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ताळगांव पठार
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(Accredited by NAAC)

GU/Acad –PG/BoS -NEP/2023/102/35 Date: 16.06.2023

**CIRCULAR**

The University has decided to implement the UGC Curriculum and Credit Framework for the Undergraduate Programme (CCFUP) of **Bachelor of Science in Physics/Bachelor of Science in Physics (Honours)** under the National Education Policy (NEP) 2020 from the Academic Year 2023-2024 onwards.

The approved Syllabus of Semesters I and II of the **Bachelor of Science in Physics/Bachelor of Science in Physics (Honours)** Programme is attached.

Principals of Affiliated Colleges offering the **Bachelor of Science in Physics/Bachelor of Science in Physics (Honours)** Programme are requested to take note of the above and bring the contents of this Circular to the notice of all concerned.

ASHWIN VYAS LAWANDE
ASHWIN VYAS LAWANDE
2023.06.16 13:29:51 +05'30'

(Ashwin Lawande)
Assistant Registrar – Academic-PG

To,

1. The Principals of Affiliated Colleges offering the Bachelor of Science in Physics**/**Bachelor of Science in Physics (Honours) Programme.

Copy to:

1. The Director, Directorate of Higher Education, Govt. of Goa
2. The Dean, School of Physical and Applied Sciences, Goa University.
3. The Vice-Deans, School of Physical and Applied Sciences, Goa University.
4. The Chairperson, BOS in Physics.
5. The Controller of Examinations, Goa University.
6. The Assistant Registrar, UG Examinations, Goa University.
7. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

**Goa University**

## Programme Structure for Semester I to VIII Under Graduate Programme - Physics

| Semester | Major -Core | Minor | MC | AEC | SEC | I | D | VAC | Total Credits | Exit |
|---|---|---|---|---|---|---|---|---|---|---|
| I | Major- 1 PHY-100 (Foundations of Physics) (3T+1P) | Minor -1 PHY-111 (Everyday Physics) (4T) | MC-1 PHY-131 History of Physics (3T) | | SEC-1 PHY-141 Basic Experimental Techniques (1T+2P) OR SEC-2 PHY-142 Photography (1T + 2P) | | | | 20 | |
| II | | | MC-2 PHY-132 Indian Contribution to Physics (3T) | | SEC-3 PHY-143 House Electrical Wiring (1T+2P) OR SEC-4 PHY-144 PCB Designing (1T + 2P) | | | | 20 | EXT-1 PHY-161 (4)* |
| III | Major- 2 PHY-200 (Mechanics, Sound and Properties of Matter) (3T+1P) Major- 3 PHY-201 | Minor -3 PHY-211 (Electrical Circuit Theory) (3T+1P) OR PHY-212 (Energy Physics) (4T) | MC-3 PHY-132 (Title ) (3T)** | | SEC-3 PHY-241 (Introduction to LaTeX and open source plotting software) (1T + 2P) OR | | | | 20 | |

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| | **(Heat and Thermodynamics) (3T+1P)** | | | | **PHY-242 (Physics using Mathematica)(1 T + 2P) OR PHY-243(Physics using Arduino)(1T + 2P)** | | | | | |
| **IV** | **Major-4 PHY-202 (Electricity and Magnetism) (3T+1P)**<br><br>**Major-5 PHY-203 (Optics and Modern Physics) (3T+1P)**<br><br>**Major-6 PHY-204 (Classical Mechanics) (3T+1P)**<br><br>**Major-7 PHY-205 (Mathematical Methods of Physics-I) (2T)** | **Minor-4 VET PHY-221 (Communication Physics) (3T+1P) OR PHY-222 (Environmental Physics) (4T)** | | | | | | | **20** | **EXT-1 PHY-162 (4)*** |
| **V** | **Major-8 PHY-300 (Electronics) (4T)** | **Minor-5 VET PHY-321 (Experimental** | | | | **Internship (2)** | | | **20** | |

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| | **Major- 9 PHY-301 (Atomic and Nuclear Physics) (4T)**<br><br>**Major- 10 PHY-302 (Physics Laboratory - I) (4P)**<br><br>**Major- 11 PHY-303 (Special Theory of Relativity) (2T)** | **Physics) (3T+1P) OR PHY-322 (Biomedical Instrumentation) (4T)** | | | | | | | | |
| **VI** | **Major-12 PHY-304 (Electromagnetic Theory) (4T)**<br><br>**Major- 13 PHY-305 (Quantum Mechanics - I) (4T)**<br><br>**Major- 14 PHY-306 (Physics Laboratory - II) (4P)** | **Minor-6 VET PHY-323 (Solid State Devices and Instrumentation) (3T+1P)** | | | | | | | **20** | |

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| | **Major- 15 PHY-307 (Project) (4P)** | | | | | | | | | |
| **VII** | **Major-16 PHY-400 (Mathematical Methods of Physics - II) (4T)**<br><br>**Major- 17 PHY-401 (Classical Mechanics-II) (4T)**<br><br>**Major- 18 PHY-402 (Electrodynamics) (4T)**<br><br>**Major- 19 PHY-403 (Physics Laboratory-III) (4P)** | **Minor -7 PHY-411 (Introduction to Biophysics) (4T) OR PHY-412 (Atomic Physics) (4T)** | | | | | | | **20** | |
| **VIII** | **Major-20 PHY-404 (Quantum Mechanics-II) (4T)**<br>**Major-21 PHY-405 (Statistical Mechanics) (4T)** | **Minor-8 PHY-413 (Introduction to Computational Physics) (4T) OR PHY-414 (Solid State Physics) (4T)** | | | | | | | **20** | |

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| | **Major- 22 PHY-406 (Nuclear Physics) (4T)**<br><br>**Major- 23 PHY-407 (Physics Laboratory-IV) (4P)** | | | | | | | | | |

