adesh University
NT OF PHYSICS
M.Phil (Physics)

Outlines of Test

Semester-I

		Max. Marks
Course I:	Mathematical Techniques	100
CourseII:	Any one of the following	100
	a) Computational Techniques	
	b) Experimental Techniques	
	c) Advanced Quantum Mechanics	

Semester-II

Course III:	Any one of the Following	100
	a) Condensed Matter Physics	
	b) Electronics	
	c) Material Science	
	d) Nuclear Physics	
	e) Particle Physics	
	Dissertation	Gradation
	Viva- Voce	Gradation

Note:

1. The special papers to be offered will be decided by the Staff Council depending on the availability of the staff and students.
2. Dissertation work will be distributed over both semesters.
3. Both the theory papers and dissertation are to be completed within one year.
4. Gradations are A (Excellent) , B (Very Good), C(Good), D (Satisfactory), E(Poor).
5. Before the dissertation is submitted candidate will be required to give a seminar on the work of his dissertation which is to be evaluated as satisfactory / unsatisfactory .

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Section A:

Green's Functions: Greenôs functions and boundary value problem for ordinary differential equation. Self adjoint differential form. Equivalence of integral and differential equations. Greenôs function for the partial differential equation and applications to physical problems.

Section B:

Integral equations: Linear integral equations. Iterative techniques. Degenerateôs and symmetric Kernels Hilbert ï Schmidt theory. Ferdhom theory. Volterra integral equation .

Section C:
Transform Methods: Fourier and Laplace transforms. Their properties and applications to solve differential and integral differential equations.

Recommended Books:

1. Mathematical Physics , Byron and Fulier.
2. Mathematical Physics, Arfken.

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l Techniques:

Section A:

1. **Some simple models and similarities in Physics**: Linear and nonlinear systems.
2. **Chaotic motion of dynamical Systems:** One dimensional map and universal features, measuring & controlling chaos, Higher dimensional models, forced damped pendulum, Logistic map Hamiltonian chaos.
3. **Random processes:** Order to disorder, Poissonôs distribution and nuclear decay, introduction to random walk and diffusion equation.

Section B:

1. **PDE:** Solution of Laplace eqation. Maxwellôs equations and time dependant schrodinger equation.
2. **Monte Carlo method of Integration:** Simple one dimensional and multidimensional integrals, error analysis, Importance sampling. Metropolis MC method, acceptance- rejection method.
3. **Percolation and fractals:** Percolation threshold, Cluster labeling, Critical Exponents, Fractal dimension, growth , processes.

Section C:

Simulation Methods in Physics: Monte Carlo Simulation of canonical ensemble: Equilibration and equilibrium properties. Molecular Dynamic simulation.

Recommended Books:

1. S.E. Koonin, computational Physics
2. H. Gould and J. Tobochnik. An introduction to computer simulation methods, 2nd edition (Addison Wesley 1996)

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Techniques

Section A:

Treatment of Experimental data: Errorôs systematic and random error, mean variance, combination of errorôs, normal error law. Poisson distribution law and statistics of counting, curve fitting, least square fit.

Section B:

Techniques of Experimental Physics:

a) Gamma-Ray spectroscopy with Ge (Li) detectors: General characteristics of a Ge (Li) detector: Electronics amplifier, analogy to digital converter (ADC) analysis of spectra determination of gamma ray energies and intensity, sources of errors in energy and intensity measurement.
b) Elemental Analysis: Using proton beam neutron activation and X- Ray fluorescence (b)

Section C:

Microwave Measurement : VSWR, dielectric constant and dielectric loss, resonance methods.

Recommended Books

1. Braddick, HJ. J. Physics of Experimental Methods.
2. Worthing and Gefiner: Treatment of Experiment Data
3. Hamilton, W.D. The Electromagnetic Interactions in Nuclear Spectroscopy.
4. Sitegbahn, K Alpha, Beta and Gamma Ray spectroscopy Vol-I and 2

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Course II C. Advanced Quantum Mechanics

Section A:

Quantization of Wave Fields: Classical and quantum field equations, complex fields, Hamiltonian formulation, quantization of non- relativistic Schrodinger equation for a system of bosons and fermions, commutation and anticommutation at unequal times, N- representations (Quantization of complex scalar (spin zero) field, positive and negative frequency parts. Quantization of Dirac (spin ½) field. Covariant anticommutation relations, interaction between charged particles and electromagnetic fields, quantization of electromagnetic field.

