SYLLABUS FOR

M.SC. Physics (ELECTRONICS)

(SEMESTER SYSTEM)

TO BE IMPLEMENTED FOR NEW BATCH FROM 2018-19

DEPARTMENT OF PHYSICS & ELECTRONICS

DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, FAIZABAD

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DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, FAIZABAD
DEPARTMENT OF PHYSICS AND ELECTRONICS
M.SC. PHYSICS (ELECTRONICS) SYLLABUS
SEMESTER I TO IV

M. SC. PERVIOUS- SEMESTER I		**Th + S***
PHY-C-101	Mathematical Physics	70 + 30
PHY-C-102	Classical Mechanics	70 + 30
PHY-C-103	Quantum Mechanics-I	70 + 30
PHY-C-104	Basic Electronics and Digital Electronics	70 + 30
Practical-I	Electronics Lab- I	100
	Seminar-I	100
	TOTAL MARKS OF FIRST SEMESTER	600

M. SC. PERVIOUS- SEMESTER II		**Th + S***
PHY-C-201	Condensed Matter Physics	70 + 30
PHY-C-202	Electrodynamics and Plasma Physics	70 + 30
PHY-C-203	Quantum Mechanics-II	70 + 30
PHY-C-204	Nuclear and particle Physics	70 + 30
Practical-II	Solid State Physics Lab	100
	Seminar-II	100
	(Related to MOOCS Course)	
	TOTAL MARKS OF SECOND SEMESTER	600

M. SC. FINAL- SEMESTER III		**Th + S***
PHY-C-301	Statistical Mechanics	70 + 30
PHY-C-302	Atomic and Molecular Physics	70 + 30
PHY-C-303	Analog and Digital Communication	70 + 30
PHY-C-E-304	Elective –I	70 + 30
Practical-III	Integrated Circuits and Communication Laboratory	100
	Project (Review of Literature and Seminar)	100
	TOTAL MARKS OF THIRD SEMESTER	600

Elective-I
1. Linear Integrated Circuit and Applications
2. Nanoscience and Technology

3. IC and Thin Film techniques

M. SC. FINAL- SEMESTER IV		**Th + S***
PHY-C-401	Programming in C, Fortran and MATLAB	70 + 30
PHY-C-402	Opto-Electronics & Optical Communication	70 + 30
PHY-C-403	Microprocessor and Microcontroller	70 + 30
PHY-C-E-404	Elective – II	70 + 30
Practical-IV	Microprocessor, Microcontrolller and Programing Lab	100
Project	Project work / Dissertation work	100
	TOTAL MARKS OF FOURTH SEMESTER	600
	Elective-II **1. Digital image processing techniques** **2. Elements of Astrophysics** **3. Radar, Satellite communication and remote sensing**	
	GRAND TOTAL	2400

***Sessional Marks Distribution**

1. Test-1: 10 Marks
2. Test-2: 10 Marks
3. Student Response in Class : 5 Marks
4. Student Attendance: 5 Marks

C Compulsory papers

E -Elective papers

PHY-C-101: Mathematical Physics

Unit-I: Function of complex variable, limit, continuity and differentiability of function of complex variables, Analytic function, Cauchy-Riemann conditions, Cauchys integral theorem, Cauchy's Integral formula, Taylor's and Laurent's series, singular points, residues, evaluation of integrals.

Unit-II : Fourier series, Dirichlets conditions, Fourier series of periodic functions, Half-wave expansions, Fourier integral theorem, Fourier and Laplace transforms and their properties, Convolution theorem, shifting theorem, Laplace transforms of derivatives and integral of a function, Inverse Laplace transform, application of Laplace transform in solving differential equations, probability theory, random variables, binomial, Poisson and normal distributions, Central limit theorem.

Unit-III. : Bessel function of first and second kind, Orthogonality, Neumann function, Henkel function, Generating function and recurrence relations, Modified Bessel functiouerre function, Spherical Bessel function, Legendre function, associated legendre function, Spherical harmonics, Hermite function, Concept of group (additive and multiplicative), Matrix representation of a group, reducible and irreducible representation of a group.

Unit-IV : Matrices: Orthogonal, Unitary and Hermitian Matrices, Inverse of a matrix, Eigen values & Eigen vectors, Tensors, Covariant and Contravariant tensors, symmetric and skew symmetric tensor, Contraction theorem, product of tensors, Quotient rule, The Kronecker delta function, Non-cartesian tensors, Metric tensors.

TEXT AND REFERENCE BOOKS:

1. Mathematical Methods for Physicists: G. Arfken and H. J. Weber, (Academic Press, San Diego)
2. Matrices and Tensors in Physics: A.W. Joshi (Wiley Eastern, New Delhi).
3. Mathematical Physics: P. K. Chatopadhyay (Wiley Eastern, New Delhi).
4. Introduction to Mathematical Physics: C. Harper (Prentice Hall of India, New Delhi).
5. Mathematical Methods in the Physical Sciences: M. L. Boas (Wiley, New York).
6. Applied Mathematics for Engineers and Physicists: L. Pipes & L. R. Horwell
7. Mathematics for Physicist: Mary L. Boas
8. Mathematical Physics: B. S. Rajput.
9. Mathematical Methods for Physicists: A. K. Ghatak, I. C. Goyal
10. Elements of Group Theory, A.W. Joshi, New Age Int. (2008)
11. Advanced Engineering Mathematics, E. Kreyszig, (Wiley Student Edition)
12. Mathematical methods for standard of Physics and related fields- Sadri Hussain, Springer (2009).
13. Complex Analysis by E. C. Tichmersh.

