Level I - Semester 1			
Course Code:	PH 1005		
Course Name:	Modern Physics & Special Relativity		
Credit Value:	02		
Core/Optional	Core		
Hourly Breakdown *This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.*	Theory	Practical	Independent Learning
	30	--	70

Course Aim/Intended Learning Outcomes:

- explain the failures of classical theories applied to microscopic world,
- interpret the conceptual basis of quantum theory,
- discuss the diverse applications of quantum theory,
- solve problems in modern physics topics,
- interpret experiments and related observations in modern physics.
- explain the underlying basis of special relativity,
- apply Lorentz Transformation to analyse time dilation, length contraction and non-simultaneity of events situations,
- analyse paradoxes in special relativity,
- solve relativistic dynamics problems,
- apply space-time diagrams to relativistic problems.

Course Content: (Main topics, Sub topics)

Modern Physics: Survey on historical background and failures of classical Physics, ideas related to blackbody radiation, Planck's theory and its implications. Photoelectric effect, Compton effect, X-rays, production of X-rays, pair production and pair annihilation, the dual nature of electromagnetic radiation, matter waves,de Broglie's postulate & de Broglie wavelength, the wave-particle duality, atomic spectra, Frank and Hertz experiment, Thomson's and Rutherford's model of the atom, Bohr model of the atom, one electron atom, energy quantization, Rydberg constant, Correspondence principle, Uncertainty principle, Introduction to Schrodinger wave equation.

Special Relativity: Galilean transformations and Newtonian relativity, Ether concept and the Michelson-Morley experiment, Lorentz-Fitzgerald contraction hypothesis and ether-drag hypothesis, Einstein's postulates of the special theory of relativity, Lorentz transformation equations, Non-absolute simultaneity; Length contraction, Time dilation, 'Twin paradox'; Relativistic velocity and acceleration transformation equations, Aberration and Doppler effect of relativity, Relativistic dynamics: momentum, mass and kinetic energy, equivalence of mass and energy, Some experimental evidence in favour of relativity, Introduction to space-time diagrams.

Teaching /Learning Methods: Lectures, Tutorials, Problem solving sessions

Assessment Strategy:

Continuous Assessment 30%	Final Assessment 70%		
Details: quizzes %, mid-term %, other % (specify) Quizzes: 10% Take Home Problem Sets: 20%	Theory (%) 70%	Practical (%) -	Other (%) -

Recommended Reading:

1. Tipler, P. A., & Llewellyn, R. (2003). *Modern Physics*. London, England: Macmillan.
2. Eisberg, R., & Resnick, R. (1985). *Quantum physics of atoms, molecules, solids, nuclei, and particles:* Wiley.
3. Resnick, R. (1971). *Introduction to special relativity*: Wiley.
4. French, A. (1968). *Special Relativity*. Boca Raton, FL: CRC Press.

Level I - Semester 2			
Course Code:	**PH 1006**		
Course Name:	**Mechanics & Thermodynamics**		
Credit Value:	**02**		
Core/Optional	**Core**		
Hourly Breakdown *This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.*	Theory	Practical	Independent Learning
	30	**--**	**70**

Course Aim/Intended Learning Outcomes:

- survey the fundamental principles of Newtonian mechanics,
- apply Newton's laws of motion to analyze simple dynamical systems,
- appreciate the versatility of work and energy related methods for solving problems in mechanics,
- appreciate the significance of conservation laws in mechanics,
- interpret fundamental definitions related to systems in equilibrium thermodynamics, its variables, properties and processes,
- apply the physical laws related to systems of thermodynamics in closed systems,
- apply developed notions in thermodynamics to analyse real world applications,
- interpret the critical phenomena in thermodynamic systems.

Course Content: (Main topics, Sub topics)

Mechanics (1C): Fundamentals of Newtonian mechanics: inertial frames, Newton's laws of motion, Galilean principle of relativity, linear momentum, impulse, conservation of linear momentum, motion at constant acceleration, motion under friction and viscous forces, uniform circular motion; Work and energy: work, power, kinetic energy, work-energy principle, conservative and non-conservative forces, potential energy, conservation of mechanical energy; Gravitation: Newton's law of universal gravitation, gravitational potential energy, escape velocity, Kepler's laws; Rotational motion: torque, moment of inertia, rotational dynamics, rotational plus translational motion, angular momentum, conservation of angular momentum, rotating frames of reference, the Coriolis effect; Dynamics of a system of particles: center of mass, conservation laws for a system of particles, motion of two interacting bodies, elastic and inelastic collisions

