Department of Physics

B. Sc. Physics Honours

Semester I

Paper Core T1:

Course Objective:

The Mathematical physics includes basic methodologies in Calculus, vector algebra and calculus, Orthogonal curvilinear coordinates, Introduction to probability and few special functions. The applications of these mathematical tools are to comprehend different physical theories and solving practical physical problems related to Physics. The objective of the course is to enable the students to:

1. Develop the foundational knowledge on the basic calculus, including the idea of limits, continuity, differentiability etc.
2. Formulate and solve different types of first order and second order differential equations.
3. Have a thorough knowledge of partial derivatives, exact and inexact differentials, constrained Maximization using Lagrange Multipliers.
4. Be familiar with the properties of vector, its properties under rotation, scalar and vector product and scalar and vector field.
5. Understand the notion of vector differential operators and their physical significances.
6. Develop the idea about line, surface and volume vector integrations and the relations between them.
7. Comprehend the idea of different types of orthogonal curvilinear coordinates, the transformation between them and the form of vector differential operators in different orthogonal curvilinear coordinates.
8. Learn fundamental idea on probability and different types of probability distribution functions.

Outcome of the course:

After the completion the course the students will

1. Acquire comprehensive knowledge on basic ideas of calculus, vector analysis, orthogonal curvilinear coordinates, Dirac delta function and introductory knowledge on theory of probability.
2. Have problem solving ability in the fields, covered in the syllabus.
3. Interlink between these mathematical theories and their applications in different physical systems.
4. Understand the foundation of differential equations and its solutions to enhance problem solving skills.
5. Obtain idea about the physical significances of line, surface and volume vector integrations and their uses in different types of problems.
6. Acquire knowledge on probability and its application in day to day problems.

7. Become familiar with the method of Lagranges undetermined multiplier to solve inter-related functions.
8. Acquire skills in using the Mathematical tolls covered by the syllabus.

Paper Core T2:

Course Objective:

Mechanics is one of the fundamental theories in Physics which helps to comprehend the interaction and properties of massive particles within classical limits. This course intends the students to familiar with the introductory ideas of basic and fundamental laws of classical mechanics and also to expose them with the different properties of materials. The course also offers introductory ideas on special theory of relativity, which may help students to realize the evaluation of this canonical theory of modern physics by compare and contrast with the classical idea of mechanics. After going through this course the students are expected to:

1. Have a thorough knowledge on about frames of reference, Newton's laws of motion, Galilean transformation, conservation of momentum, dynamics of systems of particles.
2. Comprehend the relations between force, work and energy, idea of conservative and non-conservative force.
3. Have detail knowledge on laws of Gravitation, potential fields for rigid bodies of different shapes.
4. Be introduced with the motion of particle under central force.
5. Become familiar with simple harmonic oscillator.
6. Have introductory ideas on elasticity of materials and fluid motions,
7. Have knowledge about special theory of relativity which includes ideas about Lorentz Transformations, simultaneity and order of events, Lorentz contraction, time dilation, relativistic transformation of velocity, frequency and wave number, relativistic addition of velocities, variation of mass with velocity, massless particles, mass-energy equivalence, relativistic Doppler effect, relativistic kinematics, transformation of energy and momentum.

Outcome of the course:

After the completion the course the students will

1. Acquire the introductory knowledge on Newtonian mechanics.
2. Develop skills to solve problems related to mechanical systems.
3. Acquire knowledge on properties of dynamical systems.
4. Become familiar with the properties of systems under simple harmonic oscillation.
5. Acquire knowledge on elastic properties of materials and fluid motion.
6. Gain an appreciation on the special theory of relativity.
7. Be motivated to extend the knowledge gained from the syllabus to understand modern Physics problems.

Paper Core P1:

Course Objective:

Apart from the traditional means like experimental or theoretical approaches, computation has emerged as a third independent method to practice Physics. Simulation of different

physical problems serves as a bridge between the experimental and theoretical physics. Even in hard core experimental or theoretical physics, computation has become indispensable for either interfacing the scientific instruments or analysing the data or to have numerical solutions of equations.