Section B:

Path Integral Formulation of Quantum Mechanics: The quantum mechanical law of motion classical action, quantum mechanical amplitudes, the sum over paths. Events occurring in succession, wave function. Application to free particle and harmonic and forced harmonic oscillator. Path integral as a functional and its evaluation. Schrodinger equation, time independent Hamiltonian, perturbation expansion, transition elements. Propagator and scattering matrix.

Section C:

Interacting Fields: Interaction Lagrangian for the fields. S. Matrix and its reduction, chronological product and wickôs theorem. Covariant perturbation theory. Lagrangian for quantum electrodynamics. Feynman diagrams and rules for QED in configuration and momentum space. Radiation theory, absorption and emssion. Furryôs theorem, Coulomb scattering , electron- positron annihilation. Bhabha scattering and Compton scattering.

Recommended Books

1. L.I. Schiff: Quantum Mechanics (Mc Graw Hill)
2. L.H. Ryder: Quantum Field Theory (Cambridge Univ Pr)
3. J. Bjorken and S.D. Drell: Ralativistic Quantum Mechanics (Mc Graw Hill)
4. R.P. Feynman and Hibbs: Path Integrals (Mc Graw Hill)
5. R. Ramond: Field theory; A Modern Primer (Addision Wesley)

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Section A:

Amorphous State of matter: Definition, preparation and structure, the diffraction pattern of an amorphous solid. Atomic radial distribution function in elements and compounds. The nearest neighbor configuration, modeling of the structure of amorphous semiconductors. The micro crystal approach, the perturbed crystal approach. The continuous Nework approach.

Section B:

Basic models for the electron band structure in amorphous staff, temperature variation of dc and ac conductivity. Localized and extended states, mobility edge. Photoconductivity and quantum efficiency, optical absorption. interband absorption. Behvaviour of conductivity, thermoelectric power, Hall effect, hopping conduction. Nonôohmic conduction in strong electric field .

Section C:

Devices: Thin film devices , bulk devices and optoelectronic devices.

Recommended Books

1. Mott and Davis, Electronic processes in noncrystalline materials.
2. Sze, Physics of semiconductors, devices.
3. Tauc, amorphous and liquid semiconductors.

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Section A:

Fermions Gas: Second quantized Hamiltonians for bosons and fermions, electron-phonon interaction and spin systems. Equation of motion, method of finding eignevalues.

Section B:

Various quantum mechanical representations: Linear response function approach : dielectric constant and its applications.

Green's function at zero temperature: S-matrix. Wick's theory, Feymann diagram and Dyson equation. Finites temperature (matsubara) Green's function. Frequency summation and linked cluster expansion of thermodynamic potential.

Section C:

Abinitio Methods: Born-oppenheimer approximation. Many body Hamiltonian, Independent electron interaction. Hartree approximation, Density functional theory, Hohenberg kohn theorem, local density approximation. Kohn- Shan equations using plane waves. Ion-electron interaction, Pseudo potentials Carr-Parrinelbo molecular dynamics for solving Kohn sham equation. Total energy calculations.

Recommended Books

1. Maharn G.D. Many particle Physics
2. Pines D and Nozieres, P. Quantum liquids.
3. Fetter A.L. and Walecks, J.D., Quantum theory of Many particle systems.
4. Egel Staff P.A., Theory of simple liquids.
5. Satton AP, Electronic structure of materials (Oxford UP 1996).

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Section A:

Electromagnetic Interaction with Nuclei: Interaction of radiation of field with nucleus, its multipole expansion. Transition probabilities and selection rules, angular distribution of multipole radiation theory of gamma ï gamma angular correlation, angular correlation studies and applications to problem of nuclear spectroscopy and hyperfine interactions.

Section B:

Medals: Shell model, configuration mixing , L.S.JJ coupling schemes. Collective nuclear models; Nuclear rotational motion, rotation energy, spectra and the nuclear wave function for even Nuclei, odd nuclei, energy spectrum and wave function. Nuclear moments, nuclear deformation collective vibration excitations, quadruple deformation, Davydov Silipoy model, Nilsson potential coupling between modes of collective excitation , particle coupling core excitation.

