

# DEPARTMENT OF PHYSICS

SYLLABUS FOR FOUR YEAR UNDERGRADUATE PROGRAMME

FIRST AND SECOND SEMESTER

(APPROVED BY ACADEMIC COUNCIL VIDE RESOLUTION NO. 3, DATED: 04 – 07 – 23)



ARYA VIDYAPEETH COLLEGE (AUTONOMOUS)

ARYA NAGAR, GUWAHATI – 16

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### Structure of Four Year Undergraduate Course

Semester	Type	Core	Minor	SEC	IDC	AEC	VAC/FC	IN
	Credit	4	4	3	3	2	4(2 + 2)	2
I		CE-1114	MN-1114	SE-1113	ID-1113	AE-1112	VL-1112 (Two Courses)	-
II		CE-2114	MN-2114	SE-2113	ID-2113	AE-2112	VL-2112 (Two Courses)	-
III		CE-3214	MN-3214	SE-3213	ID-3213	AE-3212	-	-
		CE-3224						
IV		CE-4214	MN-4214	-	-	AE-4212	-	IN-4212
		CE-4224						
		CE-4234						
V		CE-5314	MN-5214	-	-	-	-	-
		CE-5324						
		CE-5334						
		CE-5344						
VI		CE-6314	MN-6214	-	-	-	-	-
		CE-6324						
		CE-6334						
		CE-6344						
VII		CE-7414	MN-7314	-	-	-	-	-
		CE-7424						
		CE-7434						
		CE-7444						
VIII		CE-8414	MN-8314	-	-	-	-	-
		CE-8424**						
		CE-8434**						
		CE-8444**						

**\*\*Students who secure more than 7.5 CGPA at the end of third year (6<sup>th</sup> semester) may opt for a research dissertation of 12 credits instead of the three core papers.**

**Course code:** First two letters is the abbreviation of course component

First digit implies semester number

Second digit implies course level

Third digit implies course number

Fourth digit implies credit points per course

Digit	Course Level
1	100 - 199
2	200 - 299
3	300 - 399
4	400 - 499

## Semester Wise Credit Distribution

Semester	CREDIT DISTRIBUTION							
	CORE	MINOR	SEC	AEC	IDC	VAC/FC	IN	TOTAL
FIRST	1 x 4	1 x 4	1 x 3	1 x 2	1 x 3	2 x 2	--	20
SECOND	1 x 4	1 x 4	1 x 3	1 x 2	1 x 3	2 x 2	--	20
THIRD	2 x 4	1 x 4	1 x 3	1 x 2	1 x 3	--	--	20
FOURTH	3 x 4	1 x 4	--	1 x 2	--	--	1 x 2	20
FIFTH	4 x 4	1 x 4	--	--	--	--	--	20
SIXTH	4 x 4	1 x 4	--	--	--	--	--	20
SEVENTH	4 x 4	1 x 4	--	--	--	--	--	20
EIGHT	4 x 4	1 x 4	--	--	--	--	--	20

**SEC: SKILL ENHANCEMENT COURSE**

**AEC: ABILITY ENHANCEMENT COURSE**

**IDC: INTERDISCIPLINARY COURSE**

**VAC/FC: VALUE ADDED COURSE**

**IN: INTERNSHIP**

**Abbreviation of Course Components:**

**CE (Core), MN (Minor), SE(Skill Enhancement Course), AE (Ability Enhancement Course), VL (Value added Course), ID (Interdisciplinary Course), IN (Internship)**

**LIST OF PAPERS:**

**CORE:**

1. Mathematical Physics - I and Mechanics – I (PY – CE – 1114 )
2. Mathematical Physics - II and Properties of Matter (PY – CE – 2114 )

**MINOR:**

1. Mathematical Physics - I and Mechanics – I (PY – MN – 1114 )
2. Mathematical Physics - II and Properties of Matter (PY – MN – 2114 )

