Transparent Rare Earth compounds, S. Hufner, Acad. Press, 1978.
5. High Resolution Spectroscopy, J.M. Hollas.
6. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata Mc Graw-Hill Pub. 1983.
7. Instrumental Methods of Analysis, Willard, Merritt, Dean and Settle, CBS Pub. 2001.
8. Opto Acoustic Spectroscopy and Detection, Yoh-Han Pao, Academic Press, 1977.

Reference Books

1. Laser Spectroscopy - Basic Concepts and Instrumentation, 3rd Edition, Demtröder, Wolfgang Springer Verlag, 2003.
2. Photoacoustics and its Applications, C. Roseneweig.
3. Introduction to Non-linear Spectroscopy, M.D. Levenson.

PHY 404 B: CONDENSED MATTER PHYSICS – II

UNIT - I: Elastic Properties of Solids

Lattice as a homogeneous and continuous medium - Analysis of stress and strain tensors – Hooke's law - Elastic compliances and stiffness constants – Elastic energy density – Reduction in the number independent elastic constants in cubic crystals – Cauchy's relations – Bulk modulus and compressibility – Elastic waves in cubic crystals – Formulation and solution of wave equations along [100], [110] and [111] directions – Experimental determination of elastic constants – Pulse-echo technique.

UNIT - II: Thermal Properties of Solids

Quantum theory of lattice vibrations – Properties of phonons – Lattice specific heat at low temperatures – Einstein and Debye models – Born cut-off procedure – Inelastic scattering of neutrons by phonons – Experimental study of dispersion curves – Inadequacy of harmonic model – Anharmonicity – Thermal expansion – Gruneisen parameter- Lattice thermal conductivity – Elementary kinetic theory – Role of U and N processes.

UNIT - III: Energy bands and Fermi Surfaces

Energy band calculations: Plane Wave method and Augmented Plane Wave (APW) method. Importance of Fermi surface – Characteristics of Fermi surface – Construction of Fermi surface - Quantization of electron orbits - Experimental study of Fermi surface: Anomalousskin effect – Cyclotron resonance – de Haas van Alphen effect.

UNIT - IV: Functional materials

Amorphous semiconductors: Band structure – Electronic conduction – Optical absorption – Applications.

Liquid crystals: Classification – Orientational order and intermolecular forces – Magnetic effect – Optical properties – Applications.

Polymers: Classification –Structural property correlation – Molecular weight – Crystallinity in polymers – Applications.

Reference Books

1. Introduction to Solid State Physics, Charles Kittel 7th Edition, John Wiley & Sons.
2. Solid State Physics, A.J. Dekker, Mac Millan.
3. Solid State Physics, H.C. Gupta, Vikas Publishing House.
4. Elementary Solid State Physics, M. Ali Omar, Addison Wesley.
5. Solid State Physics, M.A. Wahab, Narosa Publishing House.
6. Science of Engineering Materials, C.M. Srivastsava and C. Srinivasan, New Age Inter. Pub.

PHY 404 C: ELECTRONICS - WIRELESS COMMUNICATION SYSTEMS

Unit – I: Base band data transmission

Digital Modulation techniques: BPSK, QPSK, DPSK, QASK, BFSK, MSK, M-ary techniques. Base band binary data transmission system – Inter symbol interference – Nyquist pulse shaping criteria – line coding, pulse shaping, and scrambling techniques.

Unit – II: Codes for error detection and correction

Detection of error probability: Gaussian probability function – properties – error function complementary – error function. Linear block codes, Convolutional codes. Encoding, Decoding of convolutional codes, State, Tree and Trellis diagrams. Maximum likelihood – Viterby algorithm, Burst error correction - Interleaving techniques – Block and convolutional interleaving, Types of ARQ.

Unit – III: Introduction to wireless communication systems

Global system for mobile (GSM): cellular concept, system design. Transmission system, Receiving system; frequency re-use; Spread spectrum modulation; Multiple access techniques as applied to wireless communications; 1G, 2G, 3G wireless networks.

Unit – IV: Satellite and Optical communications

Introduction Satellite systems: Orbiting satellites, satellite frequency bands, communication satellite system-modulation and multiple access format-satellite systems in India, Satellite receiving systems, G/T ratio, satellite uplink and down link analysis. Applications to communications and remote sensing.

Introduction to Optical communications systems: Optical fibers, sources and detectors, analog and digital systems.

