I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No. : IKGPTU/Reg/N/ *Dated :*

NOTIFICATION

Sub: **Regarding Pre-Ph.D Course work.**

This is for information of all concerned that Pre-Ph.D course work from 2016-17 will be conducted in the IKGPTU main campus Kapurthala in regular mode. The PhD course work will consists of minimum 15 credits. The structure of the course work is as under.

Sr. No.	Nature of course	Name of course	Credits	Remarks
1.	Core	1.Research Methodology	4	The syllabus of RM should be formulated faculty wise such as Engineering, Science, Management/ Humanities and Life sciences
		2.Subject related theory paper	4	Discipline specific related to advancements in theoretical methods for research
		3. Presentation	3	Discipline specific
2.	Interdisciplinary	4. Elective	4	From list of subjects from allied fields
	Total Minimum credits		**15**	

-Sd-
Registrar

Endorsement No: IKGPTU/REG/N/ 4244-4251 Dated: 22.08.2016

1. Secretary to Vice Chancellor: For kind information of Vice Chancellor
2. Dean (P&D)
3. Dean (RIC)
4. Dean (Academics)
5. Finance Officer
6. Controller of Examination
7. DR (Computers): For uploading on website
8. File Copy

Registrar 22/8/16

I. K. Gujral Punjab Technical University, Jalandhar
Jalandhar Kapurthala Highway, Near Pushpa Gujral Science City, Kapurthala - 144 603
Ph. No. 01822 - 662521. 662501 Fax No. : 01822-255506. 662526. Email : registrar@ptu.ac.in

SCHEME OF COURSES

S.NO.	Name Course	Code	L-T-P	Credits
1	**Research Methodology**	**PHS900**	3-1-0	4
2	**Theoretical methods in Physics**	**PHS901**	3-1-0	4
3	**Techniques in Experimental Physics**	**PHS902**	3-1-0	4
4	**Advanced Condensed Matter Physics**	**PHS903**	3-1-0	4
5	**Computational Physics**	**PHS904**	3-1-0	4
6	**Nano Materials**	**PHS905**	3-1-0	4

Physics

PHS900 Research Methodology

1. Introduction to Research, Objectives of research, motivation in research, types of research, significance of research, research methods vs methodology, research process in flow chart, criteria of good research, problems encountered by researchers in India.
2. Difference between TEX and LATEX, basics of using latex, latex input files, input file structures, layout of the document, titles, chapter and sections, cross references, foot note, environments, typesetting, building blocks of a mathematical formula, matrices, tables, including encapsulated postscript graphics, bibliography, downloading and installing LATEX packages.
3. Introduction to origin, basics of importing and exporting data, working with Microsoft excel, graphing, statistics in origin, hypothesis testing, power and sample size, basic linear regression and curve fitting.
4. Error Analysis and Basic Statistics Measuring errors, uncertainties, parent and sample distributions, mean and standard deviation of distribution, types of probability distribution, instrumental and statistical uncertainties, propagation of errors, specific error formulas, method of least square fitting.
5. Multivariate analysis: Multiple regression, multiple discriminant analysis, multiple analysis of variance, canonical correlation analysis, Factor analysis cluster analysis, path analysis. Computational techniques.
6. Survey of literature: The students will be required to review literature in their respective disciplines and submit an assignment for evaluation.

References:

1. Research Methods for Science by Michael P. Marde

2. The not so short introduction to LATEX by TobianOetiker, Hubert Partl, Hrene Hyna and Elisabeth Schlegl

3. T.Veerarajan and T. Ramachandran "Numerical methods" Tata McGraw Hill, New Delhi, 2008

4. Data reduction and error analysis for physical sciences by Philip R. Bevington and D. Keith Robinson

PHS901 Theoretical methods in Physics

1. Theoretical Techniques in Condensed Matter Physics: Theory of NMR techniques, Theory of Anharmonic solids, Theory of Liquid state and Density functional theory.

2. Advanced Quantum Techniques: Review of electronic properties, Density Functional Theory, Hohenberg- Kohn theorems, Kohn-Sham ansatz, Intricacies for exchange & correlation, Solving Kohn-Sham equations, Norm conserving pseudopotentials, Unscreening and core corrections, Transferability and hardness of pseudopotentials.