The objective of this course is to make the students

1. Aware of basic structure of computers.
2. Learn the different programming languages like python, mote carlo
3. familiar with data analysing software like GNUplot
4. Develop the skill of numerical analysis.

Outcome of the course:

After the completion the course the students will

1. Develop skills of error analysis using computation
2. Acquire skills to draw 2D, 3D graph and fitting data with fit functions using GNUplot
3. Write programmes in Phython
4. Use skills in solving linear and quadratic equations by Newton Raphson and Secant method using programming
5. Solve differentiations and integrations using Monte Carlo method.
6. Understand the importance of Computational methods to interlink Theoretical and Experimental results.

Paper Core P2:

Course Objective:

Hand on experiments traditionally has been an inseparable part for practicing Physics. It provides the evidence that grounds the theoretical knowledge. The objective of this course is to introduce students with the first hand experience of experimental physics. The experiments selected in this course have direct relevance with the theoretical knowledge that they gathered in the Core T1 paper so that they can appreciate the empiricism of the said course.

After completing this course the students are expected to:

1. Be familiar with basic measuring instruments in Physics
2. Have an idea about different types of error involved in measurements.
3. Be able to measure different elastic and viscous properties of certain matters using standard experimental procedures.
4. Be able to measure gravitational acceleration using different standard experimental procedures.

Outcome of the course:

After successfully completing the course the students were observed to:

1. Have expertise in using instruments like slide calliper, screw gauge, travelling microscope etc.
2. Have been able to calculate different types of errors involved in data acquiring.
3. Acquire skills with standard experimental methods in elasticity and mechanics.
4. Measure acceleration due to gravity using different standard experimental techniques.
5. Relate the theoretical knowledge with the empirical outcomes.

Semester II

Paper Core T3:

Course Objective:

This course aims to introduce the basic ideas of electric and magnetic fields and electric and magnetic properties of material.

After completing this course the students are expected to:

1. Have knowledge about electric field, potential, energy and relation between them.
2. Know about dielectric properties of materials.
3. Be introduced with the idea of magnetic field magnetic potentials and relations between them.
4. Have knowledge about magnetic properties of materials.
5. Have skill on network analysis

Outcome of the course:

After successfully completing the course the students were observed to:

1. Acquire knowledge about electric field, potential, energy and relation between them.
2. Acquire knowledge about dielectric properties of materials.
3. Acquire the idea of magnetic field magnetic potentials and relations between them.
4. Acquire knowledge about magnetic properties of materials.
5. Grown skill on network analysis.
6. Understand the interlink age between electric and magnetic fields and their importance in development of modern Physics.

Paper Core T4:

Course Objective:

This course is designed to give students knowledge about waves and optics.

After completing this course the students are expected to:

1. Have knowledge on harmonic oscillations and their super positions.
2. Have idea about longitudinal, transverse plane progressive wave and their wave equations.
3. Have introduced with the electromagnetic nature of light, interference and diffraction.

Outcome of the course:

After successfully completing the course the students were observed to:

1. Acquire knowledge on harmonic oscillations and their super positions.
2. Understand the difference in propagation of longitudinal and transverse waves and their inter-linkage with electromagnetic waves.
3. Acquire idea about longitudinal, transverse plane progressive wave and their wave equations.
4. Acquire knowledge on the electromagnetic nature of light, interference and diffraction.
5. Understand the wave characteristic nature of light and to be curious about its wave–particle characteristic.

Paper Core P3:

Course Objective:

This course is designed to give students the experience of some traditional hand on experiments on electricity and magnetism. These experiments are related with the theoretical knowledge that they gather from paper T3. After completing the course the students are expected to

1. be familiar with the basic measuring instruments related to electricity and magnetism experiments.