*** List of Exit Courses along with the syllabus will be provided separately.**

**** Title of Courses will be provided separately.**

**Name of the Programme: B.Sc. Physics**
**Course Code: PHY-100**
**Title of the Course: Foundations of Physics**
**Number of Credits: 4**
**Effective from AY: 2023-24**

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| **Pre-requisites for the Course:** | Nil | |
| **Course Objectives:** | This course aims at providing the fundamental concepts of Physics and correlating them to solve the real-world problems. | |
| **Content:** | **Theory (3 Credits)**<br><br>**Mechanics:**<br>Standards and units, vectors: vector addition, vector subtraction, components of vector. Force, discussion of Newton's First law of motion, Newtons second law, mass and weight, Motion with constant acceleration, freely falling body, Frictional force: frictional force acting on a block moving on the flat surface and inclined surface, Newtons third law of motion, Newton's law of Gravitation.<br>Work and energy: work, work done by varying force, work and kinetic energy, gravitational potential energy, conservative and dissipative forces, impulse and momentum, Conservation of momentum. Collisions, moment or torque of force.<br>Rotation: Angular velocity, angular acceleration, moment of inertia, angular momentum, conservation of angular momentum.<br>Ref 5: 1.2, 1.5, 1.6, 2.2, 2.4, 2.5, 2.8, 3.5, 3.7, 4.2, 4.4, 4.5, 6.1,6.2, 6.3, 6.4, 6.6, 7.1,7.2, 7.3, 8.1, 9.2, 9.3, 9.6, 9.12, 9.13<br>**Properties of Matter:**<br>Elasticity: stress, strain, elasticity and plasticity, elastic modulus, the force constant.<br>Surface tension: Surface tension, surface energy, pressure difference across a surface film, contact angle and capillarity.<br>Viscosity: Equation of Continuity, Bernoulli's equation, Viscosity, Poiseuille's law, Stokes law, Reynolds number.<br>Ref 5: 10.1, 10.2, 10.3, 10.4, 10.5, 12.7, 12.8, 12.9, 13.2, 13.3, 13.5, 13.6, 13.7, 13.8<br>**Heat**<br>Concept of temperature, thermometers, defining of a temperature scale, The Celsius, Rankine and Fahrenheit scales, Thermal expansion, thermal stresses, heat transfer, Quantity of heat, heat capacity, experimental values of heat capacities, change of phase, conduction, convection, radiation, Stefan's Boltzmann law. | 9 hours<br><br>6 hours<br><br>5 hours |

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| | Ref 5: 14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 15.1, 15.2, 15.3, 15.4, 15.5, 16.1, 16.3, 16.4, 16.5 | |
| | **Light**<br>The nature of light, Sources of light, speed of light, electromagnetic spectrum, waves, wavefronts and rays, reflection and refraction, total internal reflection, Huygens' principle, dispersion.<br>Interference and coherent sources, interference fringe, Young's double slit experiment, interference in thin films -Newtons rings,<br>Diffraction: Fresnel diffraction, Fraunhofer diffraction by single slit, the plane diffraction grating. resolving power of an optical instrument.<br>Polarisation-Malus law, polarisers, Brewster's law, double refraction, optical activity.<br>Ref 5: 38.1 ,38.2, 38.3, 38.4, 38.5, 38.6, 38.7, 38.8, 38.9, 41.1, 41.2, 41.4, 41.7 ,41.8, 41.9, 41.11, 42.1, 42.2, 42.4, 42.9 | 7 hours |
| | **Sound and Acoustics**<br>Noises and Musical sounds, Loudness, how loudness is measured, Decibel, intensity of a sound.<br>Acoustics- acoustic powers of different sources of sound, pitch, quality of sound, architectural acoustics, reverberation, acoustical demands on an auditorium, reverberation time and absorption coefficient. Sabine's law<br>Ref 3: 11.1, 11.2, 11.3, 11.4, 11.6, 11.7, 11.8, 23.1, 23.2, 23.3, 23.4, 23.5 | 6 hours |
| | **Electrostatics and Magnetism**<br>Electric charge, Coulomb's law, conductors and insulators, electric field, electric field lines, Gauss's law, Electric field potential, current, resistance, electromotive force. magnetic field, magnetic field lines, magnetic dipoles, Electromagnetic induction, Faradays' law, Lenzs' law.<br>Ref 4: 22.2, 22.3, 22.4, 23.2, 23.3, 29.1, 29.2, 29.6, 29.9, 31.3, 31.4 | 7 hours |
| | **Modern physics:**<br>Dual nature of light, de Broglie waves, uncertainty principle. Bohr atom, Bohr's postulates.<br>Semiconductors: Intrinsic semiconductors, doping a semiconductor, p- type and n- type semiconductor, unbiased diode, depletion layer, Forward bias, and reverse bias.<br>Ref 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.7, 1.8, 2.4,3.1, 3.7,3.8,4.5,<br>Ref 2: 2.2, 2.4, 2.5,2.6,2.7, 2.8,2.9,2.10,2.11 | 5 hours |
| | **Practicals (1 Credit)**<br>**Minimum 10 experiments to be performed**<br>1. Introduction to measurement techniques: | 30 hours |