Thermodynamics (1C): Basic concepts of thermodynamics: thermodynamic systems, state & transfer variables, reversible and irreversible processes, thermal equilibrium; Kinetic theory of gases: equation of state, Maxwellian velocity distribution, mean free path, principle of equi-partition of energy, molar heat capacity of monatomic and diatomic gases, degrees of freedom of polyatomic gases; First law of thermodynamics: heat, work and Internal energy, isothermal, adiabatic, isobaric and isochoric processes; Enthalpy: Flow work, Joule-Kelvin effect, isenthalpic process; Second law of thermodynamics: heat engines and pumps, refrigerators, Carnot engine, Entropy, entropy change of ideal gases, third law of thermodynamics; Phase transitions: Van der Waals equation of state, Andrews isotherms of carbon dioxide, critical constants, compressibility factor

Teaching /Learning Methods: Lectures, Tutorials, Problem solving sessions

Assessment Strategy:

Continuous Assessment 30%	Final Assessment 70%		
Details: quizzes %, mid-term %, other % (specify) Mid-semester: 30%	Theory (%) 70%	Practical (%) -	Other (%) -

Recommended Reading:

1. Giancoli, D. C. (2008). *Physics for Scientists and Engineers with Modern Physics*, 4th Ed., Pearson.
2. Serway, R.A, & Jewett, J.W. (2019). *Physics for Scientists and Engineers, 10th Ed*. Cengage.
3. Fowles, G. R. and Cassiday, G. L. (2004). *Analytical Mechanics*, 7th Ed., Cengage.
4. Roy, B. N. (2002). *Fundamentals of Classical and Statistical Thermodynamics*, Wiley.
5. Borgnakke C. and Sonntag, R.E. (2012) *Fundamentals of thermodynamics, 8th Ed*, Willey.

Level I - Semester 1			
Course Code:	**PH 1022**		
Course Name:	**Physics Laboratory - I**		
Credit Value:	**02**		
Core/Optional	**Core**		
Hourly Breakdown *This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.*	Theory	Practical	Independent Learning
	--	**60**	**40**

Course Aim/Intended Learning Outcomes:

- measure physical quantities using the relevant laboratory instruments with considerations for measurement accuracy and precision,
- apply basic error analysis systematically to estimate uncertainties associated with measured quantities,
- infer experimentally major physical quantities related to mechanics, thermal physics, properties of matter and geometrical optics,
- understand the relationship between experiment and theory,
- communicate verbally and in writing the results, analysis and findings from an experiment.

Course Content: (Main topics, Sub topics)

Lessons on introduction to error theory, Introduction to measuring instruments, Set experiments on the properties of matter, mechanics, geometrical optics, etc.

Teaching /Learning Methods: Lab-based experiments and/or take-home experiments

Assessment Strategy:

Continuous Assessment 60%	Final Assessment 40%		
Details: quizzes %, mid-term %, other % (specify) Weekly Experiments & Viva: 60%	Theory (%) -	Practical (%) 40%	Other (%) -

Recommended Reading:

1. Laboratory instruction sheets, Notes on error theory prepared by the Department of Physics,
2. Squires, G. L. (2001). *Practical Physics*. Cambridge university press.
3. Tyler, F. (1977). *A Laboratory Manual of Physics*. Hodder Education.

Level I - Semester 2			
Course Code:	PH 1023		
Course Name:	Physics Laboratory - II		
Credit Value:	02		
Core/Optional	Optional		
Hourly Breakdown *This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.*	Theory	Practical	Independent Learning
	--	60	40

Course Aim/Intended Learning Outcomes:

- design experiments to determine a physical quantity,
- use data acquisition and signal processing tools,
- optimize experimental parameters to enable best possible measurements precision and accuracy,
- utilize a wider variety of data processing techniques to analyze data,
- critically comment on results and limitations of an experiment.

Course Content: (Main topics, Sub topics)

This laboratory course extends on the basic notions of Physics experiments developed in Physics Laboratory - I. Project based learning will be encouraged to develop experimental skills to explore a scientific hypothesis, and the design of a scientific experiment, including methods to make data acquisition efficient. Experiments will cover topics in Physics related to properties of matter, mechanics, thermal physics, physical optics, etc.

Teaching /Learning Methods: Lab-based experiments and/or take-home experiments

Assessment Strategy:

Continuous Assessment 60%	Final Assessment 40%		
Details: quizzes %, mid-term %, other % (specify) Weekly Experiments & Viva: 60%	Theory (%) -	Practical (%) 40%	Other (%) -

Recommended Reading:

1. Laboratory instruction sheets, Notes on error theory prepared by the Department of Physics,
2. Squires, G. L. (2001). *Practical Physics*. Cambridge university press.
3. Tyler, F. (1977). *A Laboratory Manual of Physics*. Hodder Education.

