



### List of New 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.	PRE-Ph.D./Phy/p-3	III A: Advanced Materials
02.	PRE-Ph.D./Phy/p-3	III B: Spectroscopic Techniques
03.	PRE-Ph.D./Phy/p-3	III C: Advances in Plasma Physics
04.	PRE-Ph.D./Phy/p-3	III D: Advance Nuclear Physics
05.	PRE-Ph.D./Phy/p-3	III E: Advanced Astronomy and Astrophysics



## 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 M. Sc. (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 new courses were introduced in the Pre Ph.D. (Physics):

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

Signature & Seal of HoD



## Scheme and Syllabus

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

Pre-PhD Course Work (Physics)

#### Examination Scheme

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



### 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. However, it is suitable also for graduates from other engineering and science backgrounds who wish to specialise in materials engineering.

#### 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, magnetic field 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, Applications of 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. Dielectrics and Waves, R. Von Hippel



4. Physics of Low dimensional semiconductors, J.H.Davies
5. Carbon Nanotubes, Dresselhaus M.S., Dresselhaus G. and Avouris P.
6. Carbon Nanomaterials, YuryGogotsi
7. Computational Chemistry, Lewars
8. 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 light and Raman Spectrum. rotational and vibrational Raman Spectra .Learn Electronic spectra of diatomic molecules Born-oppenheimer approximation . Make Students aware of the fine structure of ESR absorption, Hyperfine structure, Double resonance in ESR, Techniques of ESR spectroscopy.

#### Text and Reference Books

1. Modern Spectroscopy, 4<sup>th</sup> Edition , J.Michael Hollas , Wiley
2. Chemical Application of Group Theory , 3<sup>rd</sup> Edition By F.Albert Cotton , Willey
3. Introduction to Molecular Spectroscopy : By Goron M.Barrow , Mc Graw Hill New York
4. Handbook of Vibrational Spectroscopy , Vol0-I & II: By John M.Chalmers and Peter R.Griffiths,



Wiley

5. Condensed Matter Optical Spectroscopy : An illustrated Introduction by Luhan Ionita , CRC Press
6. Handbook of Raman Spectroscopy : From the Research laboratory to the process line : By Lan R. Lewis , Howell Edwards .CRC Press
7. Infrared and Raman Spectroscopy of Biological Materials : By Hans Ulkrich Grelich , Bing Yan CRC Press
8. Terahertz Spectroscopy : Principles and Applications , By Susan L.Dexheimer , CRC Press
9. NMR and Chemistry : An Introduction to modern NMR Spectroscopy , Fourth Edition By J.W. Akitt , B.E Mann , CRC Press
10. Laser Spectroscopy : Basic Concepts and Instrumentation 2<sup>nd</sup> Edition By Wolfgang Demtroder Springs

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**Paper III C (Optional)**  
**Advances in Plasma Physics**

**Unit-I: Fluid theorem in Plasmas:**

Single fluid and two fluid theorems', Magnetohydrodynamics(MHD) fluid theory, fast slow and intermediate MHD wave, Dissipation in MHD Fluid, collisionless anisotropic 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
- [5] P K Shukla and A A Mamun, Introduction to Dusty Plasma Physics, IOP
- [6] I P Goedbloed and S Poedts, Principle of Magnetohydrodynamics, Cambridge press
- [7] I D Landan and F M Lifshiz, Statistical Physics
- [8] S Chandrashekar, Hydrodynamics and Hydromagnetic stability, Claredon Press

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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. quasiparticles 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. Introductory Nuclear Physics, S.M. Wong
4. In Beam Gamma ray Spectroscopy, H. Morinaga
5. Advance in Nuclear Physics – Vol 10, Baranger, Michel, Vogt, Erich
6. Techniques for Nuclear and Particle Physics Experiments, William R. Leo
7. 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. Many courses contain research or hands-on components that develop skills and knowledge in the latest advances in astronomy and astrophysics. They also offer training in areas highly relevant outside of academia, e.g. project management, computer programming, and problem solving skills. 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: UVB 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 and Analysis - 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. (Pearson International Edition).
  4. Astronomical Photometry: Henden A. A. and Kaitchuck R H (Willmann-Bell).
  5. Galactic Astronomy, Mihalas, D. and Binney, J. (W.H. Freeman & Co).
  6. Galactic Dynamics, Binney, J. and Tremaine, S. (Princeton University Press).
  7. An Introduction to Active Galactic Nuclei, Peterson B.M. (Cambridge University Press).
  8. Handbook of CCD Astronomy, Howell S.B. (Cambridge University Press).
  9. Handbook of X-ray Astronomy, K. Arnaud, R. Smith & A. Siemiginowska (Cambridge University Press).
  10. High Energy Astrophysics, M.S. Longair Cambridge University Press).
- Radiative Processes in Astrophysics, G.B. Rybicki & A.P. Lightman (Wiley-VCH)

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