SCHOOL OF STUDIES OF PHYSICAL SCIENCE
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A CENTRAL UNIVERSITY)

DEPARTMENT OF PURE AND APPLIED PHYSICS

Pre-Ph.D. (Physics & Electronics) Course structure

Academic year 2021 – 2022

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

Pre-PhD Course Work (Electronics)

Examination Scheme

Course Code	level	Course name	Credit	Remarks
	School level	Research Methodology& Computer Applications	04	Common to all
	Department level	Basic Electronic instrumentation & Electronic material characterization	04	Common to Physics Candidates
	Paper –III (Optional) Any one of the followings	III	04	Any course

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CBCS/LOCF-NEW, SYLLABUS

DEPARTMENT OF PURE AND APPLIED PHYSICS

Pre-Ph.D. (Physics & Electronics) Course structure under CBCS/LOCF
Academic year 2021 – 2022

Programme Outcomes: Ph.D. Scholars' will be able to:

PO1: Knowledge: To get basic in-depth understanding of a Physics and its related sub-theme and accomplish specialization in specific area of Physics

PO2: Strategies: Enable the students to identifying research areas, planning and execute research strategies, authentication, analyse & interpret scientific data/result

PO3: Development: Develop theoretical models, and validate it with experimental result and re-standardize the scientific data/ results that advance the specific field internationally and publish the data in appropriate form

PO4: Ethics: Get hands-on training on professional ethics and plagiarism related issues and inculcate fair practices in scientific research work.

PO5: Scientific training: Train manpower for advanced research work in the thrust areas of Physics that can be used for the development and improvement in existing technologies and to integrate with the world wide scientific communities

PO6: Tools & Technique: Use the latest protocol to obtain & validate data or results, and analyse them using most advanced CAD tools, interpret the results and corroborate the core idea behind the research undertaken

PO7: Scientific Communication: Imbibe effective scientific proficiency in oral and written communication skills by presenting scientific term papers and writing project reports and learn to collaborate to maximise the scientific outcome

PO8: Write & Defend: Write the Doctorate Thesis based on the details of the scientific research carried out and defend it in the evaluation by national and international experts

PO9: **Carrier:** To advance students research careers beyond doctoral degree and pursue careers in academics and industrial research

PO10: Society & Environment: Apply the knowledge to asses societal, health, safety, legal and cultural issues and understand the importance of environment for sustainable development.

PO11: Handling of Equipments: Handle equipments required for material preparation, characterization, interpretation of data with theoretical background and software.

PO12: Life-long Learning: Recognize and integrate life-long learning skills to become pro-active in personal and professional live

PO12: Standardization: standardize the scientific data/ results that advance the specific field internationally and publish the data in national &international Journals/Books/Magazine etc.

Programme Specific Outcomes:

PSO1: Researchers will get the training, skills and exposure in advanced experimental techniques to synthesize, characterize and modify the materials as per the need of the society/industries required to develop devices for technological advancement relevant to thrust areas of physics through advanced pre Ph.D. course work, seminar presentation, problems identification, synopsis writing, and methods optimization. As well as critically analyse results and discuss their scientific problem with researchers towards development of theoretical models.

PSO2: Present the results in-house seminars and give talks at national and international seminars/ conferences and publish scientific papers in peer reviewed journals and ultimately write and defend their PhD thesis as well as to work in a lab of national and international repute.

PSO3: Get hands-on training on issues related to professional ethics and plagiarism and inculcate fair practices in the field of scientific research and to learn to do an independent research program and lead labs in the future, and become experts in their chosen area of research.

PSO4: Develop specialization in a particular area of physics research and acquire an overall idea of the ongoing scientific research in and outside the country and to quantitatively solve a problem.

PSO5: Gain an in-depth understanding by revision of various sub branches of physics via coursework. Develop the skill of oral or written communication in terms of assignment or group/single presentations and analytical skills through problem-solving, take-home assignments and term papers during the coursework.

Syllabus

Paper I

Research Methodology & Computer applications

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: Research methodology

Definition of Research, Components of Research Problem, Various Steps in Scientific Research : Hypotheses, Research Purposes, Research Design, Literature searching Literature Survey, defining the question and formulating hypothesis/ hypothesizes, Collection of research data, tabulating and cataloging.Sampling and methods of data analysis.