Section C:

Nuclear Reactions: Direct reactions: Fundamental theory of stripping, pickup reactions and inelastic scattering , Butlerôs theory, DWAP calculations, angular distribution of rotational and vibrational levels by direct reactions.
Optical model: experimental evidence extraction of optical model parameters, use and applications.

Recommended Books:

1. I. Talmi, Simple models of Complex Nuclei
2. Roy R.R. and Nigam B.P. : Nuclear Physics
3. S.S.M.Wong, Introductory Nuclear Physics
4. G.P. Salchler, Introduction to Nuclear reactions (Mc Millan)
5. Harmier P and Sheldon, E: Physics of Nuclei and Particles
6. Tonocman, WL : Theory of Direct Nuclear Reactions.
7. Blatt, U.N. I.J. Mand Weisskopf, V.P Theoretical Nuclear physics

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Section A:

Polymer materials : Polymers, classification, Glass transition temperature, Crystallinity in polymers, Electronic states and thermoelectricity, thermally stimulated current techniques, charge storage, piezoelectricity and pyroelectricity in polymers, photoelectronic properties of photoconductive polymers, conducting polymers (polyacetylene).

Compound Semiconductors for Electronic Devices: III- V, II-VI and IV- VI compound, ternary and quaternary semiconductors , Electrical , optical and thermal properties. Epitaxy VPE, LPE MBE & MOC VD techniques of devices fabrication.

Section B:

Contacts & Electrodes: Practical Ohmic contacts to silicon, Requirements of ohmic contacts, electro migration. Gate metallization. Choice of Gate materials, metal gate electrodes. Polysilicon and silicide gate electrodes. Transport conducting electrodes.

Multilevel Metallization: Need for multilevel metallization, Materials for multilevel metallization schemes. Conductor systems. Dielectric systems, Planarization technologies, metallization technology for GA- AS integrated circuits. GA-AS IC metallization, design considerations. GA-AS contact and interconnect systems.

Section C:

Characterization of materials for VLSI: Impurities in silicon, characterization technique, chemical species. Physical defect characterization. Electrical characterization polycrystalline growth and characterization. Surface characterization for VLSI. Techniques for surface analysis. LEED, REED , XRF, SIMS, Auger and scanning electron microscopy, photoelectron spectroscopy electrical mapping.

Recommended Books

1. Mort. J. and Pfister. G., Electronic properties of polymer (1982), John Wiley & Sons.
2. Mayar, J.M and Lab, S.S. : Electronic material Science for integrated. Circutis in Si and Ga As.
3. Norman, G.E. VLSI Technology , Vol: 7,10,13,15.
4. Sze. S.M., VLSI Technology, MC Graw Hill
5. Gandhi, S.K., Theory and practice of Microelectronics.
6. Gowarikar V.R., Viswanathan. N.V., Sreedhar, J., Polymer Science 1987 Wiley Eastern Limited.

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Section A:

Particles and Forces, Natural units, gauge, invariance in classical electromagnetism, gauge invariance in quantum theory. Covariant derivatives, symmetries and conservation laws) SU (I) Gage invariance and BED, SU(2) gauge invariance, SU (3), gauge invariance and QCD, massive gauge bosons, hidden symmetry, spontaneous symmetry breaking of a global, local (gauge), symmetry and of a SU (2) gauge symmetry. Higgs mechanism.

Section B:

The Weinberg Salam Model: The choice of the Higgs field , masses of the gauge bosons and fermions. the standard model. Renormalizability of electroweak theory((qualitative idea only) idea of grand unification of forces, calculation of Broton decay barvon asymmetry of the universe.

Section C:

Applications: Weak Isospin and hypercharge, The electro weak interaction, the effective current, current interaction, Feynman rules for electroweak interaction. Neutrino electron scattering. Electroweak interference in e^+e^- annihilation. Charged and neutral currents, Cross sections, decay widths and life times, production and decay of W and Z bosons, production and detection of the Higgs bosons.

Recommended Books

1. Modern Particle Physics, Gordon Kane: Addison Wesley .
2. Quarks and Leptons, An introductory course in modern Particle Physics, F, Malzen and A.D. Martin John Wiley.
3. Gauge Theory of Elementary Particle Physics: T.P. Cheng and Ling Fong Li (Clarendon)
4. Gauge Theories of the strong, weak and Electromagnetic Interactions, C. Quigg (Addison Wesley)

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