Scheme of Examination and Syllabi for Ph.D. Course work in Physics

SCHEME OF COURSE WORK

Paper No.	Title	Hours per week	Max. Marks	Internal Assessment	Total Marks
17 PHYPC–I	Research Methodology	4	80	20	100
17 PHYPC–II	Computer Application & Programming	4	80	20	100
17 PHYPC–III	Advanced Physics	4	80	20	100

Marks of Internal Assessment = 20. The internal assessment in each paper shall be based on assignment(s) and seminar(s) presented by each candidate and their participation.

Syllabi for Ph.D. Course work in Physics
17 PHYPC–I
Research Methodology

Max. Marks : 80
Time: 3 Hrs.

Note: Nine questions are to be set by selecting two questions from each unit. Question No.1 is compulsory and will consist of 6 to 8 questions covering whole of the syllabus.

Unit-I Nuclear Detectors

General Characteristics of Detectors, Ionization Detectors, Scintillation Detectors; Photo-multipliers, semiconductor Detectors and Neutron Detectors.

Unit-II IC Fabrication Techniques

Thin film Deposition Techniques : Vacuum pumps and gauges. Chemical vapor Deposition (CVD), MOCVD, PEMOCVD (Plasma enhanced chemical vapor deposition), Physical vapor Deposition : Thermal Evaporation, Molecular Beam Epitaxy (MBE), Sputtering.

Lithography, Etching and Micro-machining of Silicon, Fabrication of integrated Circuits.

Unit-III Computer Networking –I

Uses of Computer networks, network for companies , Network for people, social Issues, local Area Networks, Metropolitan Area, Networks, Wide area Networks, Wireless Networks, Internetworks, Network software, Protocol Hierarchies, Design Issues for layers, interfaces and services connection oriented and connectionless service, service and primitives, Relationship of services to protocols, The OSI Reference Model The TCP/IP Reference Model, Comparison of OSI AND TCP Reference Models. Data communication Services SMDS, x.25 Networks, Frame relay, Broadband ISDN & ATM.

Unit IV Computer Networking –II

Network layer design issues, service provided to Transport layer, Internal organization of Network layer, Routing Algorithms, The optimality principle, Shortest path routing ,Flooding, Flow control and Buffering, The Internet, Internetworking, How networks differ, concatenated virtual circuits, connectionless internetworking, Tunneling Internet routing, IP Protocol, IP Addresses, Internet Transport Protocols (TCP AND UDP), The TCP Service model, TCP Protocol, UDP, Wireless TCP AND UDP, Domain name system (DNS) DNS Name space, Resource records, Name Servers, Electronic Mail, Architecture and Services.

References:

1. Techniques for Nuclear and Particle Physics Experiments by W.R. Leo (M/S/ Springer Verlag, 1987)
2. Nuclear Radiation Detectors by S.S.Kapoor and V.S. Ramamurthy (M/S Willey Easter Ltd., 1986
3. The Physics of semiconductor Devices by D.A. Eraser, Oxford Physics Series (1986)
4. Semiconductor Devices - Physics and Technology, by SM Sze Wiley (1985)
5. Thin film phenomena by K.L.Chopra
6. Deposition techniques for films and coating, R.F. Bunshah (Noyes publications)
7. Andrews S. Tanenbaum by Computer Networks PHI 2001
8. Computer Networks by William Stalling PHI
9. Data Networks by Gallanger

17 PHYPC–II

Computer Application & Programming

Max. Marks :80

Time: 3 Hrs.

Note: Nine questions are to be set by selecting two questions from each unit. Question No.1 is compulsory and will consist of 6 to 8 questions covering whole of the syllabus.

UNIT I: Curve Fitting, Random Numbers in computer simulation

Curve Fitting: Principle of least square fitting ; Linear regression, Polynomial regression; Exponential and Geometric regression.

Random Numbers in Computer Simulation: Generation of random numbers: Basic Strategy, Mid-Square generator, Multiplicative Congruential Generator, Monte Carlo Simulation of Radioactive Decay, Diffusion of particle in one dimension.

UNIT II Numerical solution of First and Second Order Differential Equations

Numerical Solution of First Order Differential Equations: First order Taylor Series Method; First-order, Second-order and Fourth-order: Runge-Kutta Methods. Applications: Charging and discharging of a condenser, Motion of a body falling in viscous medium, Effect of air drag on motion of a falling body.

Numerical Solution of Second Order Differential Equations: Initial Value problems: Applications: Motion of one dimensional simple harmonic oscillator, Motion of Damped Harmonic Oscillator, Motion of Anharmonic Oscillator, Solution of Radial part of Schrödinger equation for hydrogen atom, Solution of Poisson equation for spherical potential.