Unit 2: Errors in measurements and statistical methods:

Types of errors; mean deviation, standard deviation and probable errors; propagation of errors with summation, difference, product and quotient Probability Theories - Conditional Probability, Poisson Distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi-Square Test, Association of Attributes - t-Test - Standard deviation - Co-efficient of variations. Correlation and Regression Analysis, plotting of graphs.

Unit3: Laboratory practices and safety guidelines:

Safe working procedure and protective environment, Laboratory safety measures, Handling radiation, Chemical hazards and their types, Safe chemical use, Proper storage and disposal of hazardous materials, Bio-hazardous and other toxic experimental materials, Maintenance of equipment.

Unit 4: Computer applications in scientific writing skills

Applications of Microsoft Excel, power point and origin for data processing and data analysis, research paper – presentation using power point (which include texts, graphs, pictures, tables, references etc.) (oral in power point/poster);

Curve fitting, Method of least square fit, least square fit (straight line) to linear equations and equation reducible to linear equations. Non-linear curve fitting, back ground correction and mathematical manipulation in data using origin.

Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing manuscript in Latex,

Steps to better writing,

Unit 5: Ethics in Science:

The source of ethical issues in science: examples from different disciplines. 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.

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).
6. “A Students's Guide to Methodology” by Peter Clough and Cathy Nutbrown, (Sage Publications).

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	-	1	1	1	2	-	-	2	-	2	2	1	1	3	2
CO2	2	3	2	2	-	2	2	1	-	2	1	3	2	3	2	3	3
CO3	1	2	3	1	2	3	-	-	1	2	2	2	3	1	2	2	1
CO4	1	3	2	2	3	2	3	-	2	-	2	2	3	1	3	3	-

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Paper II

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

Quantum confinement and surface effect, 2-D, 1-D and 0-D Nano systems, Quantum dots and 1-D nanostructures, Nanocomposites of inorganic and organic systems, Self assembly hierarchic structures and advanced functional materials for applications in energy harvesting, , catalysis, sensors etc.

UNIT IV Ion beam Technology, Accelerators in Science & Technology, Ion beam irradiation and ion implantation in physics research especially in materials science, nuclear physics and plasma physics. Basics of nuclear techniques for ion beam analysis.

UNIT V The electron gas without interaction; Electrons in a periodic potential., The interacting electron gas; The Hartree-Fock approximation; Quasielectrons, plasmons; The Dielectric constant of the electron gas, Ion-ion interactions; Phonons; Spin-spin interactions; Magnons; Diamagnetism; Paramagnetism.

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. Studying the vacuum techniques and the vacuum systems students get their knowledge in that type of systems. Learning magnetic sensors, magneto resistance hall effect sensors students get knowledge about modern day techniques in Physics.

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. Solid State Physics; N. W. Ashcroft and N. D. Mermin.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	3	-	-	2	3	3	-	3	-	1	3	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

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. Physics of Low dimensional semiconductors, J.H.Davies
2. Carbon Nanotubes, Dresselhaus M.S., Dresselhaus G. and Avouris P.
3. Carbon Nanomaterails, YuryGogotsi
4. Computational Chemisty, Lewars
5. Density Functional Theory: A practical approach, David S. Sholl, Janice A. Steckel

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	-	1	2	-	-	-	2	-	3	2	-	-	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

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 absorption spectroscopy, 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, 4th Edition , J.Michael Hollas , Wiley
2. Chemical Application of Group Theory , 3rd Edition By F.Albert Cotton , Willey
3. Introduction to Molecular Spectroscopy : By Goron M.Barrow , Mc Grraw Hill New York

Course Outcomes and their mapping with Programme Outcomes:

	PO												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	-	-	1	3	-	-	-	2	2	3	2	-	1	2	2

2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

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

[5] P K Shukla and A A Mamun, Introduction to Dusty Plasma Physics, IOP

[6] S Chandrashekhar, Hydrodynamics and Hydromagnetic stability, Claredon Press

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	O1	O2	O3
1															
2															
3															
4															
5															

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

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. Introductory Nuclear Physics, S.M. Wong
4. Techniques for Nuclear and Particle Physics Experiments, William R. Leo
5. Radiation Detection and Measurement, G.F.Knol

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	-	2	2	-	-	2	2	2	3	2	-	2	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

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.

