List of Revised Courses

Department : *Pure and Applied Physics*

Program Name : *Pre Ph.D.. (Physics)*

Academic Year : 2016-17

List of Revised Courses

Sr. No.	Course Code	Name of the Course
01.		Research Methodology & Computer Applications
02.		Experimental, Theoretical techniques & Instrumentation inPhysics Research
03.		III A: Advanced Materials
04.		III B: Spectroscopic Techniques
05.		III C: Advances in Plasma Physics
06.		III D: Advance Nuclear Physics
07.		III E: Advanced Astronomy andAstrophysics

Minutes of Meetings (MoM) of Board of Studies (BoS)

Academic Year : 2016-17

School : *School of Physical Sciences*

Department : *Pure and Applied Physics*

Date and Time : *December 12, 2016 – 11:30 AM*

Venue : *Smart Class Room*

The scheduled meeting of member of Board of Studies (BoS) of Department of Pure and Applied Physics, School of Studies of Physical Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur, was held to design and discuss the Pre Ph.D. (Physics), scheme and syllabi.

The following members were present in the meeting:

1. Dr. R. P. Prajapati
2. Dr. M. N. Tripathi
3. Dr. R. K. Pandey
4. Dr. Parijat Thakur
5. Dr. H. S. Tewari
6. Prof. D. P. Ojha
7. Prof. P. K. Bajpai

The committee discussed and approved the scheme and syllabi. The following courses were revised in the Pre Ph.D.. (Physics):

- Research Methodology & Computer Applications
- Experimental, Theoretical techniques & Instrumentation in Physics Research
- III A: Advanced Materials

The following new courses were introduced in the Pre Ph.D. (Physics):

- III B Spectroscopic Techniques
- III C Advances in Plasma Physics
- III D: Advance Nuclear Physics
- III E: Advanced Astronomy and Astrophysics

Signature & Seal of HoD

Scheme and Syllabus

Course Structure
Pre Ph.D. Physics Syllabus 2016-17

Course Code	level	Course name	Credit	Remarks
	School level	Research Methodology& Computer Applications	04	Common to all
	Department level	Experimental, Theoretical techniques & Instrumentation in Physics Research	04	Common to Physics Candidates
	Paper –III (Optional) Any one of the followings	III A: Advanced Materials III B Spectroscopic Techniques III C Advances in Plasma Physics III D: Advance Nuclear Physics III E: Advanced Astronomy and Astrophysics	04	Any course

w.e.f. 2016-17

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Paper I

Ethics in Science Research Methodology & Scientific Presentation

Objective- • To acquaint the research scholars with the nature, scope and limitations of various methods of conducing educational research. • To develop an understanding of process of conducting educational research. • To develop an ability of appropriate selection, development and use of various tools of research • To acquaint the students with various techniques of sampling and to develop an ability of selecting appropriate sample for a research study.

Mode of study includes: Assigning the topic to students based on their basic background and presentation in the form of seminar which will be followed by discussion and submission of the write-up. This will be evaluated by group of teachers.

Unit 1: Ethics in Science: The source of ethical issues in science: examples from different disciplines. Biotechnology ,medical ,sciences defense research and development, environmental issues, space research, energy ,food security etc.

Ethical issues in science research and reporting: objectivity and integrity, the problem of plagiarism and related issues, international norms and standards. Scientific temper and virtues, expectations from scientific community.

Unit 2: Errors in measurements and Data processing :

Types of errors; mean deviation, standard deviation and probable errors; propagation of errors with summation, difference, product and quotient

Curve fitting, Method of least square fit, least square fit (straight line) to linear equations and equation reducible to linear equation . Least square fit (parabola) to quadratic equation and equation reducible to quadratic equation.

Unit3: Laboratory practices and safety guidelines:'

Literature searching Literature Survey, defining the question and formulating hypothesis/ hypothesizes,

Collection of research data, tabulating and cataloging. Sampling and methods of data analysis.

Laboratory safety measures, Handling radiation,Bio-hazardous and other toxic experimental materials, Maintenance of equipments. Maintence of equipments. Proper storage and disposal of hazardous materials.