**SKILL ENHANCEMENT COURSE:**

1. Basic Computer Knowledge (PY – SE – 1113 )
2. Programming Skills with Python (PY – SE – 2113 )

**MULTIDISCIPLINARY/INTERDISCIPLINARY COURSE:**

1. Physics for All - 1 (PY – ID – 1113 )
2. Physics for All - 2 (PY – ID – 2113 )

# FIRST SEMESTER



**PAPER NAME: Mathematical Physics - I and Mechanics - I**

**PAPER CODE: PY- CE - 1114**

**Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)**

**THEORY**

**Total Lectures: 45**

**COURSE OBJECTIVES:**

- *To impart advanced concepts and methods in Mathematics which include the Calculus of vector-valued functions.*
- *To impart basic concepts of work-energy principle, rigid body dynamics, laws of gravitation, and a basic concept of relativity.*

**COURSE OUTCOME:**

- *After completing the course a student will be able to understand vector and their applications in various fields.*
- *Further, a student will be able to understand and solve a real-life problem that needs an understanding of the laws of mechanics, gravitation, and relativity.*

**Mathematical Physics - I (Credit - 1; No. of lectures - 15)**

**Unit I: Vector and scalars(Lectures 2)**

Introduction, dot and cross products including triple products, their physical significance

**Unit II: Vector differentiation (Lectures 3)**

Ordinary derivative of vectors, continuity, and differentiability, the partial derivative of vectors, applications to problems in Physics.

**Unit III: Vector differential operator(Lectures 5)**

Gradient, divergence, and curl - definitions and physical meaning, formulas involving  $\nabla$  and invariance

**Unit IV: Vector Integration (Lectures 5)**

Ordinary integrals of vectors - line integral, surface integral and volume integral, Gauss's theorem, Stoke's theorem and Green's theorem (no rigorous proof is required)

**Mechanics – I (Credit - 2; No. of lectures - 30)**

**Unit V: Work energy principle (Lectures 8)**

Laws of motion - Concepts of work, energy, and power, Conservative forces - conservative force as a negative gradient of potential, Conservation of linear and angular momentum,

motion of a rocket.

Centre of mass - motion of the centre of mass, collision problem in the centre of mass frame of reference and laboratory frame of reference

### **Unit VI: Rigid body dynamics (Lectures 9)**

Rotational motion - translation and rotational motion, torque, angular momentum. Moment of inertia - general theorem of the moment of inertia, moment of inertia calculation in particular cases - disk, cylinder, and sphere; flywheel, the kinetic energy of rotational motion.

### **Unit VII: Gravitation (Lectures 7)**

Newton's law of gravitation, Gravitational field - the intensity of the field, gravitational potential, and gravitational potential energy; gravitational field and potential due to a solid sphere and spherical shell.

Motion under the central force field, two body problems, and reduced mass.

### **Unit VIII: Special theory of relativity (Lectures 6)**

Reference frame - inertial and non-inertial, Galilean Transformation, Galilean Invariance, Postulates of special theory of relativity, Lorentz Transformation equations - length contraction, time dilation and mass variation.

## **PRACTICAL**

**Total Lectures: 30**

### **COURSE OBJECTIVES:**

- *To impart hands-on experience and learning on the basic principle of mechanics.*

### **COURSE OUTCOME:**

- *After completing the course a student will be able to handle laboratory equipment safely and efficiently and plan and carry out experimental procedures.*

***A minimum of five experiments to be done.***

1. To measure the thickness of a piece of glass using a vernier calliper, screw gauge, and spherometer and compare their results.
2. To measure the diameter of a capillary tube using a traveling microscope.
3. To determine the height using a sextant.
4. To determine the Moment of Inertia of a Symmetrical body about an axis by the torsional oscillation method.
5. To determine the moment of inertia of a flywheel.
6. To find the angular acceleration and torque of a flywheel.
7. To determine the value of g using Bar Pendulum.



8. To determine the value of  $g$  using Kater's Pendulum
9. To determine the value of  $g$  using the motion of an oscillating spring.