<table>
<tr><th colspan="4">Level I - Semester 1</th></tr>
<tr><td>Course Code:</td><td colspan="3">PH 1007</td></tr>
<tr><td>Course Name:</td><td colspan="3">Astronomy - I</td></tr>
<tr><td>Credit Value:</td><td colspan="3">02</td></tr>
<tr><td>Core/Optional</td><td colspan="3">Optional</td></tr>
<tr><td rowspan="2">Hourly Breakdown
This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.</td><td>Theory</td><td>Practical</td><td>Independent Learning</td></tr>
<tr><td>30</td><td>--</td><td>70</td></tr>
<tr><td colspan="4">Course Aim/Intended Learning Outcomes:
• describe the development of scientific method,
• explain the fundamental concepts of modern-day astronomy,
• describe the origin and the evolution of the universe and its constituents,
• evaluate the motion of planetary bodies,
• analyse data from telescopes, CCD images, spectrograph and photometers to evaluate stellar properties,
• use sky maps and identify objects in the night sky.</td></tr>
<tr><td colspan="4">Course Content: (Main topics, Sub topics)
Development of astronomy: Introduction, geocentric and heliocentric theories; The solar system: origin, constituents - planets, moons, asteroids, comets; Planetary motion: Kepler's Laws, measurement of distances to the planets, Titius - Bode Rule, exoplanets; Structure of stars: The sun as a star, equations of stellar structure, energy sources, rates of thermonuclear reactions, Chandrasekhar limit; Stellar evolution: Evolution near the main sequence, dynamical collapse of a protostar, nucleosynthesis, white dwarfs, neutron stars, red giants, supernovae, black holes, pulsars, X-ray and Gamma ray sources, variable stars, Cepheid variables. Stellar Properties: Measurement of distances to stars, parallax; temperature; velocity, Doppler shift; masses and radii of stars: measuring techniques, study of variable stars and binary stars; Luminosity and magnitude of stars: Apparent magnitude, measurement of apparent luminosity, surface temperature, colour, UBV and RGU systems, correction for observed magnitudes, measurement of distances to nearby stars, absolute magnitude; Hertzprung-Russel diagram; Galaxies: classification of galaxies. Milky way and the Local Group, measurement of distances to galaxies; Cosmology: nature of the universe and its evolution, Big bang and isotropic models of the universe inflation in early universe, gravitational red shift, Hubble Law, cosmic microwave background radiation, quasars, dark matter, dark energy; Celestial coordinates and guide to use star charts: earth's axis of rotation,, right ascension, declination, altitude, azimuth, zenith angle, concept of time, sidereal and solar time, star catalogues; Astronomy instrumentation: optical telescope types, CCD imaging, image processing, time measurement, spectrographs and spectroscopy, photometer, radio telescopes, X-ray and gamma ray telescopes, planetary probes.</td></tr>
<tr><td colspan="4">Teaching /Learning Methods: Lectures, Tutorials, Problem solving sessions</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment
30%</td><td colspan="3">Final Assessment
70%</td></tr>
<tr><td>Details: quizzes %, mid-term %, other % (specify)
Mid-semester: 30%</td><td>Theory (%)
70%</td><td>Practical (%)
-</td><td>Other (%)
-</td></tr>
<tr><td colspan="4">Recommended Reading:
1. Abhyankar, K. (2002). Astrophysics: Stars and Galaxies. Universities Press.
2. Dodelson, S. (2003). Modern Cosmology. Cambridge, MA: Academic Press.
3. Freedman, R., & Kaufmann, W. J. (2007). Universe. London, England: Macmillan.
4. Gibilisco, S. (2002). Astronomy Demystified. New York, NY: McGraw Hill Professional.
5. Karttunen, H., Kröger, P., Oja, H., Poutanen, M., & Donner, K. J. (2013). Fundamental Astronomy. Berlin, Germany: Springer Science & Business Media.</td></tr>
</table>

<table>
<tr><td colspan="4">Level II - Semester 1</td></tr>
<tr><td>Course Code:</td><td colspan="3">PH 2005</td></tr>
<tr><td>Course Name:</td><td colspan="3">Waves & Vibrations, Optics and Circuit Theory</td></tr>
<tr><td>Credit Value:</td><td colspan="3">02</td></tr>
<tr><td>Core/Optional</td><td colspan="3">Core</td></tr>
<tr><td rowspan="2">Hourly Breakdown
This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.</td><td>Theory</td><td>Practical</td><td>Independent Learning</td></tr>
<tr><td>30</td><td>--</td><td>70</td></tr>
<tr><td colspan="4">Course Aim/Intended Learning Outcomes:
• examine the motion of free oscillators to forced oscillators,
• analyse the modes of oscillations for oscillators (single or many),
• solve problems related to wave motion and properties in a variety of situations,
• interpret direct current transient circuits and alternating current circuits.
• describe the physical nature of light in terms of the electromagnetism,
• use the wave theory of light to explain polarization, interference and diffraction of light,
• solve problems and describe practical applications related to polarization, interference and diffraction of light,</td></tr>
<tr><td colspan="4">Course Content: (Main topics, Sub topics)
Waves & Vibrations: Periodic motions: sinusoidal vibrations, simple harmonic motion, superposition of two vibrations with 1-D and 2-D; free vibrations, damped harmonic oscillator, forced vibrations, power absorbed by a driven oscillator, resonance; wave equation, wave speeds in specific media, phase and group velocities, impedance and energy flux; reflection and transmission; impedance matching between two media; Fourier analysis of pulses; coupled oscillators; superposition of normal modes, sound; Velocity of sound waves, perception of sound, intensity and pressure level, Doppler effect, acoustics of buildings. Circuit Theory: Voltage and current sources; Different types of alternating voltages and currents; root mean square (rms) values, Circuit elements; Active and passive elements, Resistor networks; Thevenin's and Norton's theorems, Conditions for maximum power and voltage transfer, loading effect, Direct current circuits; transient response of RC and RL circuits, LC oscillations, integrating and differentiating circuits, Low and high pass filters, Alternating current (AC) circuits; Analysis of series and parallel LCR circuits using complex numbers and S-domain, power in AC circuits, resonance in LCR circuits, Single phase and three phase systems (introduction).
Optics: Linear polarization, Malus's Law, circular & elliptical polarization, polarizers, coherence, divisions of wave front and amplitude: Young's double slit experiment, fringes of equal inclination and fringes of equal thickness; Fraunhofer diffraction; Rectangular and circular apertures, resolving power, single slit, double slit and diffraction grating, Fresnel diffraction; Fresnel half period zones, circular aperture, zone plates, strip division of the wave front, Cornu's spiral, straight edge and single slit</td></tr>
<tr><td colspan="4">Teaching /Learning Methods: Lectures, Tutorials, Problem solving sessions</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment
30%</td><td colspan="3">Final Assessment
70%</td></tr>
<tr><td>Details: quizzes %, mid-term %, other % (specify)
Quizzes: 10% Take Home Problem Sets: 20%</td><td>Theory (%)
70%</td><td>Practical (%)
-</td><td>Other (%)
-</td></tr>
<tr><td colspan="4">Recommended Reading:
1. French, A. P. (2001). Vibrations and Waves, MIT Press.
2. Alexander, C., & Sadiku, M. (2006). Fundamentals of Electric Circuit. 5th Ed., McGraw Hill.
3. Hecht, E. (2014). Optics (new international edition—4th edition).
4. Jenkins, F. A., & White, H. E. (1937). Fundamentals of optics. Tata McGraw-Hill Education..
5. Longhurst, R. S. (1970). Geometrical and physical optics. Orient BlackSwan.
6. Chakrabarti, P. (2010). Geometrical & Physical Optics. New Central Book Agency.
7. Fowles, G. R. (1989). Introduction to modern optics. Courier Corporation.</td></tr>
</table>

Level II - Semester 2

Course Code:	**PH 2003**
Course Name:	**Electromagnetic Theory**
Credit Value:	**02**
Core/Optional	**Core**

Hourly Breakdown	Theory	Practical	Independent Learning
This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.	**30**	**--**	**70**

Course Aim/Intended Learning Outcomes:

- explain the fundamental abstract concepts of electromagnetic theory,
- recognize the relationship between concepts of electricity and magnetism,
- apply electromagnetic theory to solve idealistic problems.

Course Content: (Main topics, Sub topics)

Electrostatics: Fields due to static charges, electric field intensity, electric potential, electric dipole, electric flux and Gauss's Law, conductors, boundary conditions at a conducting surface, Poisson and Laplace equation, capacitors, dielectrics, Boundary conditions at the interface of two dielectrics, Method of images, Current density and equation of continuity. *Magnetostatics:* Magnetic field, magnetic force on current, magnetic flux and Gauss' law of the magnetic field, Biot Savart Law, Ampere's Law *Electrodynamics:* Electric current, current density, conservation of charge, microscopic view of Ohm's law, Faraday's law of electromagnetic induction, inductance, Electric fields in different frames of reference. *Maxwell's Equations:* Maxwell's equations and displacement current, plane electromagnetic waves in free space.

Teaching /Learning Methods: Lectures, Tutorials, Problem solving sessions

Assessment Strategy:

Continuous Assessment 30%	Final Assessment 70%		
Details: quizzes %, mid-term %, other % (specify)	Theory (%)	Practical (%)	Other (%)
Quizzes: 10% Mid-term Assessment: 20%	70%	-	-

Recommended Reading:

1. Griffiths, D.J., (2005). *Introduction to electrodynamics*.
2. Purcell, E. M., & Morin, D. J. (2013). *Electricity and Magnetism*. Cambridge, England: Cambridge University Press.