Unit 4: scientific presentation and writing skills

Survey of literature and presentation of data, one seminar paper preparation in PowerPoint (which ing texts ,graphs ,picture ,table ,references etc)(oral iin power point/poste Development of communication skills in presentaticon of

scientific seminar – eye to eye contact , facing to audience ,question and answer sessions etc.

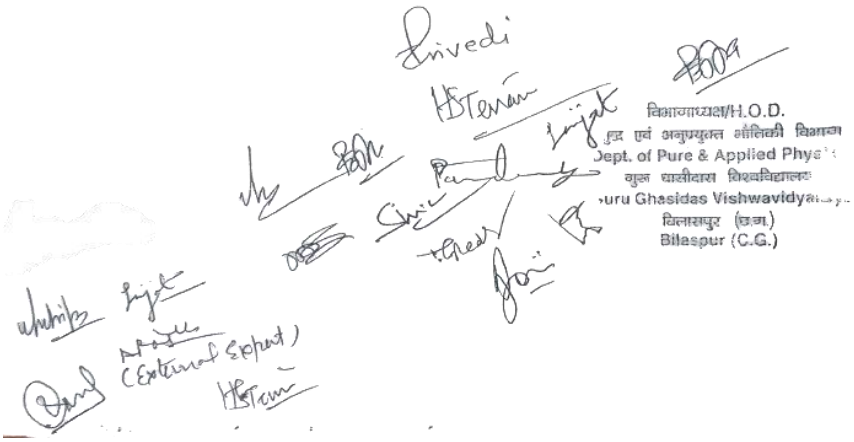
Steps to better ,flow chart method, organization of materials and stylr, drwing gigures, graphs, table footnotes, referenceetc in research paper.

Unit 5: IPR and Patent regime: Recording and storage/retention of recorded materials. Management and use responsibilities in proper utilization of the facilities. Socio-legal issues, originality.

Outcomes - Research methods courses offer students the opportunity to learn the various aspects of the research process, framing useful research questions, research design, data collection, analysis, writing and presentation.

References:

1. "How to write and Publish" by Robert A. Day and Barbara Gastel, (Cambridge University Press).
2. "Survival skills for Scientists" by Federico Rosei and Tudor Johnson, (Imperial College Press).
3. "How to Research" by Loraine Blaxter, Christina Hughes and Malcum Tight, (Viva Books).
4. "Probability and Statistics for Engineers and Scientists" by Sheldon Ross, (Elsevier Academic Press).
5. "The Craft of Scientific Writing" by Michael Alley, (Springer).



Paper II

Experimental, Theoretical techniques & Instrumentation in Physics Research

Objective- Students should have the knowledge of this course as basic techniques and different instruments are discussed here in-depth.

Unit I

Synthesis of materials: Bulk Synthesis: Solid State Route, Sol Gel, Co- precipitation, Combustion methods, thin film fabrication: spin coating, dip coating, evaporation methods, Vacuum techniques, vacuum pumps (Rotary and Diffusion pumps), vacuum gauges.

Unit II Structural and composition characterization: Basics of X – ray diffraction (XRD), grazing incidence and powder XRD, Scanning Electron Microscope, Energy dispersive X – ray analysis, X-ray photoelectron Spectroscopy, Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM) and Transmission Electron Microscope, electrical measurements, .

UNIT III Physics of nanomaterials

Opitical spectroscopy and Raman spectroscopy: review of molecular and vibrational spectroscopy, Basic principle , Instrumentation, advantages and limitation ,Fourier transform Infrared spectroscopy , UV Vis spectroscopy and Raman spectroscopy analysisof spectrum.

UNIT IV

Electric and thermal measurement : ac and dc electrical conductivity measurement as s function of temperature and frequencies. Magnetoresistance measurement ,specific heat measurement . impendence spectroscopy,A.C. impendence spectroscopy,Thermo Gravimetric analysis (TGA),differential thermal C (DTA) and differential scanning calorimetric (DSC)analysis.

UNIT V

Magnetic characterization : characterization of magnetic materials, ferromagnetic, multiferroic, spin glass materials and underlying principle Vibrating sample magnetometer (VSM), SQUID magnetometer , a.c. susceptibility and d.c. magnetization measurements.