### **BOOKS RECOMMENDED**

1. Vector Analysis, Murray R. Spiegel (Schaum Series)
2. Mathematical Methods for Engineers and Scientists, K. T. Tang
3. Higher Engineering Mathematics, H. K. Das.
4. An Introduction to Mechanics, D. Kleppner, R. J. Kolenkow, 1973, McGraw Hill.
5. Mechanics, D. S. Mathur, S. Chand and Company Limited, 2000
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. Physics, Resnick, Halliday, and Walker 8/e. 2008, Wiley.
8. B. Sc. Practical Physics, C. L. Arora, S. Chand, and Company.
9. A Text Book on Practical Physics, K. G. Mazumdar, and B. Ghosh.

**PAPER NAME: Mathematical Physics - I and Mechanics - I**

**PAPER CODE: PY- MN - 1114**

**Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)**

**THEORY**

**Total Lectures: 45**

**COURSE OBJECTIVES:**

- *To impart advanced concepts and methods in Mathematics which include the Calculus of vector-valued functions.*
- *To impart basic concepts of work-energy principle, rigid body dynamics, laws of gravitation, and a basic concept of relativity.*

**COURSE OUTCOME:**

- *After completing the course a student will be able to understand vector and their applications in various fields.*
- *Further, a student will be able to understand and solve a real-life problem that needs an understanding of the laws of mechanics, gravitation, and relativity.*

**Mathematical Physics - I (Credit - 1; No. of lectures - 15)**

**Unit I: Vector and scalars(Lectures 2)**

Introduction, dot and cross products including triple products, their physical significance

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Ordinary derivative of vectors, continuity, and differentiability, the partial derivative of vectors, applications to problems in Physics.

**Unit III: Vector differential operator(Lectures 5)**

Gradient, divergence, and curl - definitions and physical meaning, formulas involving del and invariance

**Unit IV: Vector Integration (Lectures 5)**

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**Mechanics – I (Credit - 2; No. of lectures - 30)**

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Laws of motion - Concepts of work, energy, and power, Conservative forces - conservative force as a negative gradient of potential, Conservation of linear and angular momentum,

motion of a rocket.

Centre of mass - motion of the centre of mass, collision problem in the centre of mass frame of reference and laboratory frame of reference

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Rotational motion - translation and rotational motion, torque, angular momentum. Moment of inertia - general theorem of the moment of inertia, moment of inertia calculation in particular cases - disk, cylinder, and sphere; flywheel, the kinetic energy of rotational motion.

### **Unit VII: Gravitation (Lectures 7)**

Newton's law of gravitation, Gravitational field - the intensity of the field, gravitational potential, and gravitational potential energy; gravitational field and potential due to a solid sphere and spherical shell.

Motion under the central force field, two body problems, and reduced mass.

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Reference frame - inertial and non-inertial, Galilean Transformation, Galilean Invariance, Postulates of special theory of relativity, Lorentz Transformation equations - length contraction, time dilation and mass variation.

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2. To measure the diameter of a capillary tube using a traveling microscope.
3. To determine the height using a sextant.
4. To determine the Moment of Inertia of a Symmetrical body about an axis by the torsional oscillation method.
5. To determine the moment of inertia of a flywheel.
6. To find the angular acceleration and torque of a flywheel.
7. To determine the value of g using Bar Pendulum.

8. To determine the value of  $g$  using Kater's Pendulum
9. To determine the value of  $g$  using the motion of an oscillating spring.

### **BOOKS RECOMMENDED**

1. Vector Analysis, Murray R. Spiegel (Schaum Series)
2. Mathematical Methods for Engineers and Scientists, K. T. Tang
3. Higher Engineering Mathematics, H. K. Das.
4. An Introduction to Mechanics, D. Kleppner, R. J. Kolenkow, 1973, McGraw Hill.
5. Mechanics, D. S. Mathur, S. Chand and Company Limited, 2000
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. Physics, Resnick, Halliday, and Walker 8/e. 2008, Wiley.
8. B. Sc. Practical Physics, C. L. Arora, S. Chand, and Company.
9. A Text Book on Practical Physics, K. G. Mazumdar, and B. Ghosh.