PHY-C-102 Classical Mechanics

UNIT-I: Mechanics of a system of particles, constraints of motion, generalized coordinates, constraints, principle of virtual work, D'Alemberts Principle and the generalized equation of motion, Application of Lagrangian formulation, Hamilton principle, Lagranges equation from Hamilton principle, Conservation laws and cyclic coordinates

UNIT-II: Two body problem, the equation of motion and first integrals, the equivalent one dimensional problem and the classification of orbits, Central force problem, the differential equation for orbits, Keplers Law, Conservation laws and cyclic coordinates, Two body Collisions - scattering in laboratory and Centre of mass frames. Scattering (Rutherford) in central force field. The Eulers angles, rate of change of a vector, the Coriolis force and its applications.

UNIT-III : Euler equation of motion, Torque free motion of rigid body, motion of a symmetrical top, Eigen value equation, Free vibrations, Periodic motion: Normal coordinates, small oscillations, Normal modes, vibration of Tri-atomic Molecule. Legendre Transformation, Hamiltons equations of motion, Hamiltons equations from variation principle, Principle of least action, Special theory of relativity- Lorentz transformations, relativistic kinematics and mass–energy equivalence. Four Vectors.

UNIT-IV: Canonical transformation and its examples, Poisson s brackets, Equation of motion, Angular momentum, Poissons Brackets, relations, infinitesimal canonical transformation, Conservation Theorems, Hamilton-Jacobi equation for Hamiltons principal function, Harmonic Oscillator problem

TEXT AND REFERENCE BOOKS:

1. H. Goldstein, C. Poole & J. Safko, Classical Mechanics (Pearson Education Asia, New Delhi)
2. N. C. Rana and P. S. Joag, Classical Mechanics (Tata McGraw-Hill, 1991)
3. Kiran C. Gupta, Classical Mechanics of Particles & Rigid Bodies (Wiley Eastern)
4. L. Landau and E. Lifshitz, Mechanics, Oxford (1981).
5. S. N. Biswas, Classical Mechanics, Books and Allied (P) Ltd.,Kolkata (2004) .
6. F. Scheck, Mechanics, Springer (1994).
7. Problems and Solutions on Mechanics, World Scientific (1994).
8. H. C. Corben and P. Stehle, Classical Mechanics (Dover)
9. T. W. B. Kibble, Classical Mechanics (Addison Wesley)

PHY-C-103 Quantum Mechanics-I

UNIT I: Linear vector space, Dirac's Bra-ket algebra, Matrix representation of observables and states, Determination of eigen values and eigen state for observables using matrix representation, change of representation and unitary transformation, coordinate and momentum representations.

UNIT II : Theory of angular momentum, Symmetries, invariance and conservation laws, relation between rotation and angular momentum. Commutation rules, matrix representation, Addition of angular momentum, C. G. coefficients (j_1=1/2, j_2=1/2).

UNIT III: Scattering theory, Differential and total scattering cross sections laws, partial wave analysis and application to simple cases, Greens function, Born approximation, validity and simple application.

UNIT IV: Approximation method, Time independent perturbation theory (Non degenerate and degenerate case), Zeeman effect (normal), stark effect, The Variational Method and application to Helium atom and simple cases, WKB approximation, Time dependent perturbation theory, Fermi's Golden rule, Semi-classical theory of radiation: Transition probability for absorption and induced emission, electric dipole and forbidden transition, selection rule.

TEXT AND REFERENCE BOOKS:

1. L. I. Schiff Quantum Mechanics(Tata McGraw-Hill, Delhi)
2. B. Craseman and J.L. Powell Quantum Mechanics (Narosa, New Delhi)
3. S. Gasiorowicz Quantum Mechanics (Wiley, New York)
4. J. J. Sakurai Modern Quantum Mechanics (Addison Wesley)
5. P. M. Mathews & K.Venkatesan Quantum Mechanics (Tata McGraw-Hill, Delhi)
6.Ghatak & Loknathan Quantum Mechanics
7. M. P. Khanna Quantum Mechanics (Har Anand, N. Delhi)
8.V. K. Thankappan Quantum Mechanics (New Age, N. Delhi)
9. N. Zettili Quantum Mechanics: Concepts and applications
10. Bransden and Jochain Quantum Mechanics
11. Satya prakash Quantum Mechanics
12. B. S. Rajput Advanced Quantum Mechanics
13. R. Shankar, Principles of Quantum Mechanics, Springer (India) (2008).
14. K. Gottfried and T-M Yan, Quantum Mechanics: Fundamentals,2nd Ed., Springer (2003).
15. D. J. Griffiths, Introduction to Quantum Mechanics, Pearson Education (2005).
16. F. Schwabl, Quantum Mechanics, Narosa (1998).
17. E. Merzbacher, Quantum Mechanics, John Wiley (Asia) (1999).
19. B. H. Bransden and C. J. Joachain, Quantum Mechanics, Pearson Education 2nd Ed. (2004)

PHY-C-104 Basic Electronics and Digital Electronics

Unit -I: Bipolar Junction Transistors (BJT): Transistor fundamentals, transistor Syllabus for Analog Electronics configurations, DC operating point, BJT characteristics & parameters, fixed bias, emitter bias with and without emitter resistance, analysis of above circuits and their design, variation of operating point and its stability, Small Signal BJT amplifiers: AC equivalent circuit, hybrid, re model and their use in amplifier design. Multistage amplifiers, frequency response of basic & compound configuration, Power amplifiers: Class A, B, AB, C and D stages, IC output stages.