Outcomes- This is a soft core course. It deals with different experimental techniques in Physics. Studying different temperature and electrical measurements the concept of measurements for regular equipment is grown within the students

Reference Books

1. Materials Science and Engineering (John Wiley & Sons, Inc.) By William D. Callister, Jr.
2. Introduction to Ceramics, W.D. Kingery
3. Introduction to Nanoscience and Nanotechnology, K.K. Chattopadhyay and A.N.Banerjee
4. Materials Science of Thin films, M. Ohring

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Paper III A: Advanced Materials

Objective - This course aimed at students who have a strong materials background wish to gain more specialised knowledge of the principles, structure, processing and design of advanced engineering materials

Unit I

Linear and non linear dielectric materials, Ferroelectric, piezoelectric and electro-optic materials, composite materials, Liquid crystals, Materials for solar cells and Fuel cells.

Unit II

Colossal magnetoresistance materials, magneto caloric materials, Multifunctional materials, magneticfield induced polarization and electric field induced magnetization.

Unit III

Properties of Individual Nano-particles, metal nano clusters, magnetic clusters, semiconductor nanoparticles, optical properties, methods of synthesis of nano particles,

Unit IV

Carbon allotropes, fullerene, carbon nano tubes, graphene, graphite oxide and applications, Applicationsof carbon materials, Functionalization of graphene and carbon nanotubes

Unit V

Low dimensional systems, preparation, size & dimensionality effects, excitons, single electron tunneling,applications of quantum nanostructures, self assembly, process of self assembly

Computational Techniques: Basics of ab-initio calculations, basic principles of density functional theory(DFT), exchange correlation energy functional, applications of DFT

Outcomes –students will be able to Identify and describe different types of material processing techniques for advanced materials and Ability to select suitable material for specific applications.

Reference Books

1. Colossal magnetoresistance charge ordering and related properties of manganese oxides, C.N. R.Rao and B. Raveau
2. Dielectric relaxation in solids, A.K.Jonscher
3. Density Functional Theory: A practical approach, David S. Sholl, Janice A. Steckel

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Paper III B Spectroscopic Techniques

Objective - This course will give an introduction to modern spectroscopic techniques including time-resolved laser methods.

Unit-I Raman Spectroscopy-

Instrumentation , Basic Components of Raman system, Spectrometer and Detectors, Raman Spectroscopy of Solid and Liquids, Raman spectroscopy of Materials, Qualitative versus Quantitative Raman, Vibrational Analysis, Spectral Analysis by Group Theory, Character Table

Unit –II IR-Spectroscopy

Instrumentation, Basic Components, IR-sources, Spectrometer and Detectors, Infrared absorptionspectroscopy, Fourier transformed infrared spectroscopy attenuated total Reflectance(ATR) spectroscopy, diffuse reflectance spectroscopy.

Unit-III Electronic Spectroscopy Techniques

Instrumentation, Basic Components, UV-Visible sources, spectrometer and detectors, UV-Vis spectroscopy, Absorption., Transmission, Reflection, Photoluminescence, spectroscopy, florescence and phosphorescence, circular dichroism

Unit-IV Advance Spectroscopy Techniques

Surface Enhanced Raman Spectroscopy, UV Resonance Raman Spectroscopy, Tera hertz Spectroscopy,Laser Induced Breakdown Spectroscopy (LIBS)

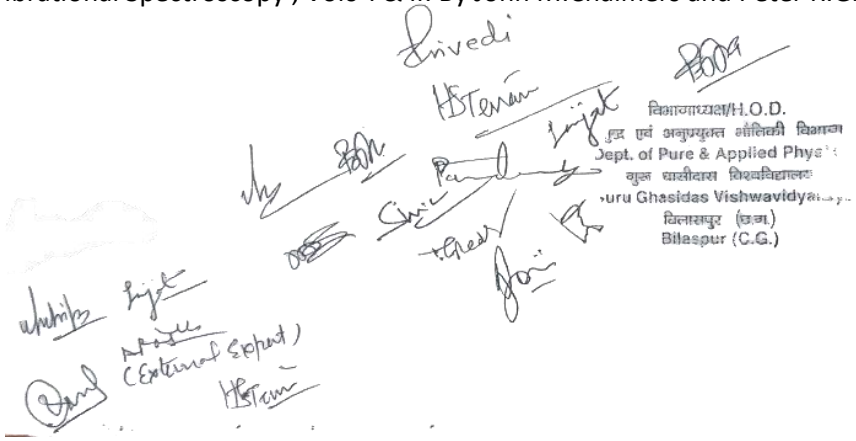
Unit –V Other Techniques

Particle Induced X-ray emission, Nuclear Magnetic Resonance(NMR) spectroscopy, Electron Spin Resonance (ESR) Spectroscopy