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| | a) Use of Vernier callipers<br>b) Use of micrometre screw gauge<br>2. Introduction to travelling microscope and finding diameter of capillary tube<br>3. Introduction to Spectrometer and finding angle of prism<br>4. Plotting of graph: slope and intercept for linear and non-linear curves.<br>5. Moment of Inertia of a flywheel<br>6. Youngs modulus by cantilever method<br>7. Surface tension by capillary rise<br>8. Viscosity by Stokes method<br>9. Determination of angle of minimum deviation and refractive index of prism<br>10. Newton's Ring<br>11. Verification of Stefan's law<br>12. Helmholtz's resonator<br>13. P-N junction diode characteristics<br>14. Determination of Dispersive power of prism<br>15. Linear expansion of solid | |
| **Pedagogy:** | Lectures/ tutorials or a combination of these and Laboratory Practicals. Sessions shall be interactive in nature to enable peer group learning. | |
| **References/ References and Readings** | Text Books for Theory<br>1. A. Beiser, Concepts of Modern Physics, 6th ed., McGraw-Hill, 2003<br>2. A. P. Malvino, Electronic Principles, 5th ed., Tata McGraw-Hill, 1996<br>3. D. R. Khanna and R. S. Bedi, A Textbook of Sound, Atma Ram and Sons, 1992<br>4. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics, Extended Fifth edition, Wiley publication,1987.<br>5. Fracis W. Sears and Mark W. Zemansky, Hugh D. Young, University Physics, 6th ed., Narosa Publishing House, 1997.<br>Other Reference Books<br>1. Jerry D. Wilson Physics a practical and conceptual approach, Second Edition, Saunders College Publications1986.<br>2. N. Subramanyam, Brij Lal, A textbook of Sound, Second Edition, Vikas Publishing House Pvt. Ltd., 2016.<br>3. P. G. Hewitt, Conceptual physics, 12th ed., Pearson, 2015.<br>Text Books for Practical<br>1. C. L. Arora, B.Sc. Practical Physics, S. Chand Publication, 2010<br>2. P. S. Bangui, V. V. Pathak, C. G. Patil, T. S. Y. Ram, N. C. Garach Handbook of Practical Physics, Sheth Publishers Pvt. Ltd. 1992 | |

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| **Course Outcomes:** | Student will be able to<br>1. Recall the fundamental concepts of Physics for critical thinking and problem solving.<br>2. Understand the fundamental concepts to comprehend the physical phenomena happening around us.<br>3. Apply fundamental concepts of Physics to solve these problems.<br>4. Analyse the concepts in different scenarios. | |

**Name of the Programme: B.Sc. Physics**
**Course Code: PHY-111**
**Title of the Course: Everyday Physics**
**Number of Credits: 4**
**Effective from AY: 2023-24**

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| **Pre-requisites for the Course:** | Nil | |
| **Course Objectives:** | This course aims to enhance the perception of physical concepts and develop deeper understanding of the world we interact with every day. | |
| **Content:** | **Exploring the laws of motion**<br>Newton's first law of Inertia, Net Force, the equilibrium rule, speed, velocity, Acceleration, how fast, friction, Mass and weight, Newtons second law of motion, when acceleration is g, when acceleration is less than g, Forces and interaction, Newtons third law of motion, Momentum, Impulse, Bouncing, conservation of momentum, collisions, work, Power, Potential, Kinetic energy, conservation of energy.<br>Ref. 1: 2.3, 2.4, 2.5, 3.2, 3.3, 3.4, 3.5, 4.2, 4.3, 4.4, 4.5, 4.6, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 6.5, 6.6, 7.1, 7.2, 7.3, 7.5.<br>**Physics of circular motion**<br>Circular Motion, Rotational inertia, Torque, Center of mass and center of gravity, Centripetal force, centripetal force, centrifugal force, Angular Momentum, conservation of angular momentum.<br>Ref. 1: 8.1, 8.2, 8.3, 8.4,8.5,8.6, 8.7, 8.8, 10.1.<br>**Wonders of gravitational force**<br>The universal law of gravity, the universal gravitational constant, Inverse square law, weight and weightlessness, ocean tides, black holes.<br>Ref.1: 9.1, 9.2, 9.3, 9.4, 9.5, 9.7<br>**Understanding Matter from solid to plasma**<br>Solids: Density, Elasticity, tension and compression, Scaling. Liquids: Pressure, Buoyancy, Flotation, Archimedes principle, what makes object sink and float, Surface tension, Capillarity, Gases: The Atmosphere**,** atmospheric pressure, Barometers, Bernoulli's Principal, Plasma.<br>Ref. 1: 12.2, 12.3, 12.4, 12.6, 13.1, 13.3, 13.4, 13.5, 13.6, 13.8, 13.9, 14.1, 14.2, 14.5,14.6.<br>**Dynamics of heat**<br>Temperature, heat, specific heat Capacity, Thermal Expansion. Heat Transfer: Conduction, Convection and Radiation. Newtons law of cooling.<br>Ref. 1: 15.1, 15.2, 15.3, 15.5, 16.1, 16.2, 16.3. 16.4<br>**The wonders of sound** | 07 hours<br><br>06 hours<br><br>05 hours<br><br>06 hours<br><br>06 hours<br><br>07 hours |