2. Experimentally verify the theoretical knowledge with which they were introduced in course T3.

Outcome of the course:

After successfully completing the course the students were observed to:

1. Have acquired the skill to carryout practical experiments related to electricity and magnetism.
2. Comprehend the empiricism of the theoretical inputs of course T3.
3. Gain insight in the digital electronics field.

Paper Core P4:

Course Objective:

This course is designed to give students the experience of some traditional hand on experiments on waves and optics. These experiments are related with the theoretical knowledge that they gather from paper T4. After completing the course the students are expected to

1. Be familiar with the basic measuring instruments related to waves and optics experiments.
2. Experimentally verify the theoretical knowledge with which they were introduced in course T4.

Outcome of the course:

After successfully completing the course the students were observed to:

1. Have the skill to carryout practical experiments related to waves and optics.
2. Experimentally verify the wave nature of light
3. Comprehend the empiricism of the theoretical inputs of course T4.

Semester III

Paper Core T5:

Course Objective:

The course aims to familiarise the students with basic concepts of differential equations, Laplace's equation, Boundary Value Problems, Orthogonal Functions and Fourier series and Fourier Integrals, which are widely used in classical as well as in modern physics to derive different physical properties of the system. Application of these mathematical tools will help students have a strong grip on the basic concepts and will be helpful in solving practical physics problems. After completing this course the students are expected to:

1. Acquire knowledge about different types of differential equations and their singular points.
2. Have the skill to convert different physical entities from one coordinate system to another.
3. Have an idea about periodic functions and orthogonality of sine and cosine functions.
4. He introduced to Fourier integrals and their transformation.

Outcome of the course:

After successfully completing the course the students are expected to:

1. Solve differential equations and use it to obtain different theories relating to the subject.
2. Have an idea about the solution of Boundary Value Problems belonging to the above class using the method of separation of variables.
3. Acquire skills to solve Legendre and Hermite equations.
4. Have knowledge about periodic functions and the Dirichlet conditions for expanding them in a harmonic series of sines, cosines and complex exponentials.
5. Have acquired skills in solving practical physics problems.

Paper Core P5:

Course Objective:
This course is designed to give students knowledge about Numerical computation. Students will be introduced to online graph plotting softwares and scipy modules.
After completing this course the students are expected to:

1. Have basic programming skills on python.
2. Get introduced to python numpy module, arrays, array operations, shaping arrays etc.
3. Have knowledge about curve fitting, least square fit, standard deviation etc.
4. Have idea about plotting Legendre Polynomials and Bessel functions.

Outcome of the course:
After successfully completing the course the students are expected to:

1. Acquire basic problem solving skills using python language.
2. Be able to plot graphs using online plotting software like matplotlib.
3. Have knowledge of curve fitting and to determine the goodness of fit.
4. Be able to solve mesh equations of electric circuits.
5. Solve Linear system of equations by Gauss elimination method and Gauss Seidal method.

Paper Core T6:

Course Objective:
This course aims to introduce the basic ideas of Kinetic theory of gases and the laws of thermodynamics. Application of these laws is to be applied in understanding the gaseous behaviour. The course briefly covers different topics like velocity distribution in gases, deviation of perfect gas from real behaviour and the different laws of thermodynamics, widely used in understanding gaseous nature.
After completing this course the students are expected to:

1. Understand the application of Maxwell's velocity distribution law and its applications in solving practical problems.
2. Get introduced to the concept of mean velocity, root mean square velocity, most probable velocity and their applications.
3. Have knowledge about molecular collision, free path, mean free path and the idea of relaxation time.
4. Get introduced to different transport phenomenons like viscosity, diffusion and thermal conductivity.
5. Get idea about the behaviour of real gases and its deviation from ideal behaviour.