3. Theoretical Techniques in Particle Physics:Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics

4. Theoretical Techniques in Nuclear Physics: Review of static properties, binding energy, density, nuclear forces, and potentials, shell model, collective models and energy levels, Hartree - Fock theory of nuclear shape and states with good J Quantum number and applications, correlations in nuclear matter and exclusive principle correlations, Bethe-Goldstone equation and G-matrix, heavy-ion physics at low and intermediate energies, simulations and QMD model, hot and dense matter and multi fragmentation.

Books recommended:

1. Solitons an Introduction by P.G. Drazin and R.S. Johan (Cambridge Univ. Press, 1989)
2. Chaos in Dynamical Systems by E. Ott (Cambridge Univ., Press, 1993)
3. Gauge theory of Elementary Particles by T.P. Cheng and Li (Oxford)2000
4. Structure of the Nucleus by M.A. Preston and R.K. Bhadhuri.
5. Quantum Theory of Solids by C. Kittel
6. Liquid State Physics by N.H. March and M.P. Tosi
7. Quantum field theory by Lahiri and Pal

Electives

PHS902 Techniques in Experimental Physics

Light/Optical Microscopy: Optical Microscope – basic principles & components, different examination modes (bright field illumination, oblique illumination, dark field illumination, phase contrast, polarized light, hot stage, interference techniques), stereomicroscopy, photo-microscopy.

Surface Analysis: Atomic force microscopy, Scanning, Tunneling microscopy, Secondary ion mass spectrometry, Auger electron spectroscopy, X-ray photoelectron spectroscopy, image analysis.

Thermal Analysis: Differential thermal analysis, Differential scanning calorimetry and Thermo-grayimetric analysis. Fourier transform infrared spectroscopy. Ultraviolet visible spectrophotometer.

Electron Microscopy: Interaction of electrons with solids, Scanning Electron Microscopy and specimen preparation techniques, Wavelength dispersive spectroscopy.

Diffraction Methods: Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, X-ray methods of analysis including powder diffraction, Wavelength and energy dispersive X-ray fluorescence (XRF).

Radiation analysis: Raman analysis and spectroscopy, Photo luminance, Photo multiplier tube, LINAC.

Experimental methods for probing nuclear structure: Experimental methods for gamma-ray, conversion-electron and charged-particle spectroscopy associated with nuclear reactions and Coulomb excitation, Compton suppressed Ge detectors, multiplicity filter, Neutron detectors, Sector field electron spectrometer.

Recommended Books:

1. Materials Characterisation, Metals Hand Book, 9th edition, Vol 10.
2. Cullity, B.D., "Elements of X-ray Diffraction", Addision Wesley Publishingh Co., Massachusetts, 1968.
3. Phillips, V.A., "Modern metallographic techniques and their applications", Wiley Interscience, 1971.
4. Cherepin and Malik, "Experimental Techniques in Physical Metallurgy:, Asia Publishing Co. Bombay, 1968.
5. Brandon D.G., "Modern Techniques in Metallography", VonNostrand Inc. NJ. USA, 1986.
6. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.
7. Weinberg F., "Tools and Techniques in Physical Metallurgy", Volume I & II, Marcel and Decker.

PHS903 Advanced Condensed Matter Physics

1. Transport Properties: Boltzmann equations, Electrical Conductivity, Calculation of relaxation time, Impurity scattering, Ideal resistance, Carrier mobility, General Transport coefficients, Thermal conductivity, Thermoelectric effects, Lattiice conduction, Phonon drag, Hall effect, Two Band Model- Magneto resistance.

2. Mesoscopic Systems: Low-dimensional systems; characteristic lengths; transverse mode or magneto-electric sub-bands; resistance of a ballistic conductor; Landauer formula; reformulation of Ohm's law; Landauer-Buttiker formula; transmission function and S-conductance fluctuations.
Quantum Hall Effect : Classical Hall effect; integral quantum Hall effect (IQHE); fractional quantum Hall effect (FQHE) and Laughlin's theory.