UNIT III Boundary Value Problems, The Dynamics of Many Particle System, The Chaotic Motion of Dynamical Systems

Boundary value problems: Shooting method, Numerov method.

The Dynamics of Many Particle System: Molecular dynamics programs for trajectories of the particles.

The Chaotic Motion of Dynamical Systems: Chaotic motion of damped harmonic oscillator under external force.

UNIT-IV C/C++ Programming

Introduction to C/C++; constants, variables, data types, declaration of variables, user defined declaration, operators, hierarchy of arithmetic operators, expressions and statements; Control statements: if, switch, conditional operator, go to, if ---- else; Decision making and looping statements: while, do --- while, for; built in functions and programme structure, strings; input and output statements; pointers and arrays; subprograms; function overloading, recursion; file access.

References books

1. Computer Simulation in Physics, R.C. Verma, Anamaya Publ., New Delhi, 2004.
2. Computer Simulation Methods, Harvey Gould and Jan Tobochnik, Addison-Wesley Publishing Company, New York, 1988.
3. Object Oriented Programming with C++, E. Balgurusamy, Tata McGraw Hill, 2000.
4. Object Oriented Programming using C++, B. Chandra, Narosa, New Delhi, 2002
5. Computational Physics by Steven E. Koonin, Addison-Wesley Publishing Company, New York, 1986.

17 PHYPC–III
Advanced Physics

Max. Marks : 80
Time: 3 Hrs.

Note: Nine questions are to be set by selecting two questions from each unit. Question No.1 is compulsory and will consist of 6 to 8 questions covering whole of the syllabus.

Unit-I Semiconductor Physics

Energy Bands, Instrinsic carrier concentration. Donors and Acceptors, Direct and Indirect band semiconductors. Degenrate and compensated semiconductors. Elemental (Si) and compound semconductors (GaAs). Replacement of group III element and Group V elements to get tertiary alloys such as $Al_xGa_{(1-x)}As$ or $GaP_yAs_{(1-y)}$ and quaternary $In_xGa_{(1-x)}P_yAs_{(1-y)}$ alloys and their important properties such as band gap and refractive index changes with x and y. Doping of Si (Group III (n) and Group V (p) compounds and GaAs (Group II (P), IV (n.p.) and VI (n compounds). Diffusion of Impurities - Thermal Diffusion, Constant Surface Concentration, Constant Total Dopant Diffusion, Ion Implantation.

Unit –II Non Linear Optics

Harmonic generation. Second harmonic generation. Phase matching. Third harmonic generation, Optical mixing. Parametric generation of light, self focusing of light. Multiquantum photoelectric effect. Two photon processes. Experiments in two photon process. Doppler – Free two photon spectroscopy. Multiphoton processes. Second harmonic generation, parametric generation of light. Parametric light oscillator. Frequency unconversion.

Unit-III Laser Applications

Multiphoton photo-electric effects, Two-photon, Three-photon and Multiphoton Processes Raman Scattering, Stimulated Raman Effect. Introduction to Applications of Lasers : Physics, Chemistry, Biology, Medicine, Material working,optical communication, Thermonuclear Fusion, Holography, Military etc

Unit-IV Concepts of Theoretical Physics

Solution of 3-D Schrodinger equation for: one electron, two electrons and many electrons systems.

Solution of Poisson equation for : spherical potential.

Molecular dynamic simulation of: (i) 2-D trajectories of particles in space (ii) 3-D trajectories of particles in solids.

Energy bands in tight binding approximation: application for bee and fee crystals

References:

1. The Physics of semiconductor Devices by D.A. Eraser, Oxford Physics Series (1986)
2. Semiconductor Devices - Physics and Technology, by SM Sze Wiley (1985)
3. Thin film phenomena by K.L.Chopra
4. Deposition techniques for films and coating, R.F. Bunshah (Noyes publications)
5. Laser Electronics by J.T. Vardeyan Prentice hall Inc., New Jersey (1981)
6. Lasers and Non-linear optics by B.B. Laud Wiley Eastern Ltd.
7. Svelto : Lasers
8. Letekhov : Non-Linear Spectroscopy
9. Lasers and Non-linear Optics by B.B. Laud
10. Computer Simulation Methods by Harvey Gould and Jan Tobechnik, Addison Wesley Publishing Company, New York, 1988
11. Computational Physics by Steven E.Koonin, Addison-Wesley Publishing Company, New York, 1986
12. Introduction to Solid State Physics by C.Kittel, Wiley Easter Ltd., New Delhi, 1985.