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| | Wave motion, wave speed, wave interference, Doppler Effect, Sound in air, forced vibrations, resonance, interference, Beats, Music, Pitch, Sound intensity, Musical Instruments.<br>Ref. 1: 19.3, 19.4, 19.5, 19.6, 20.2, 20.5, 20.6, 20.7, 20.8, 21.1, 21.2, 21.3, 21.5<br>**Fun with Electricity and Magnetism**<br>Electricity: electric charges, Coulomb's law Conductors and Insulators, electric field, electric energy storage, voltage sources, electrical Resistance, direct and alternating current, Electric power, Lamps.<br>Magnetism: Magnetic poles, magnetic fields, Electric current and magnetic field, Electromagnets, Faraday's law, Electric Motors, Electric Generators, Power Production, Transformers.<br>Ref. 1. 22.1, 22.2, 22.4, 22.5, 22.8, 23.2, 23.3, 23.5, 23.7, 23.8 24.1, 24.2, 24.3, 24.5, 24.6, 24.7, 24.9, 25.2, 25.3, 25.4, 25.5.<br>**The Magic of Light**<br>Electromagnetic wave, Electromagnetic spectrum, transparent materials, opaque materials, shadows, Seeing Light, colour, selective reflection, selective transmission, mixing coloured light, natural phenomenon like why sky is blue? Why Sunsets Are Red? Why Clouds Are White? Why Water Is Greenish Blue? Reflection, Refraction, Dispersion and Rainbows, total internal reflection, Lenses and Mirrors.<br>Ref. 1: 26.1, 26.3, 26.4, 26.5, 26.6, 27.1, 27.2, 27.3, 27.4, 27.5, 27.6, 27.7, 27.8, 27.9, 28.1, 28.2, 28.3, 28.5, 28.6, 28.7,28.2.<br>**Unlocking secrets of an atom**<br>Quantization of energy, wave particle duality, complementarity, predictability and chaos.<br>Bohr Model of the atom, concept of electron waves, Schrodinger's wave equation.<br>X-ray and radioactivity, alpha, beta and gamma rays, environmental radiation, doses of radiation, radioactive traces, The atomic nucleus and the strong force, transmutation of elements, radioactive half-life.<br>Ref. 1: 31.2, 31.4, 31.8, 32.4, 32.5, 32.6, 33.3, 33.1, 33.2, 33.3, 33.4, 33.5, 33.6 | 08 hours<br><br>07 hours<br><br>08 hours |
| **Pedagogy:** | Lectures/ tutorials or a combination of these. Sessions shall be interactive in nature to enable peer group learning. | |
| **References/ Readings:** | Text Books<br>1. P. G. Hewitt, Conceptual physics, 12th ed., Pearson, 2015.<br>Other reference Books<br>2. G. Venkataraman, Why are things the way they are? University Physics, 2017.<br>3. Jerry D. Wilson Physics a practical and conceptual approach, Second edition, Saunders college publications, 1986. | |

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| **Course Outcomes:** | Student will be able to<br>1. Recall fundamental concepts in Physics and connect them in everyday life<br>2. Describe the fundamental concept to understand the physical phenomena happening around us.<br>3. Apply fundamental concepts in Physics to analyse these phenomena.<br>4. Correlate the concepts of Physics in other branches of science. | |

**Name of the Programme: B.Sc. Physics**
**Course Code: PHY-131**
**Title of the Course: History of Physics**
**Number of Credits: 3**
**Effective from AY: 2023-24**

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| **Pre-requisites for the Course:** | Nil | |
| **Course Objectives** | To acquaint the student about the development of Physics. | |
| **Content:** | Unit 1: An introduction to the Science of Galileo<br><br>Unit 2: Halley, Kepler and Newton and their Physics<br><br>Unit 3: Isaac Newton his Mechanics and his Gravity<br><br>Unit 4: Boltzmann, Maxwell and other giants of Classical Physics<br><br>Unit 5: Coulomb, Faraday, Maxwell: Electricity and Magnetism<br><br>Unit 6: Atomic theory, the periodic table, Mendeleev, Dalton, and Lavoisier<br><br>Unit 7: The wave-particle duality of light, Max Planck, Neils Bohr, Albert Einstein and Quantum Physics | 05 hours<br><br>06 hours<br><br>06 hours<br><br>06 hours<br><br>06 hours<br><br>06 hours<br><br>10 hours |
| **Pedagogy:** | Lectures/Demonstrations/Short movies. Sessions shall be interactive in nature to enable peer group learning. | |
| **References/ Readings:** | 1. I. Glynn, Elegance in Science, Oxford University Press 2010<br>2. J. Gribbin, Science a History, Penguin, 2009.<br>3. J. Gribbin and M. Ribbin, Out of the Shadow of a Giant, William Collins, 2018.<br>4. M. Mosley. and J. Lynch, The Story of Science, Octopus Publishers, 2010.<br>5. T. Crump, Science as seen through the development of scientific instruments, Running Press, 2001.<br>6. Z. Jed Buchwald, Robert Fox - The Oxford Handbook of the History of Physics, Oxford University Press, 2014. | |
| **Course Outcomes:** | Student will be able to<br>1. Understand that the development of Physics was incremental.<br>2. Realise that a few great men and women influenced the development of physics.<br>3. Analyse different laws and theories of physics and their impact on modern science.<br>4. Understand that results that could not be explained often led to the introduction of radical new physics. | |

**Name of the Programme: B.Sc. Physics**
**Course Code: PHY-132**
**Title of the Course: Indian Contribution to Physics**
**Number of Credits: 3**
**Effective from AY: 2023-24**

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| **Pre-requisites for the Course:** | Nil | |
| **Course Objectives** | To create awareness of Indian contribution to the subject of Physics. | |
| **Content:** | **Jagdish Chandra Bose**: biography, Experiments on refraction, diffraction & polarization, radio wave detector. Contribution to Biology.<br>**Chandrashekhar Venkata Raman**: biography, Molecular diffraction of light, Raman effect. Raman at the Indian Institute of Science. Fascinating colours of butterflies.<br>**Meghnad Saha**: biography, Saha's Ionization Formula. Saha's views on National Problems (Atomic Energy and River physics & Flood) and Social Concerns (Science & Culture and Freedom Movement). Calendar Reform.<br>**Satyendra Nath Bose**: biography, Bose and his Statistics, Planck's law & hypothesis of light, Bose Condensation<br>**Homi Jehangir Bhabha**: biography, cosmic rays, birth of Atomic energy research in India, Contributions to National science (ISRO, Electronics, Pure and Applied Science Research and Molecular Biology), Bhabha Atomic Research Centre<br>**Subrahmanyan Chandrasekhar**: biography, Birth and death of a star, blackhole, neutron star and white dwarf.<br>**Sivaramakrishna Chandrasekhar**: biography, early work on crystalline optical activity and X-ray diffraction, Liquid crystals.<br>**Jayant Narlikar**: biography, Cosmology, Inter University Centre for Astronomy and Astrophysics (IUCAA).<br>**Ennackal Chandy George Sudarshan**: biography, Quantum optics.<br>**Vikram Sarabhai**: biography, PRL, Indian Space Programme, Atomic Energy Commission and other organizations, Indian Space Research Organization | 05 hours<br>05 hours<br>04 hours<br>05 hours<br>05 hours<br>04 hours<br>04 hours<br>04 hours<br>04 hours<br>05 hours |
| **Pedagogy:** | Lectures/ tutorials or a combination of these. Sessions shall be interactive in nature to enable peer group learning. | |
| **References/ Readings:** | 1. A Jayaraman, C. V. Raman A Memoir, Affiliated East-West Press (1990)<br>2. C N R Rao and Indumati Rao, Founders of Modern Science in India, Indian Academy of Sciences (2021)<br>3. Chintamani Deshmukh, HOMI JEHANGIR BHABHA, National Book Trust (2010)<br>4. D P Sen Gupta, Meher H Engineer, Virginia Anne Shepherd, Remembering Sir J.C. Bose, World Scientific | |

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| | (2009)<br>5. G. Venkataraman, Raman and his Effect, Universities Press (1995)<br>6. G. Venkataraman, SAHA AND HIS FORMULA, Universities Press (1995)<br>7. G. Venkataraman, Bose and His Statistics, Sangam Books Ltd (1993)<br>8. G. Venkataraman, BHABHA AND HIS MAGNIFICIENT OBSESSIONS, Universities Press (1994)<br>9. G. Venkataraman, Chandrasekhar and His Limit, Universities Press (1992)<br>10. Kameshwar C. Wali, A Scientific Autobiography: S. CHANDRASEKHAR, World Scientific (2011)<br>11. Patrick Geddes, The Life and Work of Sir Jagadish C. Bose, Pharos Books (2022)<br>12. Pramod V. Naik, Meghnad Saha: His Life in Science and Politics, Springer 2017<br>13. Santimay Chatterjee, Enakshi Chatterjee, SATYENDRA NATH BOSE, National Book Trust (1976).<br>14. Vikram Sarabhai - The Legend Unveiled, publisher Vijnana Bharati (2017)<br>15. Sivaramakrishna Chandrasekhar, https://wwws.rri.res.in/htmls/library/imprints_collection/bios/chandrasekhar.html<br>16. Resonance – Journal of Science Education, https://www.ias.ac.in<br>17. UNESCO Kalinga Prize Winner – 1996, https://www.drcrmishra.com | |
| **Course Outcomes:** | Student will be able to<br>1. Decipher contributions of Indians to Physics.<br>2. Understand the role played by some of them in building modern India.<br>3. Gain knowledge of Indian Atomic Energy Programme and Indian Space programme.<br>4. Get inspired from the biographies of these men. | |

**Name of the Programme: B.Sc. Physics**
**Course Code: PHY-141**
**Title of the Course: Basic Experimental Techniques**
**Number of Credits: 1L + 2P**
**Effective from AY: 2023-24**

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| **Pre-requisites for the Course:** | NIL | |
| **Course Objectives:** | The course will enable students to acquire required skills to understand basic experimental techniques and use them in a physics laboratory. | |
| **Content:** | **Theory (1 Credit)**<br>**Unit I: Units and Measurements.**<br>M.K.S., C.G.S., F.P.S. & S.I system of units (basic introduction)<br>Elementary ideas of measurements using Vernier Calipers, Micrometer Screw Gauge, Spherometer, travelling microscope, difference between precision and accuracy.<br>**Measurement of mass** using digital balance.<br>**Measurement of Temperature**<br>Thermometer, thermocouple, metal and semiconductor devices, Different scales of temperature (Celsius, Kelvin, Fahrenheit, and Reaumur).<br>**Unit II: Theory of Errors.**<br>Arithmetic mean, absolute error, relative error, percentage error. Expressing results of an experiment including errors. propagation of errors. Plotting of graphs.<br>**Unit III: Physical Optics.**<br>Convex & concave mirror and their focal length, Convex & concave lenses and simple theory about their focal length, combination of lenses.<br>**Unit IV: Basic Electrical and Electronic components**<br>Basic understanding and use of components: Transformers, switches, fixed resistors, potentiometers, rheostats, capacitors, inductors, diodes, Zener diodes, LED's, transistors and relay.<br>**Unit V: Basic Electrical and Electronic Instruments**<br>Basic understanding and use of instruments /devices: Electrical tester, Digital Multimeter, Digital LCR meter, breadboards, Variac, DC Power supplies (fixed voltage, dual voltage & variable voltage), Function generator, CRO (Cathode Ray Oscilloscope) and DSO (Digital Storage Oscilloscope)<br><br>**Practicals (2 Credits)**<br>**General Physics:**<br>Use of Vernier Calipers and Micrometer Screw Gauge.<br>Use of Travelling Microscope.<br>Use of Spherometer. | 04 hours<br><br>03 hours<br><br>03 hours<br><br>02 hours<br><br>03 hours<br><br>30 hours |

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| | Measurement of temperature using different devices.<br>To determine Focal lengths of convex and concave mirrors.<br>To determine Focal lengths of convex and concave lenses.<br>Use of Spectrometer to determine angle of Prism.<br>Plotting of graphs from given Data.<br>Calculation of percentage error in an experiment using given data and expressing the result of the experiment using errors.<br>. Use of virtual lab software for experimental demonstrations. (**Only for demonstrations**)<br>**Electrical/Electronics:**<br>Familiarization and use of Digital Multimeter for testing fixed resistors, switches, potentiometers, diodes, Zener diodes and transistors.<br>Familiarization and use of Digital LCR meter for testing different types of inductors and capacitors.<br>Use of Variac and testing of different types of transformers (step down) and rheostats.<br>Familiarization & use of Breadboard and construction of simple circuits on the breadboard.<br>Familiarization and use of Function generator, CRO & DSO and measurement of voltage (DC/AC), period and frequency.<br>Familiarization, use and testing of regulated power supplies (fixed, dual & variable voltage).<br>Construction and testing of simple DC power supply using transformer, diodes and capacitor.<br>Use of virtual lab software for experimental demonstrations. (**Only for demonstrations**) | 30 hours |
| **Pedagogy:** | Lectures, Demonstrations, Problem Solving, Laboratory work & use of Virtual lab Software (open source) for experimental demonstrations. | |
| **References/ Readings:** | 1. A. P. Malvino, Electronic Principles, Tata McGraw Hill (2007)<br>2. B. K. Sharma, Modern *ABC of Physics* Class-11, Modern Publishers.<br>3. Charles Platt, Easy Electronics, Maker Media, 2017<br>4. Charles Platt, Encyclopaedia of Electronic components (Volume I), OReilly Media (2012)<br>5. D. Chattopadhyay, P. C. Rakshit. *An Advanced Course in Practical Physics*, New Central Book Agency, 1990<br>6. H. S. Kalsi, Electronic Instrumentation, TMH (2004).<br>7. Laboratory Manual Physics Class XI, First Edition June 2010 Asadha 1932, NCERT Publisher.<br>8. Laboratory Manual Physics Class XII, First Edition June 2010 Asadha 1932, NCERT Publisher. | |

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| | 9. N. N. Bhargava, D. C. Kulshrestha and S. C. Gupta, Basic Electronics and Linear Circuits, TMH (1984).<br>10. N. Subrahmayam and N. Brijlal, Text Book of Optics, S. Chand & Company Ltd. (1991).<br>11. *NCERT PHYSICS* CLASS 11 PART I & II, NCERT publication.<br>12. *NCERT PHYSICS* CLASS 12 PART I & II, NCERT publishers.<br>13. Peter J. Nolan, Raymond E. Bigliani, Experiments in physics, Surjeet Publications.<br>14. Satish K. Gupta, Modern *ABC of Physics* Class-12 Modern Publishers.<br>15. *V. K. Mehta*. Rohit Mehta, *Principles of Electronics (*Revised Edition), S. Chand Publishers.<br><br>**Note: A minimum five experiments from each section are to be performed for the Semester.** | |
| **Course Outcomes:** | Student will be able to<br>1. Identify different components and Experimental instruments<br>2. Gain Basic understanding of Experimental instruments.<br>3. Develop Skills in performing Physics experiments.<br>4. Calculate errors in an experiment and other parameters related to the experiment. | |

**Name of the Programme: B.Sc. Physics**
**Course Code: PHY-142**
**Title of the Course: Photography**
**Number of Credits: 1L + 2P**
**Effective from AY: 2023-24**

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| **Pre-requisites for the Course:** | NIL | |
| **Course Objectives:** | 1. Familiarize the student with concepts and content of photography instruments (cameras, lenses and lighting equipment)<br>2. Introduce the professional usages of photography equipment<br>3. Learn optimization of equipment capabilities<br>4. Create capability to generate professional digital photographic content.<br>5. Provide hands on practical experience via structured photoshoots<br>6. Generate artistic talent in a scientific way | |
| **Content:** | **Theory (One credit)**<br>1. **Introduction to photography**, Definition of photography, Physics of photography, History and developments in photography, Types of photography, Digital photography.<br>2. **Camera Basics**, Types of cameras, introduction to common brands of cameras, Camera Controls, basic camera settings, Basic camera operations.<br>3. **DSLR Cameras**, Crop sensor, full frame & medium format cameras. Detailed operational procedure of a DSLR Camera and shooting modes<br>**4. Exposure**<br>**5. Aperture & Shutter Speeds**<br>6. **ISO**: Exposure compensation, Concept of high- and lowkey photographs<br>7. **Light Meter**, TTL concept<br>**8. Depth of Field**, white balance & colour compensation<br>9. **Composition rules**<br>10. **Lenses,** Importance of lens in a camera, focal length of camera lenses and its effects on photographs. Types of lenses. (Prime lens, zoom lens & tilt lens) Categorization of lenses (kit lenses, micro, macro, wide angle & telephoto lenses).<br>11. **Lighting**, Natural lighting, artificial lighting, speed lights, studio strobes, light modifiers, colour gels Effect of lighting on photographs, Fill light, back light, Rembrandt lighting; butterfly lighting, golden hour and sun set photography<br>12. **Flash Photography** TTL, high speed sink, Composition tips and Shooting at Night | 15 hours |

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| | 13. Filters, Tripod, & Camera Accessories<br>14. Introduction to a photo editing software (adobe light room)<br><br>**Practical (any 20) (two credits)**<br><br>1. Time-lapse photography: capture a sequence of images over time to create a time-lapse video.<br>2. Light painting: use long exposure times and light sources to create unique and artistic images.<br>3. U-V light photography. create an object photograph using ultra violet light<br>4. High-speed photography: capture fast-moving objects or events using fast shutter speeds.<br>5. Macro photography: capture close-up images of small objects or details.<br>6. Astrophotography: capture images of the night sky, stars, and galaxies.<br>7. HDR photography: combine multiple exposures of the same scene to create a high dynamic range image.<br>8. Bokeh photography: create images with a shallow depth of field and beautiful bokeh.<br>9. Still life photography: capture images of objects arranged in a still life composition.<br>10. Portrait photography: capture images of people in various poses and settings.<br>11. Landscape photography: capture images of the natural environment, such as mountains, forests, and oceans.<br>12. Street photography: capture candid images of people in public spaces.<br>13. Black and white photography: experiment with black and white photography to create dramatic and moody images.<br>14. Infrared photography: capture images using infrared light to create unique and surreal images.<br>15. Double exposure photography: combine two or more images to create a unique and artistic image.<br>16. Panoramic photography: capture wide-angle images of landscapes or cityscapes.<br>17. Silhouette photography: capture images of subjects against a bright background to create striking silhouettes.<br>18. Still image/video hybrid: combine still images and video footage to create a unique hybrid.<br>19. Tilt-shift photography: use a tilt-shift lens to create a miniature effect in your images. | 60 hours |