**PAPER NAME: Basic Computer Knowledge**

**PAPER CODE: PY-SE-1113**

**Total Credits: 3 (Theory: 2 + Practical/Tutorial: 1)**

**THEORY**

**Total Lectures: 30**

**COURSE OBJECTIVES:**

- *Imparting a basic level of knowledge to work with the computer.*

**COURSE OUTCOME:**

- *After completing the course a student will able to use the computer for basic purposes of preparing his letters, notes, presentation, etc., viewing information on the Internet (the web), and sending mail, etc.*
- *This allows a student to be also part of a computer user list by making them digitally literate.*
- *This would also aid the PC penetration program.*
- *This helps them to maintain their small account using the computers and enjoy the world of Information Technology.*

**Unit I: Knowing Computer (Lectures 2)**

What is a Computer, Basic Applications of a Computer; Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data, and Information; Applications of IECT; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.

**Unit II: Operating Computer using GUI-Based Operating System (Lecture 4)**

What is an Operating System; Basics of Popular Operating Systems; The User Interface, Using Mouse; Using right Button of the Mouse and Moving Icons on the screen, Use of Common Icons, Status Bar, Using Menu and Menu-selection, Running an Application, Viewing of File, Folders, and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows; Using help; Creating Short cuts, Basics of O.S Setup; Common utilities.

**Unit III: Understanding Word Processing(Lectures 6)**

Word Processing Basics; Opening and Closing of documents; Text creation and Manipulation; Formatting of text; Table handling; Spell check, language setting, and thesaurus; Printing of word document.

**Unit IV: Understanding Spreadsheet (Lectures 6)**

Basics of Spreadsheet; Manipulation of cells; Formulas and Functions; Editing of Spread Sheet, the printing of Spread Sheet.

### **Unit V: Understanding Presentation Software (Lectures 6)**

Basics of presentation software; Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation/handouts.

### **Unit VI: Introduction to Internet, WWW, and Web Browsers(Lectures 4)**

Basic of Computer networks; LAN, WAN; Concept of the Internet; Applications of the Internet; connecting to the Internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing software, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website.

### **Unit VII: Communications and Collaboration Lectures (Lecture 2)**

Basics of electronic mail; Getting an email account; Sending and receiving emails; Accessing sent emails; Using Emails; Document collaboration; Instant Messaging.

## **PRACTICAL**

**Total Lectures: 30**

### **COURSE OBJECTIVES:**

- *To impart hands-on experience in the basic knowledge of computer assembly and its associated software and to communicate digitally.*

### **COURSE OUTCOME:**

- *After completing the course a student will be able to work in a digital environment.*
1. Do the following tasks specific to Windows Operating System
    - a. Creating a new folder, copying/pasting files.
    - b. Creating a new file.
    - c. Deleting a folder/file.
  2. To check the hardware present in the computer, note down the specifications of the PC.
    - a. What is the operating system being used?
    - b. What service pack is installed?
    - c. What is the CPU name?
    - d. What is the clock speed of the computer's CPU?
  3. Take an unformatted document and do all the formatting exercises as discussed in the theory class.
  4. Create a spreadsheet and explore all the aspects discussed in the theory class.
  5. Create a PowerPoint presentation on any topic and explore all the aspects as discussed in the theory class.
  6. Choose an unknown topic and collect as much information as possible with the help of a search engine and record them appropriately.



7. Create a mail account and share documents as attached files.

### **BOOKS RECOMMENDED**

1. Operating System Principle by Galvin.
2. Data Communication Networks by UditAgarwal.
3. A-Z MS/Excel by Ms.Rinkoo Jain.
4. Exploring ms/Office by KevinWilson.

**PAPER NAME : Physics for All - 1**

**PAPER CODE : PY – ID – 1113**

**TOTAL CREDITS : 3 (Theory: 3)**

## **THEORY**

**Total Lectures - 45**

### **COURSE OBJECTIVE:**

*This course provides students with an elementary knowledge of Units and measurements, General Physics dealing with the concept of force, work, energy, fluid dynamics, properties of matter, and principles of optical phenomena.*

### **COURSE OUTCOME :**

*After completing the course, a student will be able to understand the basic concepts of different appliances in everyday life.*

#### **Unit 1: Units and measurement (5 lectures)**

Evolution of units, History of measurements, Standardization of Measurement of length and mass, Comparison between metre scale and vernier scale.

#### **Unit 2: General Physics (20 lectures)**

Sir Isaac Newton and his contribution to the development of mechanics and laws of gravitation. Motion in everyday life - translational and rotational, Concept of Work and Energy with practical examples, different forms of energy. Discovery of wheels, Practical examples of Mechanical tools: lever, pulley, and chains. Concept of pressure, Pascal's law, Ideas of hydraulic lift and hydraulic brake. Archimedes principle and the legend associated with it, Ideas of floating of ships and sinking of submarines. Application of fluid mechanics in everyday life - jet spray, capillarity.

#### **Unit 3: Matter (5 lectures)**

Matter, different states of matter and their basic properties, Change of state (Melting, boiling, vaporisation), Concept of evaporation, sublimation, and condensation. Dew, fog, and occurrence of rain. Formation of cloud.

#### **Unit 4: Waves (8 lectures)**

Concept of oscillatory motion, wave, and its different types. Application in different musical instruments - flute, guitar, drum (qualitative). Qualitative definition of frequency, time period, wavelength, velocity of wave, Echo in a Hall, Audible range of sound, Concept of ultrasonic waves and its practical applications (bat hunting, SONAR), Supersonic jets.

## **Unit 5: Optical World (7 lectures)**

Concepts of reflection and refraction, Concept of image (real and virtual), Ideas of mirrors and lenses, Types of mirrors and Lenses, Uses of mirrors and lenses. Working of camera, human eye, power of a lens. Historical background of the development of telescope and microscope (stories of Galileo and Leeuwenhoek), different types of telescopes and microscopes (Qualitative). Basics of dispersion, dispersion in a prism, VIBGYOR. Sir C. V. Raman and his historic discovery of scattering of blue light

# SECOND SEMESTER

**PAPER NAME: Mathematical Physics - II and Properties of Matter**

**PAPER CODE: PY- CE - 2114**

**Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)**

## **THEORY**

**Total Lectures: 45**

### **COURSE OBJECTIVES:**

- *To impart advanced concepts and methods in Mathematics which include the Calculus of vector-valued functions.*
- *To impart basic concepts of work-energy principle, rigid body dynamics, laws of gravitation, and a basic concept of relativity.*

### **COURSE OUTCOME:**

- *After completing the course a student will be able to understand application of differential equation in various fields.*
- *Further, a student will be able to understand and solve a real-life problem that needs an understanding of elasticity, surface tension and viscosity.*

## **Mathematical Physics - II (Credit - 1, Lectures - 15)**

### **Unit I: Ordinary Differential Equation (Lectures 8)**

Order and degree of a differential equation, 1st order linear differential equation, 1st order and 2nd order homogenous differential equation. Radioactive decay, Newton's law of cooling, Free fall.

### **Unit II: Partial Differential Equation (Lectures 7)**

Solution of Partial differential equation using separation of variables, exact and inexact differentials. Laplace's equation in the cartesian coordinate system, Wave equation.

## **Properties of Matter (Credit - 2, Lectures - 30)**

### **Unit III: Elasticity (Lectures 10)**

Hooke's law, Elastic behaviour of solids, Different types of elasticity, Elastic constants, Relation among different elastic constants, Poisson's ratio, determination of Poisson's ratio, Twisting couple of a cylinder. Bending moment, depression of a cantilever.

### **Unit IV: Surface Tension (Lectures 10)**

Surface tension and surface energy, the Pressure difference across a liquid surface - drops and bubbles, Rise of liquid in a capillary tube - Jurin's law



### **Unit V: Viscosity (Lectures 10)**

The flow of liquid, streamline flow, continuity equation - Bernoulli's theorem and its applications, Viscosity, coefficient of viscosity, Reynold's number, Poiseuille's equation, Effect of temperature and pressure on the viscosity of fluids.

### **PRACTICAL**

**Total Lectures: 30**

### **COURSE OBJECTIVES:**

- *To impart hands-on experience and learning on the basic principle of properties of matter, surface tension, and viscosity of the fluid.*

### **COURSE OUTCOME:**

- *After completing the course a student will be able to handle laboratory equipment safely and efficiently and plan and carry out experimental procedures.*

*A minimum of five experiments are to be done.*

1. To determine the Young's Modulus of the material of a wire by Searle's apparatus.
2. To determine the Modulus of Rigidity of a Wire Static method.
3. To determine the spring constant and rigidity modulus from the motion of a spring.
4. To determine the surface tension of water by Jaeger's method.
5. To determine the coefficient of viscosity of water by capillary flow method (Poiseuille's method).
6. To determine the surface tension of a liquid by the capillary rise method and verify Jurin's law
7. To determine the coefficient of viscosity of glycerine or mustard oil by Stoke's method.

### **BOOKS RECOMMENDED**

1. Mathematical Methods for Engineers and Scientists, K. T. Tang
2. Higher Engineering Mathematics, H. K. Das.
3. An Introduction to Mechanics, D. Kleppner, R. J. Kolenkow, 1973, McGraw Hill.
4. Properties of Matter by D. S. Mathur, S. Chand, and Company.
5. B. Sc. Practical Physics, C. L. Arora, S. Chand, and Company.
6. A Text Book on Practical Physics, K. G. Mazumdar, and B. Ghosh.



**PAPER NAME: Mathematical Physics - II and Properties of Matter**

**PAPER CODE: PY- MN -2114**

**Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)**

## **THEORY**

**Total Lectures: 45**

### **Mathematical Physics - II (Credit - 1, Lectures - 15)**

#### **COURSE OBJECTIVES:**

- *To impart advanced concepts and methods in Mathematics which include the Calculus of vector-valued functions.*
- *To impart basic concepts of work-energy principle, rigid body dynamics, laws of gravitation, and a basic concept of relativity.*

#### **COURSE OUTCOME:**

- *After completing the course a student will be able to understand application of differential equation in various fields.*
- *Further, a student will be able to understand and solve a real-life problem that needs an understanding of elasticity, surface tension and viscosity.*

#### **Unit I: Ordinary Differential Equation (Lectures 8)**

Order and degree of a differential equation, 1st order linear differential equation, 1st order and 2nd order homogenous differential equation. Radioactive decay, Newton's law of cooling, Free fall.

#### **Unit II: Partial Differential Equation (Lectures 7)**

Solution of Partial differential equation using separation of variables, exact and inexact differentials. Laplace's equation in the cartesian coordinate system, Wave equation.

### **Properties of Matter (Credit - 2, Lectures - 30)**

#### **Unit III: Elasticity (Lectures 10)**

Hooke's law, Elastic behaviour of solids, Different types of elasticity, Elastic constants, Relation among different elastic constants, Poisson's ratio, determination of Poisson's ratio, Twisting couple of a cylinder. Bending moment, depression of a cantilever.

#### **Unit IV: Surface Tension (Lectures 10)**

Surface tension and surface energy, the Pressure difference across a liquid surface - drops and bubbles, Rise of liquid in a capillary tube - Jurin's law

### **Unit V: Viscosity (Lectures 10)**

The flow of liquid, streamline flow, continuity equation - Bernoulli's theorem and its applications, Viscosity, coefficient of viscosity, Reynold's number, Poiseuille's equation, Effect of temperature and pressure on the viscosity of fluids.

### **PRACTICAL**

**Total Lectures: 30**

### **COURSE OBJECTIVES:**

- *To impart hands-on experience and learning on the basic principle of properties of matter, surface tension, and viscosity of the fluid.*

### **COURSE OUTCOME:**

- *After completing the course a student will be able to handle laboratory equipment safely and efficiently and plan and carry out experimental procedures.*

*A minimum of five experiments are to be done.*

1. To determine the Young's Modulus of the material of a wire by Searle's apparatus.
2. To determine the Modulus of Rigidity of a Wire Static method.
3. To determine the spring constant and rigidity modulus from the motion of a spring.
4. To determine the surface tension of water by Jaeger's method.
5. To determine the coefficient of viscosity of water by capillary flow method (Poiseuille's method).
6. To determine the surface tension of a liquid by the capillary rise method and verify Jurin's law
7. To determine the coefficient of viscosity of glycerine or mustard oil by Stoke's method.

### **BOOKS RECOMMENDED**

1. Mathematical Methods for Engineers and Scientists, K. T. Tang
2. Higher Engineering Mathematics, H. K. Das.
3. An Introduction to Mechanics, D. Kleppner, R. J. Kolenkow, 1973, McGraw Hill.
4. Properties of Matter by D. S. Mathur, S. Chand, and Company.
5. B. Sc. Practical Physics, C. L. Arora, S. Chand, and Company.
6. A Text Book on Practical Physics, K. G. Mazumdar, and B. Ghosh.

**PAPER NAME: Programming Skills with Python**

**PAPER CODE: PY-SE-2113**

**Total Credits: 3 (Theory: 2 + Practical/Tutorial: 1)**

## **THEORY**

**Total Lectures: 30**

### **COURSE OBJECTIVES:**

- *The course is designed to provide Basic knowledge of Python.*
- *It will help one to learn how to design and program Python applications.*

### **COURSE OUTCOME:**

- *After completing the course a student will acquire programming capability and will be able to solve a real-life problem.*

#### **Unit I: Introduction to Scientific Programming (Lectures 6)**

Algorithm: Definition, properties, and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of  $\sin(x)$  as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

#### **Unit II: Basics of Scientific Programming (Lectures 16)**

**Variables and Formatting:** Introduction to HLL, Concepts of a Compiler. Character Set, Constants and their types, Variables and their types.

**Operators:** Arithmetic, Relational, Logical, and Assignment Operators.

**Expressions:** Arithmetic, Relational, Logical, Character, and Assignment Expressions. I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of a Program, Format of writing Program and concept of coding, Initialization, and Replacement Logic. Examples from physics problems.

**Control Statements and Functions:** Logical statements - IF, IF-ELSE block, Looping Statements - WHILE, FOR loop, Functions, open a file, writing in a file, reading from a file.

#### **Unit III: Visualization (Lectures 8)**

Introduction to graphical analysis, the importance of visualization of computational data, simple plots, plotting data from a file, saving and exporting, multiple data sets per file, curve fitting – straight line, polynomials, user-defined function.

## PRACTICAL

**Total Lectures: 30**

### COURSE OBJECTIVES:

- *To impart hands-on experience in the basic knowledge of computer assembly and its associated software and to communicate digitally.*

### COURSE OUTCOME:

- *After completing the course a student will be able to work in a digital environment.*

1. The height of a satellite above the earth should be

$$h = \left( \frac{GM_E T^2}{4\pi^2} \right)^{1/3} - R_E$$

where,  $G = 6.673 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$  is the universal gravitational constant,  
 $M_E = 5.98 \times 10^{24} \text{ kg}$  mass of the earth,  $R_E = 6.37 \times 10^6 \text{ m}$  radius of the earth

2. To find a set of prime numbers between two given numbers.
3. Sum the series

$$\sum_{k=1}^{100} \frac{1}{k}$$

4. The Fibonacci numbers are the sequence of integers in which each is the sum of the previous two, with the first two numbers being 1, 1. Thus the first few members of the sequence are 1, 1, 2, 3, 5, 8, 13, 21. Calculate Fibonacci numbers up to 100.
5. Write a program for calculating the wavelengths of emission lines in the spectrum of the hydrogen atom, based on the Rydberg formula

$$\frac{1}{\lambda} = R \left( \frac{1}{m^2} - \frac{1}{n^2} \right)$$

The value of

$$R = 1.097 \times 10^7 \text{ m}^{-1}$$

6. The coordinate of a point in the cartesian coordinate system is given by  $(x, y)$  and that in the polar coordinate system is given by  $(r, \theta)$ . Write a user-defined function to transform coordinates from one system to another.
7. Make a plot of the curve which is defined by

$$x = 2 \cos \theta + \cos 2\theta; \quad y = 2 \sin \theta - \sin 2\theta$$

where  $0 \leq \theta \leq 2\pi$ . Take a set of values of  $\theta$  between 0 and  $2\pi$ , calculate  $x$  and  $y$  for each from the equations above, and then, plot  $y$  as a function  $x$ .



## **BOOKS RECOMMENDED**

1. Computational Physics, by Mark Newman.
2. Computational Physics: Problem Solving with Python, by Manuel J. Páez , Rubin H. Landau , Cristian C. Bordeianu.
3. Python Programming: An Introduction to Computer Science by John Zelle, Franklin, Beedle & Associates INC.

**PAPER NAME: Physics for All - Part 2**

**PAPER CODE : PY-ID-2113**

**TOTAL CREDITS : 3 (Theory: 3)**

**THEORY**

**Total Lectures - 45**

**COURSE OBJECTIVE:** *This course provides students an elementary knowledge on electricity and magnetism, Modern Physics, and Renewable Energy.*

**COURSE OUTCOME:** *After completing the course, a student will be able to understand the basic concepts of different appliances in everyday life.*

**Unit 1: Electricity and Magnetism (15 lectures)**

Concept of static and moving charges (current), household circuit, usage of fuse and MCB, and importance of earthing. Heating effect of current: Heater and Iron. Chemical effect of current: electrolysis and electroplating. Concept of direct and alternating current. Magnet, earth's magnetism, Electric current can act as a magnet, Magnet can also induce current, Concept of electromagnetic induction. Primary and secondary cells (qualitative). Qualitative explanation of generator, motor, and transformer. Application in everyday life (Washing machine, Mixer Grinder, Drilling, and Cutting machines)

**Unit 2: Modern Physics (15 lectures)**

Development of modern physics, about the father of modern physics, discovery of proton, electron, and neutron (qualitative), Discovery of X-rays and its applications. Discovery of radioactivity and its applications. Nuclear energy (qualitative idea only), nuclear holocaust with special reference to Hiroshima and Nagasaki, Nuclear isotope and its applications. Classification of materials: conductors, insulators and semiconductors, Concept of Diodes and Transistors (qualitative) and its practical Application. Superconductor and its applications - Bullet train, Computed Tomography (CT), Magnetic Resonance Imaging (MRI) machines (basic ideas only). Basics of communication systems - history and development, Geostationary and polar satellites, different modes of communications: Satellite communication, Mobile communications, GPS (qualitative discussion only).

**Unit 3: Renewable energy (15 lectures)**

Renewable and nonrenewable energy, history, and evolution of the concept of sustainable development, need for renewable energy sources, consequences of fossil fuel burning - ozone layer depletion, greenhouse effects, global warming. Brief description of renewable energy sources (Solar energy, Wind energy, Hydro energy, Tidal energy, Geothermal energy, and Biomass energy ) Ideas about solar cells and their uses in household and industrial applications, solar heater/cooker (qualitative discussions only). Future of renewable energy sources, social issues related to hydropower generation, Advantages and disadvantages of renewable energy sources.