Text Book

1. Modern Digital and Analog communication system, B.P. Lathi: Oxford 3 rd Edition.
2. Digital Communications Fundamentals and Applications, Bernard Sklar, Sklar Pearson Education.

Reference Books

1. Principles of Communication, R.E. Ziemer, WH Tranter 5th Edition John Wiley (Fifth module).
2. Morden Electronic Communication Systems, Wayne Tomoasi, Person Education/PHI.
3. Digital Communication, John G Proakis, MGH.
4. Digital Communication Techniques Simon, Hindey Lindsey PHI.
5. Communication Systems, Simon Haykin, John Wiley & Sons. Pvt. Ltd.
6. Principles of Communication Systems, Taub and Schilling, Tata McGraw-Hill.
7. Digital and Analog Communication System, K. Sam Shanmugam. John Wiley.
8. Communication Systems Engineering, Proakis, Pearson Education.
9. Digital and Analog Communication System, Leon W Couch, Pearson Education/PHI.
10. Introduction to Statistical Signal Processing with Applications, M.D. Srinath, P.K. Rajasekaran, R.E. Viswnathan PHI.
11. Analog and Digital Communication, M.S. Roden PHI.
12. Digital Modulation and Coding. Wilson, Pearson Education.
13. Applied Coding and Information Theory for Engineers, Wells, Pearson Education.

PHY 404 D: PHOTONICS –II

UNIT - I: Fibre Optic Components and Sensors

Connector principles, Fibre end preparation, Splices, Connectors, Source coupling, Distribution networks, Directional couplers, Star couplers, Switches, Fiber optical isolator, Wavelength division multiplexing, Time division multiplexing, Fiber Bragg gratings. Advantage of fiber optic sensors, Intensity modulated sensors,

Mach-Zehnder interferometer sensors, Current sensors, Chemical sensors –Fiber optic rotation sensors. Optical biosensors: Fluorescence and energy transfer sensing, molecular beacons and optical geometries of bio-sensing, Bio-imaging, Biosensing.

UNIT - II: Integrated Optics

Introduction – Planar wave guide – Channel wave guide – Y-junction beam splitters and couplers - FTIR beam splitters – Prism and grating couplers – Lens wave guide – Fabrication of integrated optical devices - Integrated photodiodes – Edge and surface emitting laser – Distributed Bragg reflection and Distributed feed back lasers - Wave guide array laser.

UNIT - III: Optical Signal Processing

Introduction, Effect of lens on a wavefront, Fourier transform properties of a single lens, Optical transfer function, Vanderlugt filter, Image spatial filtering, Phase-contrast microscopy, Pattern recognition, Image de-blurring, Photonic switches, Optical transistor, Optical Gates- Bistable systems, Principle of optical Bistability, Bistable optical devices, Self electro-optic effect device.

UNIT - IV: Photonic Crystals

Basics concepts, Theoretical modeling of photonic crystals, Features of photonic crystals, Methods of fabrication, Photonic crystal optical circuitry, Nonlinear photonic crystals, Photonic crystal fibers, Photonic crystals and optical communications, Photonic crystal sensors.

Text and Reference Books

1. Fibre Optic Communication, Joseph C. Palais, Pearson Education Asia, India, 2001
2. Introduction To Fibre Optics, A.Ghatak And K.Thyagarajan, Cambridge University Press, New Delhi, 1999
3. Optical Guided Wave Signal Devices, R.Syms And J.Cozens. Mcgraw Hill, 1993.
4. Optical Electronics, A Ghatak and K. Thyagarajan, Cambridge University Press, New Delhi, 1991
5. Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, John Willy and Sons,1991
6. Introduction to Fourier Optics, Joseph W. Goodman, McGraw-Hill, 1996.
7. Nanophotonics, P.N.Prasad, Wiley Interscience, 2003.
8. Biophotonics, P.N.Prasad, Wiley Publications, 2004.

PHY 404 E: SOLAR ENERGY - PHOTOVOLTAIC ASPECTS

UNIT - I: Fundamentals

Photovoltaic effect, Types of interfaces, homojuction, heterojunction and Schottky barrier - Choice of semiconductor materials for fabrication of homojunction solar cells - equivalent circuit of a solar cell. Solar cell output parameters -Fill-factor, conversion efficiency, quantum efficiency. Effect of series and shunt resistance on the efficiency of solar cells. Variation of Open-circuit voltage and short circuit current with intensity of incident light. Effect of temperature on I-V characteristics. p-n heterojunction solar cells - criteria for choosing absorber and window layers.