Outcome of the course:
After successfully completing the course the students are expected to:

1. Understand gaseous systems and solve problems based on mean velocity, RMS velocity and most probable velocity.
2. Acquire knowledge on molecular collisions and free paths.
3. Use thermodynamics to further address the different properties of a gaseous systems.
4. Have knowledge on heat engines and their efficiency.
5. Understand the importance of thermodynamics in Physics.
6. Get introduced to the concept of work and heat and to extend the idea to acquire knowledge about adiabatic and isothermal process.
7. Have a brief idea about the laws of thermodynamics and its applications.
8. Get introduced to the idea of reversible and irreversible process.
9. Understand heat engines and acquire knowledge of Carnots engine and its efficiency.
10. Have knowledge about phase transition and basic concept of different thermodynamic potentials.

Paper Core P6:

Course Objective:
This course aims to give practical understanding of theoretical methods in thermal physics.
After completing this course the students are expected to:

1. Practically understand thermal conductivity and heat flow.
2. To determine thermal conductivity by different experimental techniques.
3. Get knowledge about thermocouples and thermo-emf.

Outcome of the course:
After successfully completing the course the students are expected to:

1. Determine the coefficient of thermal conductivity using various experimental techniques.
2. Acquire practical knowledge about heat flow.
3. Be able to calibrate thermocouples to measure temperature in specified ranges.
4. Practically determine the theoretical knowledge gained from course core T6

Paper Core T7:

Course Objective:
This course aims to introduce basic ideas about digital systems and their applications.
After completing this course the students are expected to:

1. Get knowledge about the advantages of integrated circuits and their uses.
2. Differentiate between analog and digital circuits.

Outcome of the course:
After successfully completing the course the students are expected to:

1. Differentiate between active and passive components of integrated circuits.
2. Acquire an understanding about advantages and disadvantages of integrated circuits in digital systems.
3. Understand decimal systems in digital circuits and its conversion to binary and vice versa.
4. Understand different types of GATES using diodes and transistors.
5. Get knowledge about Boolean algebra and their uses in circuit realization.
6. Acquire understanding about block diagram and application of timers and counters.

Paper Core P7:

Course Objective:
This course is designed to give students the experience of some traditional hand on experiments on digital circuits. These experiments are related with the theoretical knowledge that they gather from paper T7.

After completing the course the students are expected to

1. Experimentally verify the theoretical knowledge with which they were introduced in course T7.

Outcome of the course:
After successfully completing the course the students were observed to:

1. Have the skill to carryout practical experiments related to digital circuits and their applications.
2. Be familiar with the basic measuring instruments related to digital circuit experiments.
3. Comprehend the empiricism of the theoretical inputs of course T7.

Paper Core SEC T2:

Course Objective:
This course aims to introduce the basics of computational methods in Physics, which will be helpful to the students for solving physics problems.

After completing the course the students are expected to

1. Use linux operating system for computational purpose and as an editor.
2. Be familiar with algorithms and flow chart for plotting different figures arising in physics problems.
3. Use latex for preparing documentation.

Outcome of the course:
After successfully completing the course the students were observed to:

1. Understand and develop skills in linux operating system for different computational purposes.
2. Be able to solve basic physics problems using Fortran and C++ computer languages.
3. Use latex with same ease as windows based Microsoft word.
4. Understand linux commands and basics of Fortran and C++ programming skills.

Semester I (DSC)

Paper GET1:

Course Objective:

The objective of the course is to develop the foundation in mathematical physics, which includes basic methodologies in Calculus, vector algebra, calculus and their applications. The applications of these mathematical tools to comprehend different physical theories and solving practical physical problems related to Physics are to be highlighted.

After going through this course the students are expected to:

1. Develop the foundational knowledge on the basic calculus, including the idea of limits, continuity, differentiability etc.
2. Have a thorough knowledge on about frames of reference, Newton's laws ofmotion, Galilean transformation, conservation of momentum, dynamics of systems ofparticles.
3. Comprehend the relations between force, work and energy, idea of conservative and non-conservative force.
4. Have a detail knowledge on laws of Gravitation, potential fields for rigid bodies of different shapes.
5. Be introduced with the motion of particle under central force.

