List of Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework

Department : *Pure and Applied Physics*

Programme Name : *B.Sc. Electronics*

Academic Year : 2022-23

Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework:

Sr. No.	Course Code	Name of the Course
01.	AECPL01	Electronics in daily life
02.	SECPL02	Simulation and Design of Digital Circuit Components

Scheme and Syllabus

Sem	Course	Course Code	Course Name	Credits	Credits (T+L+P)	Internal Marks/	ESE Max. Marks	Total Marks
I	Core 1	PLUATT1	Mathematical Foundation for Electronics	5	4+1+0	30	70	100
	Core 2	PLUATT2	Basic Circuit Theory and Network Analysis	3	3+0+0	30	70	100
		PLUALT2	Basic Circuit Theory and Network Analysis Lab	2	0+0+2	30	70	100
	GE-1		Opted from the pool course and offered by sister Departments	5		30	70	100
	AEC-1		Opted from the pool course and offered by University	2		30	70	100
	SEC-1		Opted from the pool course and offered by University	2		30	70	100
	Total			**19**				**600**
II	Core 3	PLUBTT1	Semiconductor Devices	3	3+0+0	30	70	100
		PLUBLT1	Semiconductor Devices Lab	2	0+0+2	30	70	100
	Core 4	PLUBTT2	Applied Physics	3	3+0+0	30	70	100
		PLUBLT2	Applied Physics Lab	2	0+0+2	30	70	100
	GE-2		Opted from the pool course and offered by sister Departments	5		30	70	100
	AEC-2		Opted from the pool course and offered by University	2		30	70	100
	SEC 2		Opted from the pool course and offered by University	2		30	70	100
	Total			**19**				**700**
Ability Enhancement Course (AEC) offered by Department								
1	AEC	AECPL01	Electronics in daily life	2	2+0+0	30	70	100
2	AEC	AECPL02	Organic Electronics	2	2+0+0	30	70	100
Skill Enhancement Courseoffered by Department								
1	SEC	SECPL01	Network Circuit Analysis	2	1+0+1	30	70	100
2	SEC	SECPL02	Simulation and Design of Digital Circuit Components	2	1+0+1	30	70	100

AEC - 1: Electronics in daily life
Course Code: AECPL01 **Credits = 2 (2+0+0)**

Unit – I: History of Electronics: The vacuum tube era, The semiconductor revolution, Integrated circuits, Compound Semiconductor, Digital electronics Materials, Optoelectronics, Superconducting electronics, Flat-panel displays

Unit – II: Different Electronic Components / Semiconductor Components, Passive Components-Resistors: specifications and colour coding. Capacitors: Principle, specifications and colour coding. Inductors: Principle, specifications and classification, Battery, Battery holders and connectors ,Fuses ,Transistors, Oscillation, thyristors ,Light-emitting diodes (LEDs) AC fundamentals: Generation of alternating voltages, Basic electronic functions Rectification, Amplification Using n-p-n transistor, Multimeters, MOSFETs.

Unit – III: Application of Electronics: Consumer Electronics Office Gadgets like calculators, Personal computers, Digital Camera, FAX machines, Printers, Scanners, Front Projector, etc. Home appliances Robot Vacuum Cleaner, Electric Deep Fryer Refrigerator, AC, Coffee Maker Machine, Hair dryer Water Purifier/Dispenser, Storage Devices Advanced Consumer Electronic Devices: Smart Phones, iPod and Tablets, Wi-Fi and the Internet, barcode scanners, ATM, Dishwasher and POS terminals. Medical Electronics: Stethoscope, Respiration Monitors Glucose meter, The Pacemaker, MRI, CT scan

Unit – IV: Industrial and Automotive Electronics: Power Windows, Electronic Control Unit (ECU),Airbag control , all vehicles etc. Meteorological and Oceanographic Electronics: Barometer: .Anemometer: Anemometer Hygrometer ,Data logger Smart Grid Systems Image Processing, Entertainment and Communication Electronics:Smart TVs, Set Top Boxes, Speakers , receivers etc. Defence Application: RADAR technology, Electronic Warfare Systems, Military electronic equipments etc.

Reference Books:

1. Getting Started in Electronics by Forrest, M.Mims, Master Publishing, Inc

2. Make Electronics – Learning by Discovery by Charles Platt ,Maker Media Publishers

3. Practical Electronics for Inventors , Paul Scherz, McGraw-Hill Education

4. Everyday Electronics and You: A Guide to Maintaining and Getting the Best Out of Your

Everyday Electronics Devon A. Smith Kindle Edition ,

SEC - 1: Simulation and Design of Digital Circuit Components

Course Code: SECPL02 **Credits = 1 (1+0+0)**

Course Objectives

 To acquaint students with various basic digital gates used in digital system and develop logical circuits using Boolean gates, construction of various logic circuits using basic gates.

 To impart practical working knowledge of Simulation and Analysis of digital circuits using MATLAB and/or SCILAB.

Learning Outcomes:

On successful Completion of the course, students will be able to:

 Understand the main features and importance of the MATLAB/SCI LAB mathematical programming environment.

 Apply working knowledge of MATLAB/SCI LAB package to simulate and solve Digital Electronics circuits and Applications.

Basics of the circuit components

Basics of Voltage, Current, Resistance and Power, Ohm's law, Series and parallel combinations of electrical components.Basics of electrical instruments such as multimeter, voltmeter and ammeter.

Basics and Applications of the MATLAB

Fundamentals of the MATLAB software. Logic Circuits,Equivalent circuits of an NOT Gate, Exclusive OR Gate, , NOR Gate as Universal Gate, NAND Gate, NAND Gate as Universal Gate, NOR Gate,Half Adder, Full Adder, Half Adder using NAND Gate, Full Adder using NAND Gate, Comparator.

Reference Books:

1. Electrical Circuits, K.A. Smith and R.E. Alley

2. Modern Digital Electronics by R.P. Jain

3. Digital Electronics by Malvino and Leech

4. Digital Signal Processing with Examples in MATLAB by Samuel D. Strearns and Don R. Hush

List of Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework

Department : *Pure and Applied Physics*

Programme Name : *B.Sc. Physics*

Academic Year : 2022-23

Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework:

Sr. No.	Course Code	Name of the Course
01.	AECPP01	Indian Contribution to Physics
02.	SECPP01	Analytical Techniques in Physics
03.	AECPP02	Physics for Sustainable Future
4	SECPP02	Renewable Energy and Energy Harvesting

Scheme and Syllabus

Sem.	Course	Course Code	Course Name	Credits	Credits (L+T+P)	Internal Marks/	ESE Max. Marks	Total Marks
I	Core 1	PPUATT1	Mathematical Physics-I	5	4+1+0	30	70	100
		PPUATT2	Mechanics	3	3+0+0	30	70	100
	Core 2	PPUALT2	Mechanics Lab	2	0+0+2	30	70	100
	GE-1		Opted from the pool Course and offered by Sister Departments	5		30	70	100
	AEC-1		Opted from the Pool Course offered by University	2		30	70	100
	SEC-1		Opted from the Pool Course offered by University	2		30	70	100
			Total	**19**				**600**
II	Core 3	PPUBTT1	Electricity and Magnetism	3	3+0+0	30	70	100
		PPUBLT1	Electricity and Magnetism Lab	2	0+0+2	30	70	100
	Core 4	PPUBTT2	Waves and Optics	3	3+0+0	30	70	100
		PPUBLT2	Waves and Optics Lab	2	0+0+2	30	70	100
	GE-2		Opted from the pool Course and offered by Sister Departments	5		30	70	100
	AEC-2		Opted from the Pool Course offered by University	2		30	70	100
	SEC 2		Opted from the Pool Course offered by University	2		30	70	100
			Total	**19**				**600**
Ability Enhancement Course (AEC) offered by Department								
1	AEC	AECPP01	Indian Contribution to Physics	2	2+0+0	30	70	100
2	AEC	AECPP02	Physics for Sustainable Future	2	2+0+0	30	70	100
Skill Enhancement Course offered by Department								
1	SEC	SECPP01	Analytical Techniques in Physics	2	1+0+1	30	70	100
2	SEC	SECPP02	Renewable Energy and Energy harvesting	2	1+0+1	30	70	100

AEC -1: Indian Contribution to Physics
Course Code: AECPP01 **Credits = 2 (2+0+0)**

Course Objectives

- This course would empower the student to understand the ancient contribution of India towards Classical Physics.
- It will also enable the students to analysis Vaiseshika Darshan originated by Kanada with the
- principles of Classical Physics.
- The students will also be able to understand the great contribution of Indian Physicists towards the growth of Science and Technology

Learning Outcomes

- Upon successful completion of this course, students will be able to understand understand the
- ancient contribution of India towards Classical Physics.
- It will also enable the students to analysis Vaiseshika Darshan given by Kanada with the principles of Classical Physics.
- The students will also be able to understand the great contribution of Indian Physicists towards the growth of Science and Technology

Unit -1

- Need to understand the ancient contribution of India towards Classical Physics.
- Devlopment of Classical Physics in Western civilization, Ancient Engineering, temples, Dam,
- Monastery etc.
- Basic framework of Classical Physics of ancient indian origin.
- vaisheshika darshan- introductioncommentries on important vaisheshika sutras
- Dharma of physical world, Kanada atomic theory of universe, importance of ancient thoughts in this context.

Unit -2

Contributions of contemporary indian physicists towards the growth of science and technology:

a) Dr. C.V. Raman (1888-1970), and discovery of Raman effect.

b) Satyendranath Bose (1894-1974), Bose-Einstein condensate.

c) Dr. Chandrashekhar (1910-1995) and Chandrashekhar limit in Astrology.

d) Dr. Meghnad Saha (1893-1956) and Saha Ionization equation.

e) Dr. H.J.Bhabha (1909-1966)

f) Vikram Sarabhai (1919-1971)

g) G.N. Ramachandran (1922-2001)

h) Jayant Narlikar (1938)

SEC -1: Analytical Techniques in Physics

Course Code: SECPP01 **Credits = 1 (1+0+0)**

Course Objective

 The course focuses on the properties, functions of the internal structure, and arrangement of atoms in a crystalline material. It offers an insight into how x-ray diffraction, can solve crystallographic issues related to single and poly-crystalline material, right from the base. This course will also cover the basic principles and techniques of scanning electron microscopy and Atomic Force microscopies along with demonstrations on the instrument details and imaging experiments. The sample preparation techniques for the microstructural analysis and surface Morphology analysis will be discussed. Structural studies by Fourier transform IR (FTIR) and Raman spectroscopies will be discussed.

Course learning outcomes:

 Students will have achieved the ability to: 1. apply appropriate characterization techniques for microstructure examination at different magnification level and use them to understand the microstructure of various materials 3. Determine crystal structure of specimen and estimate its crystallite size by X-ray Diffraction technique 4. Use appropriate spectroscopic technique to measure vibrational / electronic transitions.

Unit – I: Structure and Microstructure analysis by X-ray and electron diffraction: The geometry of crystals and reciprocal lattice, Basics of x-rays and their production and detection, X-ray diffraction, Determination of crystal structure: Qualitative and quantitative analysis, Particle size determination by x-rays, X-rays and stress analysis,

Unit – II: Scanning electron microscopy techniques and Composition analysis by Energy dispersive X-ray (EDX): Introduction to Scanning electron microscopy, Basic principles and components, Different examination modes (Bright field illumination, Oblique illumination, Dark field illumination, Phase contrast,Instrumental details and image formation, Energy-dispersive x-ray spectroscopy (paired with scanning electron microscopy) analysis to gain elemental information about samples.

Unit – III: Structural studies by Fourier transform IR (FTIR) and Raman spectroscopies:

Basics of Fourier Transform Infrared (FT-IR) spectrometry,Different regions in infrared radiations, Modes of vibrations in diatomic molecule. characteristic absorption bands, Instrumental details, Qualitative treatment of Rotational Raman effect, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, Instrumental details& data accusation process.

Unit – IV: Ultra-violet and Visible Absorption Spectroscopy: Principle of UV Spectroscopy, Beer's Law and Quantitation, Deviations and limitations to Beer's Law, Instrumentation for UV-VIS spectroscopy i) Components and design ii) Actual commercial instruments, Methods and applications of absorption spectroscopy

Reference Books:

1. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press, (2008).

2. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001).

3. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Liss, Inc. **USA, (2001).**

AEC -1: Physics for Sustainable Future

Course Code: AECPP02 **Credits = 2 (2+0+0)**

Course Objectives

 The students will explore the physics of energy, learning to calculate the energy content of a wide variety of systems such as speeding cars, toasty houses and hot tubs, wind, solar illumination, nuclear powerplants

 To study the basic concepts to the various energy production schemes and usages found in our lives.

 This course is meant to provide a scientific foundation for understanding the energy issues facing our country and world so that students will be able to make informed decisions regarding and participate in the ongoing debate surrounding this important global issue.

 The course goals are for each student to learn how to understand and analyze issues related to energy production and usage and its influence on the environment around us (both local and global).

Learning Outcome:

By the end of the course, the student will be able to:

 Discuss the side–effects of energy production and use, and estimate energy content and conversion.

 Explain the physical concept of energy and identify it in the world around us.

 Analyze the energy usage in our lives and be well informed on the topic of energy, its use in our society, and the impacton our environment.

 Participate in the ongoing global debate and make smart decisions.

Unit – I: Fundamental laws of Nature

Basic laws of Nature that govern all energy transformations like: statisticsand data, the second law of thermodynamics, exponential grow depletion time of a non–renewable resource, principles of relativity and anti–matter.

Unit – II: Need of energy and power losses

Power transmission and power loss.The status and current developments of energy in third–world countries.Power requirements and basics of related terminologies.

Unit – III: Nuclear Energy

Radiation and human health, radioactive wastes, history and future of nuclear power technologies, nuclear fuel resources, processing, use, and disposal. Fission and fusion power, three key issues related to reprocessing, storage and disposal.

Unit – IV: Renewable Energy

Types of renewable energies. Fundamentals of solar and wind energies and their environmental advantages/disadvantages. General characteristics of passive and active solar thermal energy, power generation with thermal solar energy, and solar photovoltaic systems. Wind tower and turbine design and their sustainability attributes.

Books Recommended:

1. University Physics with Modern Physics, Fourtheenth Edition, By Pearson.

2. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.

3. Sustainable Energy Si Edition by Dunlap R A, Cengage Learning.

SEC : Renewable Energy and Energy Harvesting

Course Code: SECPP02 **Credits = 2 (2+0+0)**

Course Outcomes:

 To understand the Energy policies and to know some of the renewable energy sources such as solar energy, off-shore wind energy, tidal energy, biogas energy and hydroelectricity.

 Illustrate Photovoltaic conversion mechanism.

 Appraise wind energy conversion and ocean energy

 Conversion of vibration into voltage using piezoelectric materials,

 Conversion of thermal energy into voltage using thermoelectric modules.

 The students are expected to learn not only the theories of the renewable sources of energy, but also to have hands-on experiences on them wherever possible.

Unit – I: Introduction to Energy Policy:

Overview of world energy scenario; Energy Demand- present and future energy requirements; Review of conventional energy resources, Global warming; Green House Gas emissions, impacts, mitigation; sustainability; Clean Development Mechanism (CDM); Prototype Carbon Fund (PCF). Need and characteristics of photovoltaic (PV) systems, PV modules and sun tracking systems

Unit – II: Renewable Energy Sources & Instruments: Solar, wind, small hydro, biomass, geothermal and ocean energy, energy flow in ecosystem, Solar Energy Resources, Solar radiation: Spectrum of EM radiation, sun structure and characteristics. Sunshine recorder, Pyranometer, Pyrheliometer, Albedometer, Radiation measurement stations, solar radiation data.

Unit – III: Photovoltaic Materials and Devices:

Bulk and thin film forms of materials, single crystal and polycrystalline, amorphous and nanocrystalline semiconductor materials, Intrinsic, extrinsic and compound semiconductor, Electrical and optical properties of photovoltaic / semiconductor materials, p-n junction: homo and hetero junctions; solar cell design, Dark and illumination characteristics; Principle of photovoltaic conversion of solar energy, various parameters of solar cell.

Unit – IV: Solar Thermal Conversion:

Solar radiation, its measurements and prediction; Solar thermal collectors- flat plate collectors, concentrating collectors; solar heating of buildings; solar still; solar water heaters; solar driers; conversion of heat energy in to mechanical energy, solar thermal power generation systems. Introduction to Geothermal Energy, Hydro Energy and Piezoelectric Energy harvesting.

Reference Books

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi

2. Solar energy - M P Agarwal - S Chand and Co. Ltd.

3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.

4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford

List of Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework

Department : *Pure and Applied Physics*

Programme Name : *M.Sc. Electronics*

Academic Year : 2022-23

Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework:

Sr. No.	Course Code	Name of the Course
01.	OPNPET1	Applications of Nanotechnology in Electronics