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 modelsfor 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 toa 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).
11. Radiative Processes in Astrophysics, G.B. Rybicki & A.P. Lightman (Wiley-VCH)

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	-	2	2	-	-	2	2	2	3	2	-	2	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Pre- Ph.D. Course work (Electronics)

Paper – II:

Basic Electronic instrumentation and electronic material characterization

Objective- This course will introduce the students to the recent trends in various domains of Electronics Engineering. By the end of the course, the student will be able to decide the major research area of his/her interest.

Unit I (RKP)

Semiconductor devices, diodes, junctions, transistors, field effect devices, homo and heterojunction devices, Optoelectronic devices including solar cells, photodetectors, and LEDs; High frequency devices

Unit II (PKB)

Operational amplifiers and their applications, Analog signal processing, Digital logic levels, Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Interfacing using IEE488 bus.

Unit III (SPP)

Vacuum techniques, Vacuum pumps (Rotary, Diffussion pumps, Turbo molecular pump), Vacuum gauges, Thin Film and Thick Film synthesis: Physical methods (Vacuum evaporation, sputtering (D.C. & RF), PLD, etc.),film thickness measurements

Unit IV

Transducers, transducer characteristics, selection of instrumentation transducers, transducer as an electrical element, Instrument probes, power measurements.

Unit V (TT)

Fluctuation and noise in measurement system, types of noise, noise in frequency domain, source of noise, signal to noise ratio and experimental design, signal to noise enhancement, digital correlation and autocorrelation methods.

Outcomes - At the end of course the student will be able to • Design systems based on Embedded and VLSI. • Use alternative computational tools in the form of soft computing techniques. • Identify various modes of electronic and data communication

Reference Books:

1. Fundamentals of electronics, Malvino and Leach
2. Physics of Semiconducting devices, S.M.Sze
3. Measurement, Instrumentation and Experiment design in Physics and Engineering, MichealSayer and Abhai Man Singh

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	-	1	3	-	-	1	3	1	2	2	-	2	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Pre- Ph.D. Course work (Electronics)

Paper III:

Electronic materials and devices

Objective - The course is designed to teach the physics behind electronic device operations and also prepare students for advanced courses in solid state and quantum electronics. The main emphasis is on the fundamental physics behind device operation. Topics include the background physics and the basic principles of electronic device operation with emphasis on bipolar transistors, and unipolar microwave devices.

Unit I (HST)

Linear and non linear dielectric materials, Ferroelectric, piezoelectric and electro-optic materials, composite materials, Liquid crystals, quasi-crystalline materials, hydride materials,

Unit II (PD)

Functional materials for device fabrication, sensor materials, shape memory alloys, hydrogen storage materials, solar cell fabrication and photovoltaic materials.

Unit III (TGR)

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

Unit IV (TGR)

Lithographic processes: Various types of lithographic processes, Photolithography, Electron beam lithography, Ion beam lithography, and advances in the field. Photoresists, Sensors fabrication, and FET fabrication.

Unit V

Nano machines and nano devices: Micro electromechanical systems, Nano electromechanical systems NEMS's, Carbon nanostructures, Carbon nanotube, Graphene and applications.

Outocmes -Students completing the course will be able to: (1) Calculate the electrical conductivity from the charge density and mobility (2) Calculate the charge density from the Hall coefficient (3) Calculate the plasma frequency from the charge density (4) Calculate the effective mass from the cyclotron frequency (5) Sketch the black-body radiation intensity as a function of frequency at a fixed temperature

Reference Books

1. Dielectric relaxation in solids, A.K.Jonscher
2. Dielectrics and Waves, R. Von Hippel
3. Physics of Low dimensional semiconductors, J.H.Davies
4. Carbon Nanotubes, Dresselhaus M.S., Dresselhaus G. and Avouris P.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	-	2	1	1	-	2	2	2	2	1	-	1	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly