Physics Curriculum - Level 1G

Title of the Course Unit	**Practical Physics I**	
Course Code	PHY 101 G2	
Credit Value	02 (90 Hours of Practicals)	
Objectives	• Improve skills in carrying out basic measurements and writing practical reports • Assess different types of experimental errors and propose methods to minimize them • Design of experiments to extract maximum possible information • Extraction of useful information from experimental data	
Intended Learning Outcomes	• Analyze different types of errors associated with scientific measurements • Develop experimental skills to carry out laboratory practicals • Explain experimental findings in relation to existing theories • Conclude the experimental results	
Contents	Introduction of measuring instruments for mechanical, electrical and thermal measurements	
	Basic measurements of physical quantities, estimating experimental errors and ways to minimize them	
	Experiments related to Mechanics, Properties of Matter, Optics, Basic Electricity and Electronics	
Teaching and Learning Methods / Activities	Laboratory demonstration Handouts Weekly lab reports	
Evaluation	Continuous assessment on practical classes and lab reports	20 %
	Full reports	20 %
	In-course assessment on basic measurements and error analysis	20 %
	End of semester practical examination	40 %
Recommended References	• Practical Physics (fourth edition), G.L. Squires, Cambridge University Press (2001) • Experiments and Demonstrations in Physics (second edition), Yaakov Kraftmakher, World Scientific (2014) • The Uncertainty in Physical Measurements: An Introduction to Data Analysis in the Physics Laboratory, Paolo Fornasini, Springer (2008)	

Title of the Course Unit	**Mechanics**	
Course Code	PHY 102 G2	
Credit Value	02 (30 Hours of Lectures and Tutorials)	
Objectives	• Apply the principles of Newtonian mechanics to a wide variety of problems observed in nature • Introduce the conservation of momentum and energy to solve particle collision problems • Illustrate the particle motion in gravitational field	
Intended Learning Outcomes	• Apply different forces and work-force problems applying Newton's laws • Identify the different forms of energy and use conservation of energy to solve problems • Define impulse, momentum and collisions • Describe the fluid in motion and stationary • Apply law of universal gravitation and explain the motion of planets and satellite	
Contents	**Mechanics:** Laws of motion, inertial and non-inertial frames of reference, inertial mass, inertial forces, conservation of mass and momentum, work and kinetic energy, conservative forces and potential energy, conservation of total energy, collision of particles. Motion in the centre of mass frame of reference, motion relative to a rotating frame of reference, torque and angular momentum, conservation of angular momentum, rotational motion of rigid bodies, moment of inertia, gyroscopic motion.	
	Fluid Mechanics: Fluid motion, Bernoulli's theorem, Poiseuille's law for flow through a capillary tube, Stokes' law.	
	Gravitational field: The law of universal gravitation, gravitational mass and the principle of equivalence, motion of planets and satellites, Kepler's laws, atomic analogue of planetary motion, concept of reduced mass	
Teaching and Learning Methods / Activities	Lectures and tutorial discussions Laboratory works Home-work assignments	
Evaluation	In-Course Assessment Examinations	30 %
	End of Course Examination	70 %
Recommended References	• An Introduction to Mechanics (2nd edition), Daniel Kleppner and Robert Kolenkow, Cambridge University Press (2013) • Problems and Solutions in Introductory Mechanics, David J. Morin, Create-Space Independent Publishing Platform (2014)	

Title of the Course Unit	**Vibrations, Waves and AC theory**	
Course Code	PHY103 G2	
Credit Value	02 (30 Hours of Lectures and Tutorials)	
Objectives	• Distinguish different types of vibratory motions • Describes vibrations, oscillations and waves • Assess the performance of various combination of electrical components in *ac* circuits	
Intended Learning Outcomes	• Solve different types of vibratory motions using the basic principles of physics • Develop the mathematical formalism that describes vibrations, oscillations and waves • Analyze different kinds of vibrations and waves • Analyze circuits with various electrical components	
Contents	**Mechanical vibrations:** Simple harmonic and damped harmonic oscillations, free and forced oscillations, mechanical impedance, resonance, coupled oscillations and normal modes.	
	Waves: Types of waves, Waves on a string, 1-D wave equation, running and standing waves, superposition of waves, phase and group velocities, beats, Doppler Effect.	
	Electrical oscillation: Alternating current and voltage, relative phases of voltages and currents, simple filter circuits, phase diagrams, superposition of oscillations, beats, amplitude modulation, electrical resonance in an LCR circuit, bandwidth power and quality factor.	
	Complex representation of oscillations: Representation of oscillations in the complex plane, complex *ac* current and voltage in resistors, capacitors and inductors and complex impedance.	
Teaching and Learning Methods / Activities	Lectures and tutorial discussions	
Evaluation	In-Course Assessment Examinations	30 %
	End of Course Examination	70 %
Recommended References	• The Physics of Vibrations and Waves (6th edition), H.J. Pain, John Wiley & Sons, Ltd (2005), Print ISBN:9780470012956, Online ISBN:9780470016954 • Vibrations and Waves, A.P. French, The MIT Introductory Physics Series, CBS Publishers (2003) ISBN 0748744479, 9780748744473 • Advanced AC Circuits and Electronics: Principles and Applications, J. Michael Jacob, Herrick & Jacob series, Cengage Learning (2004), ISBN 076682330X, 9780766823303	

Course Unit	Electricity and Electromagnetic fields		
Course Code	PHY106 G2		
Credit Value	02		
Hourly break down	Theory	Practical	Independent Studies
	30	-	70

Objectives

- Develop problem solving skills in linear electric circuits
- Apply basic laws of electromagnetic fields to solve simple problems

Intended Learning Outcomes

- Recall the concept of electric potential, current and resistance
- Discuss Ohm's law, Kirchhoff laws, Thevenin's Theorem and Norton's theorem
- Make use of the above theorems to analyze resistive circuits
- Apply the fundamental laws of the electric and magnetic field for solving simple problems

Contents

- **Electrical circuits:** Voltage, current and charge in circuits, electrical resistance, Resistors in series and parallel, linear electric circuits, Kirchhoff's Laws, Superposition theorem, Thevanin's theorem, Norton's theorem, Maximum power transfer theorem, Wheatstone's Bridge, Meter bridge and Potentiometer
- **Electric fields:** Coulomb's Law, electric field, electrostatic potential, Gauss's Law in electrostatics, electric dipoles, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy
- **Magnetic fields:** Force on moving charges, Biot-Savart law, magnetic flux density, Ampere's Law, magnetic flux in circuits, Faraday's Law, self-inductance, energy in magneto-statics, motion of charged particles in electric and magnetic fields.

Teaching and Learning Methods / Activities

Lecture, tutorial discussions, Self-learning, handouts, e-resource

Evaluation

In-Course Assessment Examinations	30 %
End of Course Examination	70 %

Recommended References

- Electricity and Magnetism (Vol 1, 3rd Ed.), B.I. Bleaney and B. Bleaney, Oxford University Press, 2013 (ISBN-10: 0199645426ISBN-13: 9780199645428)
- Electromagnetism (2nd Ed.), I.S. Grant and W.R. Phillips, Wiley-Blackwell, 1990 (ISBN 10: 0471322458, ISBN-13: 9780471322450)

Course Title	Electronics		
Course Code	PHY107 G2		
Credit Value	02		
Hourly break down	Theory	Practical	Independent Studies
	30	-	70

Objectives

- Describe the fundamentals and properties of semiconductors
- Explain the working principles of semiconductor Diodes and Transistors and their applications
- Design simple analog and digital electronic circuits

Intended Learning Outcomes

- Recall the properties and classification of semiconductors
- Explain the working principle of a p-n junction diode and its applications
- Discuss the characteristics of Bipolar junction transistors (BJT) and Field Effect Transistors (FET)
- Design simple electronic circuits using BJT and FET
- Discuss the key characteristics of operational amplifiers and its application in analog computing
- Design simple combinational and sequential logic circuits using logic devices.

Contents

- **p-n junctions:** Semiconductors, Energy levels and bands, types and properties of semiconductors, Diodes and their characteristics, rectification, smoothing, voltage regulation using Zener diodes, light emitting diodes and photovoltaic devices.
- **Bipolar Junction Transistor (BJT):** Junction transistors and their characteristics, Biasing a BJT, Transistor as an amplifier, AC equivalent circuit of a BJT (h-model), Small signal AC analysis of common emitter, and common collector amplifiers
- **Field Effect Transistors (FET):** Junction field effect transistors (JFETs) and their characteristics, JFET amplifiers, DC and AC analysis of a common source, and source follower amplifiers, Introduction to MOSFETs.
- **Operational amplifier circuits**: Properties of an ideal and practical operational amplifiers, the 741 op-amp, Application of op-amps to perform mathematical operations.
- **Introduction to digital electronics**: Basics of digital electronics, Boolean algebra, logic simplification, logic gates, combinational circuits, introduction to flip-flops, shift registers, counters, and sequential circuits.

Teaching and Learning Methods

Lectures, Self-learning, Tutorial discussions, Handouts, e-resource

Evaluation

In-Course Assessment Examinations	30 %
End of Course Examination	70 %

Recommended References

- Millman, J., Halkias, C.C. and Jit, S., Electronic Devices and Circuits (3rd Ed.), McGraw Hill Education (India) Pvt. Ltd, 2013 (ISBN 10: 0070700214 , ISBN 13: 9780070700215)
- Roy Choudhury, D., and Jain, B., Linear Integrated Circuits, New Age Science Limited, 4th illustrated edition, 2010, ISBN 1906574715, 9781906574710
- Morris Mano, M., Digital Design, Prentice Hall; 3 Ed., **2001**, ISBN-13: 978-0130621214