Scheme and Syllabus

Sem	Course Opted	Course Code	Name of the course	Credit	L:T:P	Internal	External	Total
I	Core-1	PEPATT1	Mathematical Techniques for Electronics	5	4+1+0	30	70	100
	Core -2	PEPATT2	Semiconductors Materials & Devices	3	3+0+0	30	70	100
		PEPALT2	Semiconductors Materials & Devices Lab	2	0+0+2	30	70	100
	Core -3	PEPATT3	Analog and Digital Electronics	3	3+0+0	30	70	100
		PPPALT3	Analog and Digital Electronics Lab	2	0+0+2	30	70	100
	Open Elective		Opted from the pool and offered by other departments	5	5+0+0	30	70	100
	Other if any*							
			TOTAL	**20**				**600**
		Open Elective offered by the Department						
	Open Elective	OPNPET1	Applications of Nanotechnology in Electronics	3	3+0+0	30	70	100
		OPNPEL1	Applications of Nanotechnology in Electronics Lab	2	0+0+2	30	70	100
II	Core-4	PEPBTT1	Electromagnetic theory and Wave Propagation	5	4+1+0	30	70	100
	Core -5	PEPBTT2	IC Fabrication and VLSI Technology	5	4+1+0	30	70	100
	Core -6	PEPBTT3	Microprocessors and Microcontrollers	3	3+0+0	30	70	100
		PEPBLT3	Microprocessors and Microcontrollers Lab	2	0+0+2	30	70	100
	Discipline Specific Elective 1	PEPBTD1	Advanced Communication System-1	3	3+0+0	30	70	100
		PEPBLD1	Analog and Digital Communication System Lab	2	0+0+2	30	70	100
	Other if any*							
			TOTAL	**20**				**900**

Open Elective: Applications of Nanotechnology in Electronics
Course Code: OPNPET1 **Credits = 3 (3+0+0)**

Course Objectives

- Foundation knowledge of the nanoscience field
- To bring out the distinct properties such as electronic, optical properties of nanostructures
- To make the students acquire an understanding the nanomaterials and their applications

Learning Outcomes

Upon successful completion of this course, students will be able to address following points:

- Learn about the distinct properties of nanomaterials
- Understand the principles of nanomaterial characterization techniques
- Describe the principle and operation of nanomaterial-based devices

Unit – I: Definition of Nano-science and nano technology, History of nanoscience, Energy band-gap in semiconductors, Fermi level, Donors, acceptors and deep traps, Excitons, Mobility, Conduction electrons, density of states, Zero dimensional (0D), one dimensional (1D) , two dimensional (2D) , three dimensional (3D), Nano-structured materials, Influence of nano over micro/macro.

Unit – II: Properties of Nanomaterials: Size dependence of properties, Optical: Absorption, transmission, Photoluminiscence, Fluoroscence, Phosphorescence, Surface Plasmon Resonance, effect of size of nano particles. Electrical: Conduction mechanisms in 3D (Bulk), 2D (Thin film) and Low dimensional systems.

Unit – III: Type of Nanomaterials: different type of nano materials,Carbon nanotube, Fullerene, Type of CNT: SWNT (Single wall nano tube), Multi wall nano tubes, Graphite and Graphene, metal nano particle silver and gold, ZnO and TiO2 metal oxides, Semiconductors, Nano-composites,Creating nanoparticles by using software.

Unit – IV: Synthesis of nanomaterials: Combustion method, Sol-gel method, Co-precipitation method. Characterization tools for nanomaterials: X-Ray Diffraction, UV-VIS Spectrophotometer, Spectrofluorophotometer, Scanning Electron Microscopy, Transmission Electron Microscopy.

Reference Books:

1. Introduction to Nanotechnology, Charles P. Poole, Jr., Frank J. Owens, Wiley India (P)Limited New Delhi.

2. Nanoscience and Nanotechnology, K.K. Chattopadhyay, A.N. Banerjee, PHI Learning Private Limited, New Delhi.

3. Understanding of Nano Science and Technology, PoorviDutta, Sushmita Gupta, Global Vision Publishing House, New Delhi.

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List of Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework

Department : *Pure and Applied Physics*

Programme Name : *B.Sc. Physics*

Academic Year : 2022-23

Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework:

Sr. No.	Course Code	Name of the Course
01.	OPNPPT1	Nanomaterials and its Applications