<table>
<tr><td colspan="4">Level II - Semester 1</td></tr>
<tr><td>Course Code:</td><td colspan="3">PH 2006</td></tr>
<tr><td>Course Name:</td><td colspan="3">Nanoscience & Nanotechnology</td></tr>
<tr><td>Credit Value:</td><td colspan="3">02</td></tr>
<tr><td>Core/Optional</td><td colspan="3">Optional</td></tr>
<tr><td rowspan="2">Hourly Breakdown
This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.</td><td>Theory</td><td>Practical</td><td>Independent Learning</td></tr>
<tr><td>15</td><td>30</td><td>55</td></tr>
<tr><td colspan="4">Course Aim/Intended Learning Outcomes:
describe historical developments in the field of nanoscience and nanotechnology in relation to theory, processing, properties and applications,
describe qualitatively the underlying main concepts in nanoscience and nanotechnology,
describe and analyse above concepts in relation to nanomaterial synthesis, structure and activity,
apply the above leaning to evaluate case studies of national importance,
work with experts both internal and external in carrying out short term feasibility projects that is of national importance</td></tr>
<tr><td colspan="4">Course Content: (Main topics, Sub topics)
Course will be offered in two parts; 15 hours of lectures that discuss basic concepts related to theory, synthesis, structure and characterization in nanoscience and nanotechnology and guided group projects where the student will apply the concepts learned in part 1 in evaluating case studies of national importance.
Part1: Nanoscale; scaling laws; historical developments: theoretical framework, nanoscale imaging; introduction to nanoscale physics: wave-particle duality, quantization of energy, energy bands, atomic spectra, photoelectric effect, electrons and holes, plasmonic resonance, tunnelling; Nanomaterials: Bonding in atoms, crystal structures, zero, one, two and three dimensional materials, porous materials, molecules; Nanomaterial synthesis: top-down and bottom-up approaches; imaging and characterization at nanoscale; nanobiotechnology
Part 2: Student will work on case studies in one of the following identified areas of local importance
High value mineral resources, Smart textile and flexible electronics, Water purification, Smart agriculture and packaging</td></tr>
<tr><td colspan="4">Teaching /Learning Methods: Lectures, Tutorials, Problem solving sessions, Projects</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment
50%</td><td colspan="3">Final Assessment
50%</td></tr>
<tr><td>Details: quizzes %, mid-term %, other % (specify)
Quizzes/viva voce: 20% Take Home Problem
Sets/Projects Report: 30%</td><td>Theory (%)
50%</td><td>Practical (%)
-</td><td>Other (%)
-</td></tr>
<tr><td colspan="4">Recommended Reading:
Ben Rogers, Jesse Adams, Sumita Pennathur (1996). Nanotechnology the Whole Story (Vol. 8, pp. 105-130). New York: Wiley.
Alain Nouailhat (2010). Introduction to Nanoscience and Nanotechnology (saunders college, philadelphia, 1976). Appendix N.</td></tr>
</table>

<table>
<tr><td colspan="4">Level II - Semester 1</td></tr>
<tr><td>Course Code:</td><td colspan="3">PH 2022</td></tr>
<tr><td>Course Name:</td><td colspan="3">Analog and Digital Electronic Principles Laboratory</td></tr>
<tr><td>Credit Value:</td><td colspan="3">02</td></tr>
<tr><td>Core/Optional</td><td colspan="3">Core</td></tr>
<tr><td rowspan="2">Hourly Breakdown
This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.</td><td>Theory</td><td>Practical</td><td>Independent Learning</td></tr>
<tr><td>--</td><td>60</td><td>40</td></tr>
</table>

Course Aim/Intended Learning Outcomes:

- describe the operational behaviour of basic electronic devices,
- recognize the functionality of basic electronic components,
- analyse the operational behaviour of electronic circuits,
- synthesize electronic circuits for given requirements,
- follow instructions and build electronic circuits that perform simple tasks,
- apply the concepts and principles of analogue and digital electronic circuits to solve engineering problems required for initial design activities,
- design and analyse simple analogue and digital circuits,
- develop, implement, and test an electronic circuit,
- document the implementation and verification of electronic circuits,
- orally explain the function and operation of simple electronic circuits.

Course Content: (Main topics, Sub topics)

The course focuses on providing the student with hands-on knowledge in the electronics laboratory through a series of experiments. The course involves exercises such as studying the characteristics of electrical & electronic components/circuits and their applications & interpretation of results. Student active forms of hybrid learning sessions include participating in student centered lecture sessions and laboratory activities with guidance by the instructors which consist of laboratory exercises using personal lab equipment. Following topics are to be covered under this course:

Diode as a circuit element, Diode models, Rectifier circuits, Zener diodes, Voltage regulation and low voltage power supply. Bipolar transistors, Operation of an npn transistor in the active mode, Transistor biasing and transistor as an amplifier, Designing of a common emitter amplifier, Voltage gain, Transistor as a switch using cut-off and saturation modes. Oscillators, Operational amplifiers, Inverting and non-inverting amplifiers, Op-amp based electronic ammeters and voltmeters, Analogue differentiators and integrators, Digital electronics and voltage levels, Basic logic gates, Introduction to logic families, Designing of combinational logic circuits, Minimization of logic expressions using algebraic and Karnaugh map methods, Construction of a full adder, Addition and Subtraction

Teaching /Learning Methods: Lab-based experiments and/or Take Home Experiments

Assessment Strategy:

<table>
<tr><td>Continuous Assessment
60%</td><td colspan="3">Final Assessment
40%</td></tr>
<tr><td>Details: quizzes %, mid-term %, other % (specify)
Weekly Experiments & Viva: 60%</td><td>Theory (%)
-</td><td>Practical (%)
40%</td><td>Other (%)
-</td></tr>
</table>

Recommended Reading:

1. Horowitz, P., & Hill, W. (2015). The Art of Electronics. Cambridge, England: Cambridge University Press.
2. Malvino A. and D. J. Bates, Electronic Principles 7/e, Tata McGraw Hill, 2010.
3. Boylestad R. L. and L. Nashelsky, Electronic Devices and Circuit Theory, 10/e, Pearson Education India, 2009.
4. Lecture Handouts and Laboratory instruction sheets prepared by the Department of Physics.

Level I - Semester 2			
Course Code:	PH 2023		
Course Name:	Analog and Digital Electronic Applications Laboratory		
Credit Value:	02		
Core/Optional	Optional		
Hourly Breakdown *This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.*	Theory	Practical	Independent Learning
	--	60	40

Course Aim/Intended Learning Outcomes:

- design and synthesize operation of selected electronic circuits using principles related to analogue & digital Electronics,
- setup and use appropriate laboratory instruments to test, evaluate and communicate the functionality and performance of practical electronic circuits,
- apply appropriate computer-based methods in capturing, designing, modeling and analysing the functionality and performance of analogue and digital circuits.
- implement the designed electronic circuits with cost-effective readily available components,
- troubleshoot shortcomings in the designed circuit,
- design, draw, and construct printed circuit boards for the given application,
- document the implementation and verification of the designed/tested circuits,
- orally explain the function and operation of the designed/tested circuits.

Course Content: (Main topics, Sub topics)

This course focuses on providing the student with hands-on learning in applications in analogue & digital electronics through relevant laboratory work and a series of experiments. The course involves exercises such as designing a circuit for a relevant application using analogue and digital electronic components, devices, integrated circuits and systems/ units. The course also involves participating in student-centered lecture sessions, performing designing, testing, validating, etc., using electronic schematic capture and simulation programs such as EWB, Multisim and SPICE or any other appropriate software.

Teaching /Learning Methods: Lab-based experiments

Assessment Strategy:

Continuous Assessment 60%	Final Assessment 40%		
Details: quizzes %, mid-term %, other % (specify) Weekly Experiments & Viva: 60%	Theory (%) -	Practical (%) 40%	Other (%) -

Recommended Reading:

1. Horowitz, P., & Hill, W. (2015). The Art of Electronics. Cambridge, England: Cambridge University Press.
2. Sedra, A. S., & Smith, K. C. (2004). Microelectronic Circuits. New York: Oxford University Press.
3. Boylestad R. L. and L. Nashelsky, Electronic Devices and Circuit Theory, 10/e, Pearson Education India, 2009.
4. Choudhury R., Linear Integrated Circuits, New Age International Publishers. 2008.
5. Handouts and Laboratory instruction sheets prepared by the Department of Physics.

<table>
<tr><td colspan="4">Level I - Semester 2</td></tr>
<tr><td>Course Code:</td><td colspan="3">IT 1001</td></tr>
<tr><td>Course Name:</td><td colspan="3">Programming Laboratory</td></tr>
<tr><td>Credit Value:</td><td colspan="3">03</td></tr>
<tr><td>Core/Optional</td><td colspan="3">Optional</td></tr>
<tr><td rowspan="2">Hourly Breakdown
This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.</td><td>Theory</td><td>Practical</td><td>Independent Learning</td></tr>
<tr><td>15</td><td>60</td><td>75</td></tr>
<tr><td colspan="4">Course Aim/Intended Learning Outcomes:
● critically analyse, divide and conquer problems
● solve real world problems using computer programs
● design, develop and reuse software libraries</td></tr>
<tr><td colspan="4">Course Content: (Main topics, Sub topics)
Introduction to flowcharts; Introduction to languages: history, high level and low level languages, compiled vs interpreted languages; setting up programing environment; keywords, comments, variables, constants and data types, type casting; statements and expressions: operators: arithmetic, logical, relational, bitwise, operator precedence; basic program control: conditional statements, loops, break/continue statements; functions: returning, arguments, recursions; arrays, matrices, and composite data types; I/O operations: command line arguments and parsing, file handling; exception handling; debugging; popular numerical libraries; data visualisation; statistical data analysis: error analysis, curve fitting; simple applications: basic numerical integration of Newton's second law, logistic equation, fractals, turtle graphics, random numbers and simple Monte Carlo methods.</td></tr>
<tr><td colspan="4">Teaching /Learning Methods: Computer lab-based learning and/or take-home programming exercises</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment
70%</td><td colspan="3">Final Assessment
30%</td></tr>
<tr><td>Details: in-class assignments 40%, take-home assignments 30%</td><td>Theory (%)
-</td><td>Practical (%)
30%</td><td>Other (%)
-</td></tr>
<tr><td colspan="4">Recommended Reading:
1. Zhang, T. (1997). Teach yourself C in 24 hours (1st ed.). Indianapolis IN: Sams Pub.
2. Matthes, E. (2019). Python crash course : a hands-on, project-based introduction to programming (2nd ed.). San Francisco, CA: No Starch Press</td></tr>
</table>

Level I - Semester 1			
Course Code:	**PH 1051**		
Course Name:	**Modern Physics for Medical Imaging**		
Credit Value:	**02**		
Core/Optional	**Core**		
Hourly Breakdown *This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.*	Theory	Practical	Independent Learning
	30	**-**	**70**

Course Aim/Intended Learning Outcomes:

- explain the failures of classical theories applied to microscopic world,
- interpret the conceptual basis of quantum theory,
- discuss the diverse applications of quantum theory,
- solve problems in modern physics topics,
- interpret experiments and related observations in modern physics.

Course Content: (Main topics, Sub topics)

Survey on historical background and failures of classical Physics, ideas related to blackbody radiation, Planck's theory and its implications. Photoelectric effect, Compton effect, X-rays, production of X-rays, pair production and pair annihilation, the dual nature of electromagnetic radiation, matter waves,de Broglie's postulate & de Broglie wavelength, the wave-particle duality, atomic spectra, Frank and Hertz experiment, Thomson's and Rutherford's model of the atom, Bohr model of the atom, one electron atom, energy quantization, Rydberg constant, Correspondence principle, Uncertainty principle, Introduction to Schrodinger wave equation.

Teaching /Learning Methods: Lectures, Tutorials, Problem solving sessions

Assessment Strategy:

Continuous Assessment 30%	Final Assessment 70%		
Details: quizzes %, mid-term %, other % (specify) Mid-semester-30%	Theory (%) 70%	Practical (%) -	Other (%) -

Recommended Reading:

1. Tipler, P. A., & Llewellyn, R. (2003). *Modern Physics*. London, England: Macmillan.
2. Serway, Raymond A., Clement J. Moses, and Curt A. Moyer. (2004) *Modern physics*. Cengage Learning.

<table>
<tr><td colspan="4">Level I - Semester 2</td></tr>
<tr><td>Course Code:</td><td colspan="3">PH 1052</td></tr>
<tr><td>Course Name:</td><td colspan="3">Electronics for Medical Imaging</td></tr>
<tr><td>Credit Value:</td><td colspan="3">02</td></tr>
<tr><td>Core/Optional</td><td colspan="3">Core</td></tr>
<tr><td rowspan="2">Hourly Breakdown
This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.</td><td>Theory</td><td>Practical</td><td>Independent Learning</td></tr>
<tr><td>0</td><td>60</td><td>40</td></tr>
<tr><td colspan="4">Course Aim/Intended Learning Outcomes:
At the completion of this course student will be able to
● explain the behavior of the materials and electronic components
● make use of test and measuring instruments to diagnose and evaluate electronic circuits
● design and synthesize electronics circuits to perform a given task</td></tr>
<tr><td colspan="4">Course Content: (Main topics, Sub topics)
Materials and conductivity:semiconductors, doping, pn junctions; passive electrical elements and LCR networks, signals and filters; diodes and applications: diode networks, Zener diodes, LEDs, photodiodes and solar cells; BJT transistors and their applications as switches and as amplifiers; operational amplifiers and their applications; sequential logic circuits; combinational logic circuits; ADCs and DACs</td></tr>
<tr><td colspan="4">Teaching /Learning Methods:
Interactive laboratory sessions will be conducted</td></tr>
<tr><td colspan="4">Assessment Strategy: Continuous assessment together with capstone project will be conducted</td></tr>
<tr><td>Continuous Assessment

70%</td><td colspan="3">Final Assessment

30%</td></tr>
<tr><td>Details: Weekly assignments:50% Capstone project: 20%</td><td>Theory (%)

-</td><td>Practical (%)

30%</td><td>Other (%)(specify)