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| | 20. High-key and low-key photography: experiment with high-key and low-key lighting to create images with bright or dark tones.<br>21. In-camera multiple exposures: experiment with multiple exposures using the camera's multiple exposure function to create unique and artistic images.<br>22. Night Photography: Use long exposures and capture a subject at night.<br>23. Wildlife Photography: Take photos of animals in their natural habitats<br>24. Product Photography: Take photos of products for advertising or e-commerce purposes.<br>25. Sports Photography: Capture action shots of athletes in various sports, such as basketball or soccer.<br>26. Fashion Photography: Take photos of clothing and accessories for fashion magazines or advertising.<br>27. Documentary Photography: Use photography to tell a story or document a particular event or social issue.<br>28. Concert Photography: Take photos of musicians and performers during concerts or live shows.<br>29. Architectural Photography: Capture buildings, interiors, and landscapes for architectural purposes or real estate.<br>30. Food Photography: Take photos of food for menus, cookbooks, or social media.<br>31. Aerial Photography: Capture photos from above using drones or other aerial vehicles.<br>32. Underwater Photography: Take photos of marine life and scenery underwater using waterproof cameras or housings. | |
| **Pedagogy:** | Lectures, Demonstrations and Laboratory work | |
| **References/ Readings:** | 1. Brenda Tharp, Extraordinary Everyday Photography: Awaken Your Vision to Create Stunning Images Wherever You Are, Amphoto Books 2012<br>2. Bruce Barnbaum, The Art of Photography: An Approach to Personal Expression, Photographic Arts Editions in cooperation with Rocky Nook Inc 2010<br>3. Bryan Peterson, Understanding Exposure, 3rd Edition: How to Shoot Great Photographs with Any Camera, Random House India Edition: 3rd Edition, 2010<br>4. Craig Alesse, Basic 35mm Photo Guide: For Beginning Photographers 5th Edition, Amherat Media Inc. 2001<br>5. David Busch’s Mastering Digital SLR Photography (David Busch's Digital Photography Guides) 3rd Edition, David D. Busch, Course technology PTR 2012<br>6. Jim Miotke, Better Photo Basics: The Absolute Beginner's Guide to Taking Photos Like a Pro 1st Edition, Amphoto Books 2010 | |

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| | 7. Michael Freeman, The Photographer's Eye: Composition and Design for Better Digital Photos 1st Edition, Focal Press; *1st edition* (May 23, 2007);<br>8. Scott Kelby, Scott Kelby's Digital Photography Boxed Set, Volumes 1, 2, and 3 1st Edition, Peachpit Press, 2007, 2009<br>9. Tom Ang, How to Photograph Absolutely Everything: Successful Pictures from Your Digital Camera, DK; Reprint edition 2009<br>10. 50 Photo Projects - Ideas to Kickstart Your Photography, Lee Frost, David & Charles; 2009 | |
| **Course Outcomes:** | Student will be able to<br>1. Understand the fundamental concepts, theoretical formulations and practical applications pertaining to the topics listed in syllabus.<br>2. Attain capability to evaluate and calculate all major aspects pertain to a professional photoshoot.<br>3. Create professional digital photographic content by optimal utilization of equipment potentials.<br>4. Draw the geometries of practical photoshoot problems<br>5. Deduce the common tricks and techniques practiced in a professional photoshoot.<br>6. Transform into a professional photographer. | |

**Name of the Programme: B.Sc. Physics**
**Course Code: PHY-143**
**Title of the Course: House Wiring**
**Number of Credits: 1L + 2P**
**Effective from AY: 2023-24**

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| **Pre-requisites for the Course:** | NIL | |
| **Course Objectives:** | The course will impart necessary skills for basic electrical and house wiring. | |
| **Content:** | **1. Basic Electrical circuits** - Ohm's Law, Laws of resistance - Resistances in series and parallel - Voltage and current division - Kirchhoff's Laws and applications. | 01 hour |
| | **2. Electric Circuits and Connections**<br>Concept of single-phase wiring, Concept three-phase wiring, Star and Delta connections, Resistive, Inductive & Capacitive loads | 02 hours |
| | **3. Electrical Measuring Instruments**<br>PMMC & MI meter (Ammeter, Voltmeter), Range extension Study of Multimeter (Digital/Analog), Wattmeter - P.F. meter, Energy meter (Digital/analog) - Insulation Tester (Megger), measurements using Oscilloscope | 02 hours |
| | 4. **Electrical Wiring**<br>Introduction - Common Electrical wiring Accessories, their specifications – Different methods of measuring the values of resistance - Circuit connection, Solders, flux, soldering and de-soldering technique - Wire Crimping | 02 hours |
| | 5. **Switches and Cables**<br>Explanation of switches - Lamp holders, plugs and sockets - Conductors, Strands, Cores of Cable - Insulation of a Cable - Types and Selection of cables | 01 hour |
| | **6. Circuit Breakers and Panel Board**<br>Brief description of Fuse - MCB's, MCCB's | 01 hour |
| | 7. **Lighting and Illumination**<br>Basics of illumination - Types of light (GLS, FTL, CFL, LED, MVL etc.) - Construction, working and applications - Light selection by manual method - IE rules | 02 hours |
| | **8. Fan and Heating Appliances**<br>Types and selection of fans used at home - Ceiling fans, Table fan, Exhaust and Geysers<br>Fan - Trouble shooting and servicing of fans | 02 hours |
| | **9. Electrical Hazards and Basic Safety**<br>Electrical Hazards and its effects - Basic safety introduction - Personal protection Hazard identification and avoidance | 02 hours |
| | **Practicals** | 60 hours |