Outcomes -Recognize spectroscopy in microwave, Rotational spectra of rigid diatomic molecules, selection rules, interaction of spectral lines . Study of Vibrating diatomic molecule, energy levels of a diatomic molecule, simple harmonic and anharmonic oscillator, Scattering of ligh.

Text and Reference Books

1. Modern Spectroscopy, 4th Edition , J.Michael Hollas , Wiley
2. Chemical Application of Group Theory , 3rd Edition By F.Albert Cotton , Willey
3. Handbook of Vibrational Spectroscopy , Vol0-I & II: By John M.Chalmers and Peter R.Griffiths, Wiley



Paper III C (Optional)
Advances in Plasma Physics

Unit-I: Fluid theorem in Plasmas:

Single fluid and two fluid theorems', Mangnetohydrodynamics(MHD) fluid theory, fast slow and intermediate MHD wave, Dissipation in MHD Fluid, collisonless anistropic plasma, chew Goldberger and low theory

Unit-II: Nonlinear Phenomenon:

Concept of Sheath, wave particle interaction, Nonlinear landau damping,Wave kinetic equation, KDV Equations, Reductive perturbation analysis.

Unit-III: Instabilities in Plasma

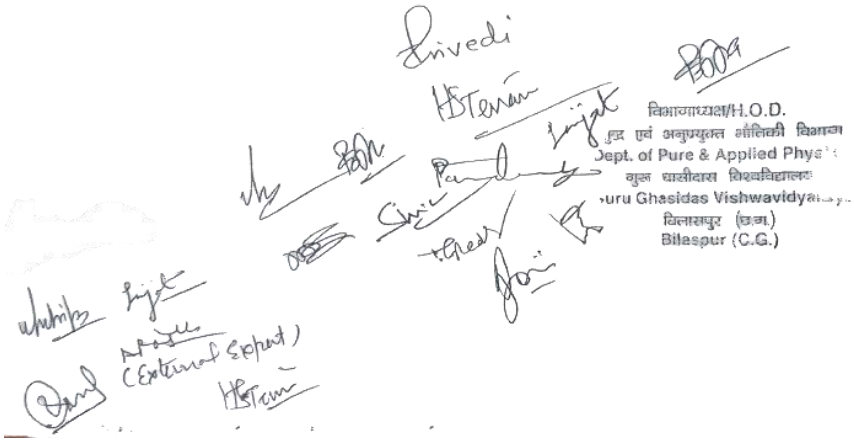
Stable neutral and unstable systems, Analysis of stability and non-stability, kinetic theory, macro stabilities, self-gravitational stability, Rayleigh- Taylor (R-T) instability, Kelvin– Helmholtz (k-h) instability, structure formation, Micro stabilities, Electron cyclotron instability.

Unit-IV: Basin of Dusty (Complex) Plasmas:

Dusty plasma and parameters, Characteristics of complex plasma, Application, dust charging process, Dynamics of dust grain, strong coupling phenomenon, Complex plasma crystal formation.

Text and Reference Books:

[1] J.A Bittencourt, Fundamental of Plasma Physics, Pergamon press
[2] N A Krall and A W Trivelpiece, Principle of Plasma Physics, McGraw Hills
[3] F F Chen, Introduction to Plasma Physics and controlled Fusion, Plenum press
[4] P M Bellan, Fundamental of Plasma Physics, Cambridge University press



Paper III D(Optional)

III D: Advance Nuclear Physics

Objective -To impart knowledge about nuclear deformations, properties and nuclear models for understanding of related reaction dynamics. Beside this, students will be exposed to heavy ion physics and nuclear astrophysics.