UNIT – II: Silicon Photovoltaics

Single crystal silicon (c-Si) ingot growth – Float Zone and Czochrolski methods – silicon wafer fabrication – wafer to cell formation - I-V characteristics and spectral response of c-Si solar cells. Factors limiting the efficiency - Polysilicon wafer fabrication methods – EFG and SRG methods. Amorphous Silicon - differences in properties between crystalline silicon and amorphous (a-Si) silicon. a-Si deposition by glow discharge method – Electrical and optical properties of a-Si. Outline of a-Si solar module processing steps.

UNIT – III: Thin Film Solar Cells

Principle of multijunction cells – Structure and fabrication of GaInP/GaAs/Ge triple junction solar cell – Metamorphic solar cells. CdTe/CdS and CuInGaSe/CdS (CIGS) solar cells - Cell configuration – techniques used for the deposition of each layer- cell characteristics. Organic solar cells – Configuration and principle – Types of organic solar cells, Dye-sensitized (DS) solar cells – Principle – Configuration and performance, Basic concept of quantum dot, nano wire (NW), hot carrier and plasmonic solar cells.

UNIT - IV: Solar Photovoltaic Systems

Photovotaic Module Assembly: Description of steps involved in the fabrication of Silicon Photovoltaic Module - Performance of Photovoltaic Module - Module Protection - Modules in series and in parallel - Use of Bypass and Blocking Diodes, Solar photovoltaic system - components – PV Array, battery, invertor and load. Applications of solar photovoltaic systems. Stand alone, Hybrid and Grid connected PV systems.

Books for Study

1. Solar Photovoltiacs – Fundamentals, Technologies and Applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd.
2. Solar Power Generation – Technology, New concepts and Policy, P. Jayarma Reddy, CRC Press, 2012.
3. Science and Technology of Photovoltaics, P. Jayarama Reddy, BS Publications, 2004.

Reference Books

1. Fundamentals of Solar Cells, A.L. Farenbruch and R.H. Bube.
2. Terrestrial Solar Photovoltaics, Bhattacharya.
3. Amorphous Silicon Solar Cells, K.Takahashi & M.Konagai, North Oxford Academic Press, 1986.
4. Thin Film Solar Cells, K. L. Chopra and Das, Plenum.

PHY 404 F: PROPERTIES AND APPLICATIONS OF THIN FILMS

UNIT - I: Chemical and Physical Characterization of Thin Films

Surface Analytical Techniques: Auger Electron Spectroscope (AES), Secondary Ion Mass Spectroscopy (SIMS), Secondary Neutral Mass Spectroscope (SNMS) and Rutherford Back Scattering Spectroscope (RBS).

Spectroscopic techniques: UV-Vis-NIR and IR spectrophotometers, Fourier Transform Infrared Spectroscope (FTIR) and Raman spectroscope.

UNIT - II: Transport Properties of Thin Films

Metallic Films: Sources of resistivity in metallic conductors – sheet resistance and temperature coefficient of resistance of thin films – Influence of thickness on the resistivity of structurally perfect thin films – Fuchs Sondhemier theory – Hall effect – Annealing, agglomeration and oxidation.

Dielectric films: Electrical conduction in insulator films – Schottky emission – Tunneling, Poole - Frenkel emission.

UNIT - III: Optical Properties of Thin Films

Reflection and transmission at an interface – Reflection and transmission by single film – Reflection from an absorbing film - Multilayer films – Optical absorption – Determination of optical constants by Ellipsometry.

Optical devices: Beam splitters – Reflection and antireflection coatings- Optical filters: Neutral filters, Broad band filters, Narrow band filters – Thin film polarizers.

UNIT - IV: Applications of Thin Films

Photolithography: Photoresists, Mask and pattern generation. Thin film resistors – Thin film capacitors – Thin film diodes and transistors – Thin film solar cells, Thin film microbatteries – Thin film sensors: Gas sensors, Bolometers – Transparent conducting oxide coatings - Thin films for superconducting devices – Metallurgical coatings. Hard coatings and Tribological coatings.