Unit-II: Feedback & Oscillator Circuits, Effect of positive and negative feedbacks, basic feedback, feedback topologies & their properties, Analysis of practical feedback amplifiers, Sinusodial Oscillators (RC, LC and Crystal), Multivibrators, The 555 timer.

Unit-III: Data and number systems**,** Binary representation, Codes and their conversions, BCD, Octal, Hexadecimal, ASCII, EBDIC, Gray, Signed binary number representation with 1's and 2's complement methods, Binary arithmetic, Boolean algebra, logic gates and circuits, Minimization of logic expressions by algebraic method, K-map method and Quine Mc Clauskey method, adder, subtractor, encoder, decoder, comparator, multiplexer, de-multiplexer, parity generator, Design of combinational circuits, Programming logic devices and gate arrays.

Unit-IV: Sequential Circuits & Logic families: Flip-Flops, Registers, counters and their design, Irregular counter, State table and state transition diagram, sequential circuits design methodology, Different types of A/D and D/A conversion techniques, TTL, ECL, MOS & CMOS operation and specifications.

Text and Reference Books:

1. Jain—Modern Digital Electronics, 2/e , TMH
2. Digital Logic Design- Morries Mano, PHI.
3. Jacob Millman, and C. C. Halkias, "Electronic devices and circuits", TMH Publications.
4. Ben G. Streetman, Solid State Electronic Devices, PHI, 5th Ed, 2001.

PHY-C-201: Condensed Matter Physics

UNIT I : Amorphous and Crystalline solids, Direct lattice, translational vectors, two and three dimensional Bravais lattices, Miller Indices, Reciprocal lattice, Braggs Law, Brillouin zones and applications of reciprocal lattice to diffraction techniques.

UNIT II : Vibrations of mono and diatomic lattices, lattice heat capacity, Einstein and Debye models, phonon momentum, Inelastic scattering by phonons, Classical theory of Free electron, Fermi gas, energy levels and density of orbitals, Fermi-Dirac distribution function.

UNIT III: Electrons in a periodic lattice: Bloch theorem, band theory and classification of solids, van der Waals solids, ionic and covalent solids, metals, effective mass. Tight binding approximations. Fermi surface, Conduction in Semiconductors (both Intrinsic and Extrinsic), Hall effect; elementary concepts of quantum Hall effect, structure and scattering; crystalline solids, liquids and liquid crystals; nanostructures, Basic Properties of Superconductors, Meissner Effect, Transport Behavior, Types of Superconductors, London s equations, penetration depth, coherence length, energy gap parameter, Josephson Effects, BCS theory of Superconductivity, flux quantization, Introduction to high temperature super conductors, Quasi-crystals.

UNIT IV: Dielectrics: Polarization mechanism, dielectric constatnt, Cavity field, Claussius-Mossoti relation, Magnetism: exchange interaction, Langevins theory of Dia- and Para-magnetism, Weiss Theory of paramagnetism and Ferromagnetism, Quantum theory of Ferro-magnetism, Hesignbergs theory of magnetism, Ferromagnetic domains, Anti-ferromagnetism, Ferrimagnetism and Bloch-wall. Structure of Ferrites, Hund's rules, Pauli paramagnetism, Heisenberg model, mean field theory, spin waves, giant and colossal magnetoresistance.

TEXT AND REFERENCE BOOKS:

1. C. Kittel Introduction to Solid State Physics (Wiley, New York)
2. C. Kittel Quantum Theory of Solids (Wiley, New York)
3. Verma and Srivastava Crystallography for Solid-State Physics
4. J. Ziman Principles Of the Theory of Solids (Cambridge University Press, Cambridge)
5. Azaroff- Introduction to Solids
6. Omar- Elementary Solid-State Physics
7. Aschroft & Mermin Solid State Physics (Reinhert & Winston, Berlin)
8. Chaikil & Lubensk Principles of Condensed Matter Physics
9. M. Tinkham Introduction to Superconductivity
10. S. O. Pillai Solid State Physics (new Age International Publishers)
11. M. A. Wohab Soild State Physics (Narosa).
12. H. Ibach and H. Luth, Solid State Physics (Springer)

PHY-C-202: Electrodynamics and Plasma Physics

UNIT I: Maxwell's equations, The wave equation, Sinusoidal Waves, Electromagnetic waves, wave equations and their propagation in vacuum, linear dielectric medium and conductors, skin depth, Maxwells equations using phasor notation, Lorentz invariance of Maxwell's equation.

UNIT II : Vector and Scalar Potential, Gauge transformation, Coulomb Gauge and Lorentz Gauge, Radiation from moving charges and dipoles, Retarded Potential and Lienard-Wiechert Potential, Electric and Magnetic fields due to a uniformly moving point charge and an accelerated charge, Power radiated by a point charge.

UNIT III: Contravariant and Covariant four vectors and their products, tensors of rank two and their differentiation, covariant form of Maxwell's equation, Four potential and four current, E. M. field tensor, Its curl and divergence.