Advance Nuclear Models: Single particle motion, Shell model with configuration mixing. Nilsson model. Strutinsky and shell corrections. Liquid drop model and collective motion. Rotation and vibration with particle coupling, Cranking models, Hartree-Fock model. quasipanicles and pairing

Experimental Techniques for Nuclear Structure Studies: Production of nuclei at extreme of spin. isospin and excitation energies. Nuclear reactions for production of various isotopes. Gamma ray spectroscopy for the study of discrete states of nuclei. Electromagnetic properties. Lifetime measurement: RDM. DSAM and Introduction to High-spin phenomena

Signal Processing: Pre-amplifiers. amplifiers. polezero cancellation. Base line restoration, Pile up rejection, Function generator. NIM & CAMAC Standards

Detectors: Energy loss of charged particles in matter, range & straggling. energy. position & time detection for charged particles with solid state detectors, ionization chamber. Multi wire proportional counter, semiconductor gamma detector, scintillation detectors,

Outcomes- Students will have achieved the ability to: 1. explain nuclear deformation and related orientation effects 2. collective description of nuclear behavior. 3. to examine dynamics of heavy-ion reactions 4. basic aspects of astrophysics

Reference Books:

1. Nuclear Structure from a Simple Perspective, R. F. Casten
2. Basic Ideas and Concepts in Nuclear Physics, K Heyde
3. Techniques for Nuclear and Particle Physics Experiments, William R. Leo
4. Radiation Detection and Measurement, G.F.Knol

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Paper III E (Optional)

Advanced Astronomy and Astrophysics

Objective - The coursework may be tailored to a student's needs, and can include astrophysical techniques, astrophysical computing, planetary science, stellar astrophysics, galaxies, cosmology, and courses from cognate disciplines. Some of the courses may include the acquisition and analysis of telescope data, the development of theoretical models, or the development and testing of new astronomical instrumentation.

Unit-I

Introduction to Astronomy and Astrophysics

Stellar structure and evolution - The HR diagram - Colors, magnitudes, Spectral classification - White dwarfs, neutron stars, black holes – Binary Stars – Binary X-ray Sources & Accretion discs – Extra-solar planetary Systems - ISM - Structure of Milky Way - Stellar population and galactic structure.

Unit-II

Galaxies: Structure, Dynamics and Evolution

Galaxies as self gravitating objects, virial equilibrium - Estimates of collision times - Collisionless Boltzmann equation and some steady state solutions - Globular clusters - stability - Spiral structure, bars and disc dynamics - Ellipticals - Galaxy morphology - Chemical evolution -Galaxy formation and evolution.

Unit-III

Extragalactic Astronomy

Phenomenology of AGNs (Seyferts, Quasars, Radio Galaxies, LINERS, BL Lacs) with a survey of continuum, emission and absorption features of spectra - Black hole and accretion disc models for AGNs - Emission line regions (BLR, NLR) - Physics of jets and hot spots.

Unit-IV

Telescope: Ground Telescopes and Space based Telescopes

Photometry: Instrumental magnitudes and colors, seeing and atmospheric effects, extinction correction. Standard photometric systems: UBV and other systems, transformation to a standard photometric systems, Absolute and differential photometry

Unit-V

Basics of CCD data reduction: Plate scale, readout noise and gain, signal-to-noise ratio, correction for bias, dark and flat fielding, fringing and cosmetic effects.

Basic understanding of X-ray Astronomy: X-ray Optics – Detectors - X-ray Data Reduction andAnalysis - Spectral & Timing Analysis

Learning Outcomes

1. Demonstrate high level knowledge in Astronomy & Astrophysics and relate it to a range of disciplinary and interdisciplinary contexts;
2. Apply their knowledge in the discipline to new problems;
3. Interpret, synthesise and critically analyse new published literature of relevance to Astronomy & Astrophysics;

Recommended Text and Reference Books:

1. The physical universe, Shu F., (University of California).
2. Astrophysics for Physicists, Choudhuri, A.R. (Cambridge University Press).
3. An introduction to Modern Astrophysics, Bradley W. Carroll & Dale A. Ostlie. (PearsonInternational Edition).