Text Books

1. Thin Film Fundamentals, A. Goswami, New Age Internatuional. Publications, 1996..
2. Preparation of Thin Films, J. Goege, Marcel Dekker, New York, 1992.
3. Hand Book of Thin Film Technology, L.I. Maissel and R.L. Glang, Mc Graw Hill Book Co., 1970.
4. Thin Film Phenomena, K.L. Chopra by Mc Graw Hill book Co., New York, 1969.
5. Introduction to Semiconductor Materials and Devices, M.S. Tyagi, John Wiley & Sons Pvt. Ltd. Singapore, 2000.
6. Thin Film Solar Cells, K.L. Chopra and S.R. Das, Plenum Press, New York, 1983.
7. The Materials Science of Thin Films, M. Ohring, Academic Press, New York, 1992.

PHY 407: Human Values and Professional Ethics – II

Chapter I: Value Education – Definition – Relevance to present day – Concept of human values - Self introspection – Self esteem. Family values-Components, Structure and responsibilities of family Neutralization of anger – Adjustability – Threats of family life – Status of women in family and society – Caring for needy and elderly – Time allotment for sharing ideas and concerns.

Chapter II: Medical ethics – Views of Charaka, Sushruta and Hippocratus on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia, Ethical obligation to animals, Ethical issues in relation to health care professionals and patients. Social justice in health care, human cloning, problem of abortion. Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge.

Chapter III: Business ethics – Ethical standards of business – Immoral and illegal practices and their solutions. Characteristics of ethical problems in management, ethical theories, causes of unethical behavior, Ethical abuses and work ethics.

Chapter IV: Environmental ethics – Ethical theory, man and nature - Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and pollution, Justice and environmental health.

Chapter V: Social ethics – Organ trade, Human trafficking, Human rights violation and social disparities, Feminist ethics, Surrogacy/pregnancy. Ethics of media – Impact of Newspapers, Television, Movies and Internet.

Books for study:

1. Johns S Mackenjie: A Manual of ethics
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D. Irwin Inc.
3. Management Ethics – Integrity at work by Joseph A. Petrick and John F. Quinn, Response Books, New Delhi.
4. "Ethics in Management" by S.A. Shelekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed) G.C. Haughton.
10. Sasruta Samhita: Tr. KavirajKunjanlal, KunjanlalBrishagratha, Chowkamba Sanskrit Series, Vol I,II and III, Varanasi, Vol I PP, 16-20, 21-32 and 74-77 only.
11. Charaka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series Office. Varanasi I, II, III Vol I PP 183-191.
12. Ethics, Theory and Contemporary Issues. Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed.,) John H. Piet and Ayodya Prasad, Cosmo Publications.
15. Text Book for Intermediate First Year Ethics and Human Values, Board of Intermediate Eduction – Telugu Academy, Hyderabad.
16. I.C. Sharma Ethical Philosophy of India. Nagin& Co Julundhar.

EXTERNAL ELECTIVES

PHY 408: DIGITAL SIGNAL PROCESSING

UNIT - I: Introduction

Signal Processing Example – Structure of Special Digital Signal Processors – Other Realizations of Digital Filters – Implementation of Digital Filters – Advantages of Digital Filters and Processing.
Fundamentals of Discrete-Time systems: Introduction – Basic Definitions – Important Discrete-Time Signals – Discrete-Time systems – Fourier Transform of sequences – Sampling of Continuous-Time Signals – Digital filter with A/D and D/A.

UNIT - II: Z Transform

Definition of the Z Transform – Inverse Z Transform – Relationships Between System Representations – Computation of Frequency Response – Solution of Linear Constant Coefficient Difference Equations.

UNIT - III: Analog Filter Design

Introduction – Butterworth Filters – Chebyshev Filters – General Filter Forums. Digital Filter Design**:** Discrete-Time Filters – Design by Using Numerical Solutions of Differential Equations – Analog Design Using Digital Filters – Design of Digital Filters Using Digital-to-Digital Transformations – Impulse Invariant Design – FIR Filter Design.

UNIT - IV: Discrete Fourier Transform

Introduction – Continuous-Time Fourier Series – Discrete-Time Fourier Series – The Discrete Fourier Transform – Computation of the Discrete Fourier Transform – Fast Fourier Transform – Interpretation of DFT Results – DFT-Fourier Transform Relationships – Discrete Fourier Transforms of Sinusoidal Sequences.

Book for Study

1. Fundamentals of Digital Signal Processing, L.C. Ludeman, John Wiley & Sons (Asia),Pvt. Ltd., 2003.

Reference books

1. Elements of Digital Signal Processing, N. Sarkar, 2nd Edn. Khanna Publishers, 2000.
2. Digital Signal Processing, Steve White, 1st Edn. Vikas Publishing House, 2002.
3. Digital Signal Processing, O. P. Verma, 1st Edn, Dhanpat Rai & Co.