UNIT IV : Elementary Concepts: Phase transition, Definition of Plasma as fourth state of matter, Various kinds of Plasma, Debye Shielding, Plasma Parameters, Plasma Oscillations and plasma frequency expression, Fluid equations, electron plasma wave, ion acoustic wave, Magnetoplasma and Plasma Confinement, applications of Plasma. Dispersion relations in plasma,

TEXT AND REFERENCES BOOKS:

1. Introduction to Electrodynamics: David J. Griffiths, (Prentice Hall India, New Delhi).
2. Keith W. Whites, EE 382.
3. Classical Electrodynamics: J.D. Jackson, (Wiley Eastern, New Delhi).
4. Classical Electromagnetic Radiation: J.B. Marion and M.A. Heald, (Academic Press, San Diego).
5. Plasma Physics by Bittencourt
6. Introduction to Plasma Physics by F. F. Chen
7. Electromagnetic Waves by Jordan & Balme
8. Classical Electrodynamics : S. P. Puri, (Tata McGraw Hill, New Delhi)

PHY-C-203: Quantum Mechanics-II

UNIT-I: Identical particles: Symmetric and anti symmetric wave functions, distinguishability of identical particles, Pauli's exclusion principle, connection with statistical mechanics, collisions of identical particles. Spin angular momentum: connection between spin and statistics, spin matrices and eigen functions. Spin functions for many electron system, Atomic levels of Helium atoms as an example of two electron system, Slater determinant.

UNIT-II : Born approximation, Its application to Yukawa potential and other simple potentials, Electron scattering by an atom, Neumann equation and its solution , Neumann series and Bessel function.

UNIT-III : Relativistic quantum mechanics : Klein Gordon equation , Dirac equation and its plane wave solutions, Dirac equation, negative energy solutions, antiparticles, Dirac hole theory, Feynman interpretation of antiparticles, Gama-matrics and their properties.

UNIT-IV : Field quantization, lagrangian density and equation of motion for field, Symmetries and conservation laws, Noether's theorem, Canonical quantization of scalar field, Complex scalar field, Electromagnetic and Dirac fields.

TEXT AND REFERENCES BOOKS:

1. Quantum Mechanics by L.I. Schiff (Tata McGraw-Hill)
2. Quantum Physics by S. Gasiorowicz (Wiley, New York)
3. Quantum Mechanics by . Craseman and J.D. Powell (Narosa, New Delhi).
4. Quantum Mechanics by A.P. Messiah.
5. Modern Quantum Mechanicsby J.J. Sakurai (Addison Wesley).
6. A Text book of Quantum Mechanics by P. M. Mathews & K. Venkatesan (Tata McGraw Hill, New Delhi).
7. Quantum Mechanics by Ghatak & Loknathan.
8. Quantum Mechanics by Chhen Tannoudji.
9. Quantum Mechanics by M. P. Khanna (Har Anand, New Delhi).
10. Quantum Mechanics ,J. L. Powell and B. Crasemann, (Narosa).
11. The Feynman Lectures on Physics vol. III ,R. P. Feynman, (Pearson).
12. A first book on Quantum field theory- Amitabh Lahiri and P. B. Pal.

PHY-C-204: Nuclear and Particle Physics

UNIT –I: Nucleon-nucleon interations: Nature of nuclear forces, form of nucleon-nucleon potential, Deutron problem: the theory of ground state of deuteron, excited state of deuteron, n-p scattering at low energies (cross section, phase shift analysis, scattering length, n-p scattering for square well potential, effective range theory); p-p scattering at low energies (cross-section. Experiment and result) exchange forces, tensor forces, high energy N-N scattering (quantative discussion) charge independent and charge symmetries of nuclear forces.

UNIT –II : Nuclear Models: Evidence of shell structure, single-particle shell model, its validity and limitations, Collective model: Collective vibration and collective rotation, Single particle motion in a deformed potential.

UNIT –III : Nuclear reactions, Elementary idea of alpha, beta and gamma decays and their classifications, characteristics, selection rules and nuclear reactions, fission and fusion.

UNIT –IV : Particle Physics: Classification of fundamental forces, elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness etc) G-L formula, Quark model.

REFERENCES:

1. Nuclear Physics: Principle and Application by John Lilley (Wiley Pub.).
2. Concepts of Nuclear Physics by Bernard L Cohen (TMH).
3. Nuclear Physics Experimental and Theoretical by H S Hans (New Age Int.).
4. Nuclear Radiation Detector by S S Kapoor and V S Ramamurthy(New Age Int.).
5. Introduction to Nuclear Physics by H.A. Enge(Addison-Wesley).
6. Atomic Nucleus by R D Evans(Tata Mc Graw Hill).
7. Nuclear Physics 2nd edition by I Kaplan(Narosa) .
8. Concepts of Modern Physics by Arthur Beiser (TMH).
9. Introduction to particle ohysics- M. P. Khanna (PHI, 1999).
10.Introduction to Nuclear Physics, K. S. Krane (Wiley).
11. Fundamentals of Nuclear Physics, W. E. Burchas and M. Jobes (Addision Wesley augman, England 1998)
11. Fundamentals of Nuclear physics- Sohan Singh (Pragati prakashan 2012).

PHY-C-301: Statistical Mechanics

UNIT – I : Canonical and grand canonical ensembles, partition function, thermodynamic functions, statistical mechanics of ideal Bose and Fermi gases, Density matrices, density matrix in statistical mechanics, some simple applications (Harmonic oscillators, Free particle in a box).

UNIT – II : Cluster expansion for classical gas, Mayer cluster expansion, equation of state, low temperature behavior of imperfect Bose and Fermi gases, superfluidity of liquid He-II, Ising model, mean field theory.

UNIT – III: Phase transition and thermodynamic functions, Thermodynamic limit and its importance, Landau Theory, Correlation functions, Ornstein-zermine theory.

UNIT – IV: Dynamic correlation and response function, example of damped harmonic oscillator, Diffusion, Brownian motion and langevin equations.

REFERENCES:

1. Statistical Mechanics (2nd edition): R.K. Patharia (Butterworth Heinemann, Oxford).
2. Statistical Mechanics: K. Huang (Wiley Eastern, New Delhi).
3. Statistical Mechanics: B. K. Agarwal and M. Eisner (Wiley Eastern, New Delhi).
4. Elementary Statistical Physics: C. Kittel (Wiley, New York).
5. Statistical Mechanics: S.K. Sinha (Tata McGraw Hill, New Delhi).
6. S. R. A. Salinas, Introduction to Statistical Physics, Springer (2004).
7. A textbook of Statistical Mechanics by Suresh Chandra, CBS Publishers, New Delhi.
8. Fundamentals of Statistical and Thermal Physics, F. Reif, (Levant Books)
9. L. D. Landau and E. M. Lisfsitz, Statistical Physics (Butterworth-Heinemann)
10. Statistical Mechanics, S. K. Ma, (World Scientific Publishing Company)
11. Principles of Equilibrium Statistical Mechanics, D. Chowdhury and D. Stauffer, (Wiley)
Ical
12. A modern course in statistical physics, 2nd edition, L. E. Reichel.

PHY-C-302: Atomic and Molecular Physics

UNIT I: Spin – orbit interaction, L-S and J-J coupling, Lande g-factor for L-S coupling, Lande interval rules, selection rules, Intensity relations.

UNIT II : Zeeman, Paschen back and stark effects, hyperfine structure and isotopic shift, Lamb shift, X-ray spectra (Characteristics of X- rays, Moseley's Law)

UNIT III : Rotation and vibration spectra , IR and Raman spectra of non – rigid rotator , anharmonic oscillator and vibrating rotator , Intensities in rotation – vibration spectra , Isotope effects in rotation and vibration spectra, Electronic energy and total energy , vibration structure of electronic transitions.

UNIT IV: Principles of resonance , spectroscopy (NMR and ESR)

REFERENCES :

1. Introduction to Atomic spectra: H.E. White
2. Fundamental of Molecular spectroscopy: C.N. Banwell, TMH.
3. Atomic spectra & Structure: G. Herzberg
4. Physics of Atoms and Molecule: Bransden and Joachain
5. Molecular spectroscopy: J. M. Brown
6. Introduction to Molecular spectroscopy : G. M. Barrow
7. Spectra of Atoms and Molecule: P.F. Bemath
8. Spectroscopy, Vol I, II and III, B. P. Stranghan and S. Walker, Chapman and Hall (1976).
9. Elementary atomic structure, G. K. Woodgate, (Claredon Press).
10. Atoms and Molecules, M. Karplus, (Benjamin-Cumming Pub. Co.)
11. Molecular spectroscopy- J M Brown, Oxford University Press (1998).

ELE-C-303 Analog and Digital Communication

UNIT I: AMPLITUDE MODULATION: Frequency translation, Single Tone Modulation, Recovery of base band signal, Spectrum & power relations in AM systems. Methods of Modulation & Demodulation of AM-DSB, DSB-SC and SSB signals, AM Broadcast Transmitters & Receivers, Single Sideband Transmission and Reception, Super heterodyne receivers, Vestigial Sideband Modulation.

UNIT II: FREQUENCY MODULATION: Phase & freq. modulation & their relationship, Spectrum & band width of a Sinusoidal modulated FM signal, Narrow band & wide band FM. Generation & demodulation of FM signals, Effect of Channel Non-Linearity, Comparison of AM, FM & PM, PPM, Threshold in FM, PLL demodulator.

UNIT III: Digital Transmission of Analog Signals: Uniform and Non-uniform quantization. PCM and delta modulation, Signal to quantization noise ratio in PCM and delta modulation.

UNIT IV: Digital Modulation Techniques: Geometric interpretation of signals and Ortho-gonalization, ASK, BPSK, BFSK, QPSK, M-ary PSK, MSK and GMSK modulation techniques and Coherent detection of these techniques. Signal constellation and calculation of error probabilities, Information Theory: Shannon's Theorem and Shannon's bound, Coding and decoding of Information Source coding, Entropy coding, Hamming code, Single Parity- Bit Code

RECOMMENDED BOOKS:

1. Principles of Communication Systems, Herbert Taub, Donald Schilling, Goutam Saha, TMH
2. Analog and Digital Communication, Schum Series, TMH
3. Digital & Analog Communication Systems, Leon W. Couch, Pearson
4. Analog & Digital Communication Systems, Singal, TMH
5. An Introduction to Analog & Digital Communications, Haykins, Wiley.
6. Electronic Communication Systems, Kennedy Devis, TMH

Elective-I

PHY-C-E-304Nanoscience and Technology

Unit-I : Definition of nanotechnology, Nanomaterials, Novel combination of properties of materials of nanoscale, Device miniaturization, Functional enhancement. Nanoparticles as superatoms, Size dependence of melting point, vapour pressure, Nucleation, reactivity, Intermolecular interactions, Surface tension of solid surfaces, Wetting dewetting of rough and chemically inhomogeneous surfaces, Quantum confinement & energy levels, Band structure, Density of states in 0D, 1D, 2D & 3D materials, Quantum dots, wires, & wells, Parabolic, triangular, cylindrical & spherical wells, Quantum corral, Band gap engineering, Heterostructures & superlattices, 2D electron gas, Effective mass in hetero-structures.

Unit-II: Nano particles-communication & dispersion, Nucleation & growth, Ultrathin coatings, Molecular beam epitaxy Atomic layer deposition, Self assembly of mono layers, Langmuir Blodgett films, Thermodynamics of self organization, Crystallization and super molecular interactions. Top down and bottom up approaches to nanofabrication, Optical & electron beam lithography, Dip pen lithography, Focussed ion beam technique, Thin films deposition, Evaporation, Sputtering, Electro deposition and sol Gel Tech, Plasma assisted chemical vapour deposition.

Unit-III: Contact & Non contact methods of surface characterization, AFM, STM and Near field microscopy, Ellipsometry, Surface plasma resonance techniques, Electron spectroscopy techniques AES, XPS, SIMS, optical profilometry, various spectroscopic techniques for surface analysis.

Unit-IV: Carbon based nano materials, carbon nanotubes, Fullerens, Graphene, Metal matrix composites, Polymers- electro active material blends, Semiconductor Nano particles, Nano wires, Nano ribbon and nano spring..Issues of miniaturization, Digital information processing, Quantum computing, Ballistic transport, Coulomb blockade, Single electron devices, Molecular electronic devices, Coupled quantum dots, Spintronics, Ultra-sensitive magnetic sensors, Spin dependent transistors, Photonic devices, Mechanical and Fluidic devices, Chemical and bio-chemical sensors, energy conversion devices.

Recommended Books:

1. The Physics of Low Dimensional Semiconductors John H. Davies Cambridge University Press
2. Nanotechnology- An Introduction J.J. Ramsden William Andrew Elsevier
3. Nano-optoelectronics Sensors & Devices Ning Xi & King w. Chiu Lai - William Andrew Elsevier
4. Quantum Heterostructures- Microelectronics & Optoelectronics V.V. Mitin, V.A. Kochetp & M.A. Stroscio Cambridge University Press
5. Nanostructures & Nanomaterials Synthesis, Properties & Applications G. Cao Imperial College Press
6. Introduction to Nanotechnology C.P.Poole Jr. & F.J. Owens - John Wiley & Sons
7. Nanotechnology M. Wilson, K. Kannangara, G. Smith, M. Simmons & B. Raguse Overseas Press

PHY-C-E-304Measurement and Characterization technique

Unit-I: Principles of measurement systems; low pressure generation and measurement; low temperature generation and measurement; Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors), Measurement and control, Signal conditioning and recovery. filtering and noise reduction, shielding and grounding. Fourier transforms, lock-in detector, box-car integrator, modulation techniques, High frequency devices (including generators and detectors).

Unit-II: Instruments: X-ray diffractometer, LASER, Spectrometers - FTIR, UV-Vis, near IR, Raman, Photoluminescence; Microscopes - optical, SPM, SEM, TEM; Magnetic measurement systems: VSM, SQUID, FIB.

Unit-III: Thermal measurement system: DSC, Resonance Spectroscopy: ESR, NMR, Optical spectrum analyzer, Scientific seminar on related topics.

Unit-IV: Basic of nuclear magnetic resonance (NMR) and electronic spin resonance (ESR) spectroscopy, Mossbauer spectroscopy, Microwave spectroscopy, Photoacoustic spectroscopy and their applications. Laser as a source of radiation and its characteristics Laser fluorescence and absorption spectroscopy, Multiphoton ionization and separation of isotopes. Linear and non-linear curve fitting, chi-square test. Impedance matching, amplification (Op-amp based, instrumentation amp, feedback).

Texts / References:

1. A. D. Helfrick and W.D.Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI (1996).
2. J. P. Bentley, Principles of measurement systems, Pearson Education Ltd, England (2005).
3. A. S. Morris, R. Langari, Measurement and Instrumentation: Theory and Application, Academic Press, London (2012).
4. G. C. M. Meijer, Smart Sensor Systems, John Wiley & Sons Ltd, UK (2008).
5. A. Ghatak and K.Thyagarajan, Optical Electronics, C.U.P. (1991).
6. D. A. Skoog, F. J. Holler and T. A. Nieman, Principles of Instrumental Analysis, Saunders Coll. Publ. (1998).
7. H. J. Tichy, Effective Writing for Engineers, Managers, Scientists, John Wiley & Sons (1988).
8. M. Alley, The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid, Springer-Verlag New York (2003).
9.Analytical Techniques for Thin Films-Treatise on Material Science and Technology, Vol. 27: K.N. Tu and R. Rosenberg (ed).
10.Electron Microprobe Analysis: S.J.B. Reed.
11. Topics in Applied Physics, Vol. 4: R. Gomer (ed.).
12. Analysis of high Temperature Materials: Van Der Biest (ed.)

PHY-C-E-304IC, VLSI DESIGNING &THIN FILM TECHNOLOGY

UNIT-I : Properties of silicon wafers: Mechanical, Electrical, structural Epitaxial growth, VPE, LPE and MBE, mechanism, apparatus and methods of evaluation of EPI-layers. Oxidation, Ion implantation system and principles, Annealing and sintering, Fick's law, diffusion mechanism, measurement techniques, diffusion in SiO_2.

UNIT-II : Metallization: Deposition techniques, CVD and PVD, Laser ablation, Laser annealing and mixing. Lithography, photolithography, EBMF and X-ray lithography, Wet chemical etching, lift off process and plasma etching. Bonding.

UNIT-III : MOS Technology and VLSI, Electrical properties of MOS circuits and Device modelling, Sealing of MOS circuits, MOS Transistors – fabrication and characteristics. MOSFET scaling and short-channel effects, Analysis and design of inverters and inverter based circuit. Packaging of VLSI devices, Fault finding in VLSI chips.

UNIT-IV: Properties of thin Film Passive circuit elements, Properties of thin film active elements; Thin film diodes, transistors, Hot electron amplifier, Thin film micro- circuitry: Basic processing steps, preparation of drawings, photographic Techniques, Mask fabrication, Thin film Image sensors.

RECOMMENDED BOOKS

1. VLSI Fabrication Principles, S.K. Gandhi, John Willey & Sons.
2. VLSI Technology, S.M. Sze, McGraw Hill,Int. Book Company.
3. Integrated Circuit Engineering, A.B. Glasser, S.Sharpe
4. Semiconductor & Integrated, P.E. Gise, R. Blanchard Fabrication Techniques Restonn Pub. Co. Inc. PHC.
5. Large Scale Integration, M.J. Hower, D.V.Morgan,John Wiley & Sons Ltd.
6. VLSI Technology, C. Y. Chang, S.M. Sze, McGraw Hill.

PHY-C-401: Programming in C, FORTRAN and MATLAB

Unit –I : Expressions, Statements, Symbolic constants. Operators: Arithmetic, binary, relation for common operations. Operator precedence and associativity. Bitwise operations . Special operators . Data input and output. Single character input and output. Formatted input and output, String input and output. Control statements: the while and do-while statements; the for statement; nested loops, if-else statement; the switch statement; the break statement; the continue statement; the comma operator; the go to statement.

Unit –II : Functions; defining a function; accessing a function; passing arguments to a function; specifying argument data types. String-handling function. Recursion. Storage classes; automatic, external, static and register variables. Arrays; defining and processing, passing arrays to a function, multi-dimensional arrays, initialization.

Unit –III : Pointers: declaration; passing pointers to a function, pointers and one dimensional arrays; operations on pointers, pointers and multidimensional arrays, arrays of pointers; passing function to other functions. Structures and unions defining and processing a structure, structures and pointers; passing structure to a function; self referential unions.

Unit IV : User-defined data types, Enumerations, Bit fields. Dynamic memory allocation, Data files, defining, opening and closing a file, input/output operations on files; error handling, random access to files, Multifile programs command line parameters, Macros. C. Preprocesser.

Introduction and programming to **MATLAB.**

References:

1. LET US C BY YASHAVANT KANETKAR ,BPB PUBLICATION, 3RD EDITION
2. Exploring C by Kanetkar
3. C++ by Balaguru Swamy
4. The Waite group's object oriented programming in Turbo C++: Robert Lafore, Galgotia Publication. Pvt. Ltd, 2005

PHY-C-402: Opto-Electronics and Optical Communication

UNIT-I : LED – Laser Diodes – Light Source Linearity – Sources to Fiber Power Launching – Lensing Schemes – LED coupling to Single Mode Fibers – Fiber Splicing – Optical Fiber Connectors, Fundamental Receiver Operation , Digital Receiver Performance, Pre Amplifier Types, Analog Receivers, Basic Applications and Types of Optical Amplifiers Semiconductors Optical Amplifier, spontaneous and stimulated emission, Einstein A & B coefficients, Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

UNIT-II: Optical detectors-optical detector principle, absorption coefficient, detector, characteristics, Quantum efficiency, responsivity, response time-bias voltage, Noise in detectors P-N junction-photo diode, characteristics, P-I-N-photo diode, response, Avalanche photo diode (APD) multiplication process-B,W-Noise photo transistor

UNIT-III : Optical fibers: modes of an optical fiber, multimode fibers, single mode fibers and their propagation characteristics. Dispersion management in optical fibers and link design considerations, Modal analysis of guided modes in symmetric step-index planar wave-guides, Optical fiber- numerical aperture, V-parameter, refractive index profile.Integrated optics: planar and channel waveguides. BER calculation, quantum limit, EDFA, Raman amplifier.

UNIT –IV : Operational Principles of WDM, Passive Components, Tunable Sources, Tunable Filters, Wavelength Converters, Basic Network, SONET/SDH, Broadcast and Selection of WDM networks - Wavelength – Routed networks, Performance of WDM + EDFA System, Optical CDMA.

RECOMMENDED BOOKS

1. Optical Communication- John M. Senior
2. Optical Communication –Gerd Keiser
3. Optical communication and Systems- Pallies
4. Optical Electronics by Ghatak and Thyagrajan
5. Optical Communication by Gower
6. An Introduction to Electro Optic Devices by Kaminov
7. Optical Information Processing by FTS Yu
8. Optical Communication Components and Systems by J. H. Franz and V. K. Jain Narosa Publication House. ISBN 81-7319-145-x
9. Optical Fiber Transmission by J. E. Midwinter, John Wiley, 1979.
10. Understanding optical communication by H. Dutton, Prentice Hall.

PHY-C-403: Microprocessor and Microcontroller

UNIT I: MICROPROCESSOR 8085: Introduction, Buffer registers, Bus oraganised computers, SAP-I, Microprocessor (P) 8085 Architecture, memory interfacing, interfacing I/O devices, Assembly language programming : Instruction classification, addressing modes, OP code and operand, fetch and excute cycle, timing diagram, machine cycle, instruction cycle and T states, Data transfer, Logic and Branch operations- Programming examples.

UNIT II : MICROPROCESSOR 8086 : Architecture, Pin description for minimum and maximum modes, Internal operation, Instruction execution timing diagram, Addressing modes, Instruction format for constructing machine, language codes for different instructions. Introduction to assembly language, Instruction set and directives, Stacks, Procedures, Macros and interrupts. Flow chart of standard programming structures, I/O interfacing and data transfer scheme.

UNIT III: ADVANCED MICROPROCESSOR: Multitasking, Architecture and memory management of microprocessor 80286, Brief idea about architecture of microprocessor 80386, 80486 and Pentium, Introduction to microcontroller.