Scheme and Syllabus

Sem	Course Opted	Course Code	Name of the course	Credit	L:T:P	Internal	External	Total
I	Core-1	PPPATT1	Classical Mechanics	5	4+1+0	30	70	100
	Core -2	PPPATT2	Quantum Mechanics	4	3+1+0	30	70	100
		PPPALT2	Quantum Mechanics Lab	1	0+0+1	30	70	100
	Core -3	PPPATT3	Electronic and Experimental Methods	3	3+0+0	30	70	100
		PPPALT3	Electronic and Experimental Methods Lab	2	0+0+2	30	70	100
	Open Elective		Opted from the pool and offered by other departments	5		30	70	100
	Other if any							
			TOTAL	**20**				**500**
		Open Elective offered by department						
	Open Elective	OPNPPT1	Nanomaterials and its Applications	3	3+0+0	30	70	100
		OPNPPL1	Nanomaterials and its Applications Lab	2	0+0+2	30	70	100
	Open Elective	OPNPPT2	Advanced characterization and computational techniques in Physics	3	3+0+0	30	70	100
		OPNPPL2	Advanced Characterization and Computational Techniques in Physics Lab	2	0+0+2	30	70	100
II	Core-4	PPPBTT1	Concepts of Mathematical Physics	5	4+1+0	30	70	100
	Core -5	PPPBTT2	Advanced Quantum Mechanics	4	3+1+0	30	70	100
		PPPBLT2	Advanced Quantum Mechanics Lab	1	0+0+1	30	70	100
	Core -6	PPPBTT3	Statistical Mechanics	5	4+1+0	30	70	100
	Discipline Specific elective 1	PPPBTD1	Computational Physics and Programming	3	3+0+0	30	70	100
		PPPBLD1	Computational Physics and Programming Lab	2	0+0+2	30	70	100
	Other if any							
			TOTAL	**20**				**1000**

Open Elective: Nanomaterials and Its Applications
Course Code: OPNPPT1 **Credits = 3(3+0+0)**

Course Objectives:

The objective of the subject is that the student acquires knowledge

- To foundational knowledge of the Nanomaterials and related fields.
- To understand the influence of dimensionality of the object at nanoscale on their properties
- To make the students acquire an understanding the basic Nanoscience/Nanotechnology and their Applications .
- Students gain knowledge about the principles of various synthesis techniques**.**

Learning Outcomes:

After completing this course students will be able to:

- Learn about the background on Nanoscience
- Understand the various synthesis methods of Nanomaterials and their application and the impact of Nanomaterials on environment
- Apply their learned knowledge to develop new Nanomaterial's.

Unit – I: History of nano- materials, Ancient Indian Culture and Nanotechnology, Role of Feynman in development of Present Nano-sciences, what are Nanoscience and Nanotechnology?Atomic structure and atom size and their effects, Types of 1D, 2D, 3D Nano-structured materials, Influence of nano over micro/macro.

Unit – II: Properties of Nano materials: Physical, Magnetic, Optical, Thermal, Mechanical, Electrical for nano materials and Chemical Properties, Size effects, Surface Effects and Surface to Volume ratio.

Unit – III : Type of Nanomaterials: different type of nano materials,Carbon nanotube, Fullerene, Type of CNT: SWNT (Single wall nano tube), Multi wall nano tubes. 2D nano material, Graphite and Graphene, metal nano particle silver and gold, ZnO and TiO2 metal oxides, Semiconductors, Nanocomposites, Creating nanoparticles by using software.

Unit – IV: Synthesis of nano materials**:** Top- down or bottom up approach, Physical Methods, PLD, Sputtering, Thermal evaporation, Chemical Methods – CVD, Sol-gel, Hydrothermal, Biological Methods – Green Synthesis, mechanical milling, sputtering and microwave plasma, chemical reduction and oxidation, hydrothermal, micelles, sol-gel processes, photolysis, and metal organic chemical vapor deposition

Reference Books:

1. Introduction to Nano Science and Nano Technology – K.K. Chattopadhyay&AN Banerjee PHI Pvt. Ltd., 2009.
2. Nano technology: Principles and practices - Sulabha K. Kulkarni, Capital Publisher Co. ,2015.
3. Introduction to nano technology: Charles P. Poole, Jr. Frank J. Owen, Wiley, Interscience Pub., May, 2003.

4. Nanostructures &Nanomaterials Synthesis Properties & Applications. Guozhong Cao, Imperials C
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List of Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework

Department : *Pure and Applied Physics*

Programme Name : *Pre-PhD. Physics/Electronics*

Academic Year : 2022-23

Courses which focuses on Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework:

Sr. No.	Course Code	Name of the Course
01.	Paper-I	Research Methodology & Computer applications

Scheme and Syllabus

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 D: Advance Nuclear Physics III E: Advanced Astronomy and Astrophysics	04	Any course

Paper I
Research Methodology & Computer applications

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 equipments.

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

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).
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