PHY 409: APPLICATIONS OF STATISTICS TO PHYSICS

UNIT – I: Statistical Measures

Statistical Diagrams and Graphs; Measures of Central Tendency : Arithmetic Mean, Median, Mode, Weighted Mean; Measures of variation: Range, Quantile Deviation, Mean (average), Deviation, standard Devisation, Co-efficient of Variation, Measures of Skeuness.

UNIT – II: Probability and Distributions

Basic concepts in probability; Laws of Probability; Random Vaviable, Mathematical expectation; Probability Distibiutions: Binomial, Poisson, Normal and Exponential distributions and their applications.

UNIT – III: Correlation and Regression Analysis Co-efficients of correlation; curve Fitting: Least squares: Fitting of Straightline, parabola, Exponential and power curves; Linear Regression analysis: Simple and Multiple Linear Regression Equations; Partial and Multiple correlation coefficients.

UNIT – IV: Errors of Measuremnet and Tests of Significance

Types of errors, Gaussion Law of errors; Precission and probable error; Error analysis of experiemtns: Determination of 'g' and Elastic constants; Basic concepts in Tests of significance; Large sample tests for single sample mean, difference between two sample means; single sample proportion differnce between two sample proportions; small sample tests; student's t-test, chi-square test – confidence Intervals and F-test.

Reference books

1. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapor, Sultan Chand and Sons, New Delhi ,1998.
2. Experimental Errors and their Treatment , M.G. Gadad and H.R. Hiregonder, OrientLongman, New Delhi, 1975.
3. Statistical Analysis of Measurment Errors, J.L. Jaech, John Wiley & Sons, NY,1985.
4. Statistical Physics, A.F. Brown, Edinburgh University Press, 1968.
5. Statistical Theory and Methodology in Science and Engineering by K.A. Brownlee, John Wiley, New York, 1960.

M.Sc. DEGREE EXAMINATIONS
I, II, III & IV SEMESTERS
Branch II (A): Physics
PHYS 101-104, 201-205, 301-304 & 401-405: TITLE OF THE PAPER
(Revised Syllabus for CBCS with effect from 2014 - 2015**)**

Time: 3 hours **Max. Marks: 70**

PART – A

(Short Answer Type)

Answer any **FOUR** of the following. All questions carry equal marks (Marks: 4x5 = 20)

1. From **UNIT - I**
2. From **UNIT - I**
3. From **UNIT - II**
4. From **UNIT - II**
5. From **UNIT - III**
6. From **UNIT - III**
7. From **UNIT - IV**
8. From **UNIT - IV**

PART B

(Essay Type)

Answer **ALL** questions. All questions carry equal marks (Marks: 4x12½ = 50)

9. (a), (b) **OR** (c), (d) From **UNIT – I** **(With internal Choice)**
10. (a), (b) **OR** (c), (d) From **UNIT – II** **(With internal Choice)**
11. (a), (b) **OR** (c), (d) From **UNIT – III** **(With internal Choice)**
12. (a), (b) **OR** (c), (d) From **UNIT – IV** **(With internal Choice)**

M.Sc. DEGREE EXAMINATIONS
I, II, III & IV SEMESTERS
Branch II (A): Physics
PHYS 101-104, 201-205, 301-304 & 401-405: TITLE OF THE PAPER
(Revised Syllabus for Non-CBCS with effect from 2014 - 2015**)**

Time: 3 hours **Max. Marks: 80**

PART – A

(Short Answer Type)

Answer any **FOUR** of the following. All questions carry equal marks (Marks: 4x5 = 20)

1. From **UNIT - I**
2. From **UNIT - I**
3. From **UNIT - II**
4. From **UNIT - II**
5. From **UNIT - III**
6. From **UNIT - III**
7. From **UNIT - IV**
8. From **UNIT - IV**

PART B

(Essay Type)

Answer **ALL** questions. All questions carry equal marks (Marks: 4x15 = 60)

9. (a), (b) **OR** (c), (d) From **UNIT – I** **(With internal Choice)**
10. (a), (b) **OR** (c), (d) From **UNIT – II** **(With internal Choice)**
11. (a), (b) **OR** (c), (d) From **UNIT – III** **(With internal Choice)**
12. (a), (b) **OR** (c), (d) From **UNIT – IV** **(With internal Choice)**