UNIT IV: MICROPROCESSOR BASED MEASUREMENT/CONTROL CIRCUITS
Transducer, D/A and A/D Converters, PPI 8255 Data Acquisition and storage, Microprocessor based traffic light controller, Temperature and water level indicator/controller. DC and steper motor speed measurements, Waveform generation and frequency measurement.

TEXT & REFERENCE BOOKS:
1. Fundamentals of Microprocessor and Microcomputer : B. Ram.
2. Microprocessor System the 8086/8088 Family : Liu and Gibson.
3. Microprocessor Architecture Programming and Application : R.S. Goanker.
4. Introduction to microprocessor : A.P. Mathur.
5. Microprocessor and Interfacing : D.V. Hall.

Elective – II

PHY-C-E-404 Digital Image Processing

UNIT I: DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS Elements of visual perception, Image sampling and quantization Basic relationship between pixels, Basic geometric transformations, Introduction to Fourier Transform and DFT, Properties of 2D Fourier Transform, FFT, Separable Image Transforms, Walsh – Hadamard, Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

UNIT II: IMAGE ENHANCEMENT TECHNIQUES Spatial Domain methods: Basic grey level transformation, Histogram equalization, Image subtraction, Image averaging, Spatial filtering: Smoothing, sharpening filters, Laplacian filters, Frequency domain filters : Smoothing, Sharpening filters, Homomorphic filtering.

UNIT III: IMAGE RESTORATION Model of Image Degradation/restoration process, Noise models, Inverse filtering, Least mean square filtering, Constrained least mean square filtering, Blind image restoration, Pseudo inverse, Singular value decomposition.

Unit-IV: IMAGE COMPRESSION Lossless compression: Variable length coding, LZW coding, Bit plane coding, predictive coding, DPCM. Lossy Compression: Transform coding – Wavelet coding, Basics of Image compression standards: JPEG, MPEG,Basics of Vector quantization.

RECOMMENDED BOOKS:

1.Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing, Pearson Education 2003.

2. William K Pratt, Digital Image Processing, John Willey Publishers

3. Millman Sonka, Vaclav hlavac, Image Processing Analysis and Machine Vision,Thompson Learning (1999).

4. A.K. Jain, Fundamentals of Digital Image Processing, PHI.

PHY-C-E-404 Elements of Astrophysics

UNIT I : Basic Astronomy : Mass, length and timescales, Celestial coordinates, Magnitudes, Astronomy at different wavelengths , Equations of radiative transfer, Optical depth, Opacity, Local thermodynamic equilibrium, Spectral line formation.

UNIT II : Stellar Structure and Evolution : Hydrostatic equilibrium, Virial theorem, Energy transport, Convective Instability, HR Diagram, Stellar evolution, Eddington luminosity limit, Nuclear reaction and elemental burning in stellar interiors, Solar neutrino problem.

UNIT III : Stellar Collapse :Degeneracy pressure, Chandrasekhar mass limit, White Dwarfs, Neutron Stars and Pulsars as physical extremes of nature, Virial theorem for dynamics, Collisional relaxation, Incompatibility of thermodynamics equilibrium and self-gravity, Bolztmann equation, Jeans equation.

UNIT IV : Plasma Astrophysics : Basic concepts, Basic fluid and plasma equations, Jeans instability, Magneto hydrodynamics (MHD) equations, Dynamo theory, Magnetic diffusion, viscosity and pressure, magneto hydrodynamic flow, pinch effect and its dynamic model, instabilities, MHD waves, high frequency plasma oscillations, short wavelength limit, Debye screening distance, Space time fabric of the Universe, Thermal history of the Universe, Cosmic Microwave Background Radiation, Friedman-Robertson-Walker metric, Gravitational red shift, Cosmological constant.

RECOMMENDED BOOKS

1. Arnab Rai Choudhuri- Astrophysics for Physicists.
2. Baidyanath Basu, Tanuka Chattopadhyay & Sudhindra Nath Biswas- An Int. to Astrophysics.
3. K. D. Abhayankar, Astrophysics – Stars and Galaxies.

PHY-C-E-404 Radar, Satellite Communication and Remote sensing

UNIT I: Introduction to radar, radar block diagram and operation, radar frequencies, Applications of radar, The Radar Equation: Detection of signals in noise , Receiver noise and the signal to noise ratio, Probabilities of detection and false alarm, Integration of Radar Pulses, Radar cross section of targets, Radar cross section fluctuations, Transmitter Power, Pulse Reception Frequency , Antenna Parameters, System Losses.

UNIT II: MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay Line cancellers, Staggered Pulse Reception Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.

UNIT IV: Tracking Radar: sequential lobing, conical scan, monopulse Tracking, low angle tracking, tracking in range. Elements of Satellite Communications, Orbital mechanics, look angle and orbit determination, launches and launch vehicle, orbital effects. Introduction to geo-synchronous and geo-stationary satellites.

UNIT IV: Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of down link and uplink, design of satellite links for specified C/N, satellite data communication protocols, Direct broadcast satellite television and radio, satellite navigation and the global positioning systems, GPS position location principle, GPS receivers and codes, Satellite Signal Acquisition, GPS navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation

Text/Reference Books:

1. Merrill I. Skolnik " Introduction to Radar Systems", Mc Graw- Hill.
2. J. C.Toomay, Paul J. Hannen "Principles of Radar", PHI Learning.
3. B. Pratt, A. Bostian, "Satellite Communications", Wiley India.
4. D. Roddy, "Satellite Communications", TMH.