3. Material at Nanoscale: Synthesis and Fabrication methods (Physical and chemical approaches), characterization methods (microscopy, diffraction, spectroscopy techniques), surface analysis and depth profiling, techniques for physical property measurement, processing and properties of inorganic nanomaterials, special nanomaterials, Thermodynamics and statistical mechanics of small systems, Nucleation and growth of nanocrystals; kinetics of phase transformations. Effects of nanometer length scales, self assembling nanostructures molecular materials and devices, applications of nanomaterials: molecular electronics and nanoelectronics; nano-biotechnology; quantum devices; nanomagnetic materials and devices : magnetism, nanomagnetic materials, magnetoresistance; nanomechanics

4. Defects and Dislocation- Lattice Vaccancies, Diffusions, Color- Centers, Dislocations and their types, Strength of Alloys, Dislocation and crystal growth, Hardness of materials.

Recommended Books

1. Introduction to Solid State Physics : C. Kittel (Wiley, New York) 2005.
2. Quantum Theory of Solids : C. Kittel (Wiley, New York) 1987.
3. Principles of the Theory of Solids : J. Ziman (Cambridge University Press) 1972.

PHS904 Computational Physics

1. Introduction to simulation approach: Introduction to modeling and simulation, Methods of performance evaluation-simulation approach- Advantages and limitations, various type models and simulations, System model steps and its types involved in simulation study, Deterministic and Stochastic process, Introduction to random variables - univariate models and multi-variate models.

2. Numerical methods for differential equations: Euler's method, Runge - Kutta method for ordinary differential equations: stability and convergence. Partial differential equations using matrix method for difference equation, relaxation method, initial value problems, stability, convergence and qualitative properties and qualitative properties. Random numbers, Monte Carlo Integral methods, Importance sampling, Fast Fourier Transform.

3. Simulation Techniques: Monte Carlo methods, molecular dynamics, simulation methods for the Ising model and atomic fluids, simulation methods for quantum-mechanical problems, time-dependent Schrödinger equation, discussion of selected problems in Physics, nonlinear dynamics, diffusion-limited aggregation and transport properties, etc.
Introduction to parallel computation, Physical Simulations: N body methods and particle simulations,

Books Recommended:

1. Fortran Programming – V. Rajaraman
2. Numerical Methods: A Computer Oriented Approach, BPB Publ. 1996 R.S. Salaria
3. Computer based Numerical Methods 3rd Ed. Prentice Hall India 1980, V.Rajaraman
4. Mathematica, S. Wolfram, Addison. Wesley
5. Application of the Monte Carlo Method, K. Binder, Springer Veriag
6. An Introduction to Computer Simulation Methods, H.Gould and J. Toobochnlik, Addison Wesley, 1996.
7. Computational Physics by S.E. Koonin And Meredith

PHS905 Nano Material

Synthesis and processing: Nano particles from low- pressure, Low temperature plasmas and its applications, Low temperature compaction of nanosize powders, Nanofabrications with atom optics, Processing of nanocrystalline materials. Vapour processing of nanostructured materials.

Electrical properties: Quantized states in low-dimensional systems, Self-consistent treatment of one- and two- dimensional problems, Quantum wires- magnetosize effects and weak localization; magnetophonon reaonances; vertical tunneling, Quantum dots- fabricated quantum dots; impurity dot system; energy states, Current-voltage characteristics, Vertical transport through quantum dots.

Magnetic properties: Magnetic field profile, quantum motion in nonhomogeneous magnetic fields, Diffusive transport of electrons through magnetic barriers, One- and two- dimensional magnetic modulation, Hall effect devices, Nanoscale magnets.

Optical properties: Photo refractive quantum well structures and its optical properties, electronic transport and grating formation, Diffraction - Raman-Nath diffraction; nondegenerate four-wave mixing; two- wave mixing, Photorefractive effects and applications, Non-linear optical properties, Non-linear phenomenon – theoretical treatment of optical nonlinearities.

Books Recommended:

1. Nalwa, H.S. "Handbook of Nanostructured Materials and Nanotechnology", Vol.1, 3 and 4, Academic Press 2000.
2. Ying.J.Y. " Nanostructured materials", Academic Press, U.S.A., 2001.