-</td></tr>
<tr><td colspan="4">Recommended Reading:
1. Laboratory sheets available in the LMS
2. Horowitz, P., & Hill, W. (2015). The Art of Electronics. Cambridge, England: Cambridge University Press</td></tr>
</table>

<table>
<tr><td colspan="4">Level II - Semester 1</td></tr>
<tr><td>Course Code:</td><td colspan="3">PH 2051</td></tr>
<tr><td>Course Name:</td><td colspan="3">Electromagnetic Theory for Medical Imaging</td></tr>
<tr><td>Credit Value:</td><td colspan="3">02</td></tr>
<tr><td>Core/Optional</td><td colspan="3">Core</td></tr>
<tr><td rowspan="2">Hourly Breakdown</td><td>Theory</td><td>Practical</td><td>Independent Learning</td></tr>
<tr><td>30</td><td></td><td>70</td></tr>
<tr><td colspan="4">Course Aim/Intended Learning Outcomes:
(how to write ILOs: At the completion of this course student will be able to - in action verbs)
● understand the fundamental concepts of electricity and magnetism
● recognize the relationship between concepts of electricity and magnetism
● apply concepts in electricity and magnetism to solve problems.</td></tr>
<tr><td colspan="4">Course Content: (Main topics, Sub topics)
Static Electric Fields: Coulomb's law, Electric field and potential due to charge distributions, electric dipole, Gauss' law for electrostatics, capacitors, dielectrics, Static Magnetic Fields: Biot Savart law, magnetic flux density, Static Force on a current carrying wire due to a magnetic field, magnetic moment, Ampere's law, Faraday's law, self and mutual inductance, magnetic energy.</td></tr>
<tr><td colspan="4">Teaching /Learning Methods:
Lectures, Tutorials, Problem solving sessions</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment
30%</td><td colspan="3">Final Assessment
70%</td></tr>
<tr><td>Details: quizzes %, mid-term %, other % (specify)
Quizzes: 10% Take Home Problem Sets: 20%</td><td>Theory (%)
70%</td><td>Practical (%)
----</td><td>Other (%)(specify)
-----</td></tr>
<tr><td colspan="4">Recommended Reading:
1. Serway R.A. and Jewett J.W. Jr. (2019), Physics for Scientists and Engineers (9th Edition) Chap 22 to 25 and Chap 28 to 31
2. Halliday, D. Resnick, R. and Walker, J. (2010), Fundamentals of Physics, 9th Edition, Chap 21 to 25 and 28 to 30
3. OR Young, H.D. and Freedman, R.A. (2013), University Physics, 13th Edition, Chap 21 to 24 and 27 to 30.</td></tr>
</table>

Level I - Semester			
Course Code:	PH 2024		
Course Name:	Electronics and computing laboratory		
Credit Value:	02		
Core/Optional	Optional		
Hourly Breakdown *This should be provided as hours assigned for lectures, practical classes or independent learning, such that a total of 50 notional hours of learning are required for each credit. For industrial training and research projects, one credit requires 100 notional hours of learning.*	Theory	Practical	Independent Learning
	-	60	40

Course Aim/Intended Learning Outcomes:

- solve real world problems using computer programs,
- program microcontroller-based platforms to make standalone devices,
- develop electronic circuits for interfacing external peripherals to microcontroller-based systems.

Course Content: (Main topics, Sub topics)

Hands-on learning in computer programing, algorithm development, and numerical computing, and applying the programming skills in the context of programmable electronics through relevant laboratory work and a series of experiments. In addition, design and development of interfacing circuits for sensors and actuators. Setting up programing environment; keywords, comments, variables, constants and data types, type casting; statements and expressions: operators: arithmetic, logical, relational, bitwise, operator precedence; basic program control: conditional statements, loops, break/continue statements; functions: returning, arguments, recursions; arrays, matrices, and composite data types; introduction to microcontroller platforms/families; handling built-in peripherals: ports, ADCs, comparators, timers; interfacing external peripherals: LEDs, SSDs, LCDs, switches, sensors, etc.; communication between devices: RS232, SPI, I2C;

Teaching /Learning Methods: Computer lab-based learning and/or take-home programming exercises

Assessment Strategy:

Continuous Assessment 70%	Final Assessment 30%		
Details: Assignments 70%	Theory (%) -	Practical (%) 30%	Other (%) -

Recommended Reading:

1. Zhang, T. (2000). Teach yourself C in 24 hours (2nd ed.). Indianapolis, IN: Sams Pub.
2. Matthes, E. (2019). Python crash course: a hands-on, project-based introduction to programming (2nd ed.). San Francisco, CA: No Starch Press
3. Sedra, A. S., & Smith, K. C. (2004). Microelectronic Circuits. New York: Oxford University Press.
4. Laboratory instruction sheets prepared by the Department of Physics.