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| | 1. Handling and measurements using voltmeter, ammeter, wattmeter, oscilloscope, multimeter<br>2. Handling, identification of various electrical wires, switches, sockets of various ampere or wattage rating, fan control<br>3. Resistors series and parallel connection and measurement of resultant values using multimeter<br>4. Identify types of wires, cables and verify their specifications.<br>5. Make simple straight twist and rat-tail joints in single strand<br>conductors.<br>6. Making a switch/extension board<br>7. Making a table lamp with ON/OFF switch<br>8. Testing of earthing leakage using voltmeter and test lamp<br>9. Drawing up a plan for house wiring with load calculations<br>10. Assembling/disassembling a ceiling fan, table fan, fixing tubelights, iron<br>11. Basic fault finding for lights, fans, electrical wiring, iron<br>12. Study of transformers, variacs<br>13. Handling of electrical drill, types of drill bits, wall wiring (creating an electrical point with switch, MCB, fuse)<br>14. Drawing for proper illumination of a room, placement of lights and fans<br>15. Install Earthing pipes/ plates<br>16. Light fitting for showcase<br>17. Identify the types of fuses their ratings and applications<br>18. Estimation of cost for electrical wiring of a room and service charges<br>19. Basic electrical safety procedures<br>20. Stair case wiring<br>21. Connect 3 single phase transformers for 3 phase operation of delta<br>delta /delta-star /star-star /star-delta<br>22. Basics of soldering<br>**23.** Connection of remote ON/OFF control of switches | |
| **Pedagogy:** | Lectures, Demonstrations, Laboratory work | |
| **References/ Readings:** | Text Book<br>1. David W Rongey Home Electrical Wiring: A Complete Guide to Home Electrical Wiring Explained by a Licensed Electrical Contractor, Home Electrical Wiring Publication, 2013.<br>Reference books<br>2. M Lotia, Modern Basic Electrical & House Wiring Servicing Paperback – Hindi Edition Bnp Publications 2012<br>3. Basic Electrical House Wiring \| abdulaziz hassan - | |

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| | Academia.edu<br>4. https://extremehowto.com/electrical-101-homeowner/<br>5. https://www.electricaltechnology.org/2013/09/electrical-wiring.html<br>6. https://www.coynecollege.edu/learn-basics-of-home-electrical-wiring/<br>7. House Wiring Diagram - Everything You Need to Know \| EdrawMax Online | |
| **Course Outcomes:** | Student will be able to<br>1. Acquire hands-on training on handling and using equipment used for household wiring<br>2. Perform simple electrical jobs<br>3. Undertake home wiring<br>4. Design proper lighting and fan placements for a room<br>5. Check for proper earthing and electrical safety<br>6. Find simple faults of electrical gadgets | |

**Name of the Programme: B.Sc. Physics**
**Course Code: PHY-144**
**Title of the Course: PCB Designing**
**Number of Credits: 1L + 2P**
**Effective from AY: 2023-24**

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| **Pre-requisites for the Course:** | NIL | |
| **Course Objectives:** | The course will prepare the student/s to develop skills of the design and implementation of electronic circuits and fabricate the same using PCB designing for a prototype and/or circuit production in Electronic Industry. | |
| **Content:** | **Introduction:** Practical acquaintance with techniques for measurement and use of necessary tools and instruments such as CRO, Signal generator, Multimeter, Power supply.<br>**PCB components:** Exposure to different types of components: diodes, resistors, capacitors, transistors, operational amplifiers, field effect transistors, unijunction transistor and testing of various components.<br>**Breadboard theory:** Circuit implementation using breadboards, soldering and de-soldering techniques, construction of circuits using Vero boards.<br>**PCB designing:** Need for PCB design, various types of PCB designs such as single and multilayer, PCB material.<br>**Schematic designing:** Introduction to schematic design, understanding various symbols and their respective functions, circuit designing, tracing and artwork on copper clad boards, technique of etching on copper clad boards.<br>**PCB layout design:** PCB layout design process, layout and rules, cleaning of PCB, PCB drilling, mounting/placement of components, soldering and testing of PCB circuit.<br>**Introduction to PCB design software (Opensource software)** Create circuit board layouts with any software such as: FreePCB, DesignSpark PCB, Osmond PCB, Express PCB, KiCad (multi-platform PCB design package), ZenitPCB, EasyEDA, etc.<br><br>**Practical Component:**<br>1. Practical acquaintance with instrumental techniques for measurement: CRO, Signal generator, Multimeter.<br>2. Testing of various components: Resistors, capacitors, transistors, diodes, FET, UJT etc.<br>3. Constructing a given circuit using a breadboard and testing the same for the required output/s.<br>4. Soldering and de-soldering technique, constructing circuits using vero boards.<br>5. Circuit designing, tracing and Artwork on Copper Clad board or circuit board layouts using opensource software. | 02 hours<br>02 hours<br>02 hours<br>02 hours<br>02 hours<br>02 hours<br>03 hours<br><br>60 hours |

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| | 6. Etching of copper clad boards using ferric chloride and commonly used precautions to be taken.<br>7. Cleaning of PCB, PCB drilling, mounting of components.<br>8. Soldering and testing of designed circuits on PCB. | |
| **Pedagogy:** | Lectures, Demonstrations, Laboratory work, use of opensource software for practicals. | |
| **References/ Readings:** | 1. Charles A. Harper: Handbook of Electronics Packaging, Tata McGraw-Hill, 2005<br>2. R. S. Khandpur: Printed Circuit Boards: Design, Fabrication, Assembly and Testing, Tata McGraw-Hill, 2017.<br>3. Walter C Bosshart: Printed Circuit Boards: Design and Technology, Tata McGraw-Hill 2013. | |
| **Course Outcomes:** | 1. Develop the necessary skills in drawing circuit diagrams and use techniques of circuit analysis for designing a given circuit as per given specifications.<br>2. Use a Breadboard for a prototype implementation of circuits, test the performance of the circuit design using testing and measuring instruments (Multimeter, CRO, power supply etc).<br>3. Develop soldering and de-soldering techniques and develop the necessary skills in etching PCB's.<br>4. Create and fabricate a PCB, construct and test the circuit design on PCB's. | |