Outcome of the course:

After successfully completing the course the students were observed to:

1. Acquire the introductory knowledge on Newtonian mechanics.
2. Develop skills to solve problems related to mechanical systems.
3. Acquire knowledge on properties of dynamical systems.
4. Become familiar with the properties of systems under simple harmonic oscillation.
5. Acquire knowledge on elastic properties of materials and fluid motion.
6. Gain an appreciation on the special theory of relativity.
7. Become familiar with simple harmonic oscillator.
8. Have introductory ideas on elasticity of materials and fluid motions,
9. Have knowledge about special theory of relativity which includes ideas about Lorentz Transformations, simultaneity and order of events, Lorentz contraction, time dilation, relativistic transformation of velocity, frequency and wave number.

Paper GEP1:

Course Objective:

This course is designed to give students the experience of some traditional hand on experiments on mechanics. These experiments are related with the theoretical knowledge thatthey gather from paper T1.

After completing the course the students are expected to

1. Be familiar with the basic measuring instruments related to mechanics experiments.
2. Experimentally verify the theoretical knowledge with which they were introduced in course T1.

Outcome of the course:

After successfully completing the course the students were observed to:

1. Have the skill to carryout practical experiments related to mechanics and motion.
2. Comprehend the empiricism of the theoretical inputs of course T1.

Semester II

Paper GET2:

Course Objective:

The objective of the course is to develop the foundation in mathematical physics, which includes basic methodologies in Electricity and Magnetism. The course is designed to give students knowledge about electrostatics, magnetic properties, electromagnetic induction and basic concepts about electromagnetic nature of light.

After going through this course the students are expected to:

1. Gain knowledge about electricity and magnetism and to understand these phenomenon as a consequence of one another.
2. Be introduced to Faraday's law of electromagnetic induction.

Outcome of the course:

After successfully completing the course the students were observed to:

1. Understand the phenomenon of electricity and magnetism and their applications.
2. Understand transverse nature of electromagnetic waves and propagation of light as an electromagnetic wave.
3. Understand light as electromagnetic wave.

Paper GEP2:

Course Objective:

This course is designed to give students the experience of some traditional hand on experiments on electricity and magnetism. These experiments are related with the theoretical knowledge that they gather from paper T2.

After completing the course the students are expected to

1. Experimentally verify the theoretical knowledge with which they were introduced in course T2.

Outcome of the course:

After successfully completing the course the students were observed to:

1. Be familiar with the basic measuring instruments related to electricity and magnetism experiments.

2. Have the skill to carryout practical experiments related to mechanics and motion.
3. Comprehend the empiricism of the theoretical inputs of course T1.

Semester III (DSC and GE)

Paper GET3:

Course Objective:

This course aims to introduce the basic ideas of Kinetic theory of gases and the laws of thermodynamics. Application of these laws are to be applied in understanding the gaseous behaviour. The course briefly covers different topics like velocity distribution in gases, deviation of perfect gas from real behaviour and the different laws of thermodynamics, widely used in understanding gaseous nature.

After completing this course the students are expected to:

1. Understand the application of Maxwell's velocity distribution law and its applications
   in solving practical problems.
2. Get introduced to the concept of mean velocity, root mean square velocity, mostprobable velocity and their applications.
3. Have knowledge about molecular collision, free path, mean free path and the idea ofrelaxation time.

Outcome of the course:
After successfully completing the course the students are expected to:

1. Understand gaseous systems and solve problems based on mean velocity, RMSvelocity and most probable velocity.
2. Acquire knowledge on molecular collisions and free paths.
3. Use thermodynamics to further address the different properties of gaseous systems.
4. Have knowledge on heat engines and their efficiency.
5. Understand the importance of thermodynamics in Physics.
6. Get introduced to different transport phenomenon's like viscosity, diffusion and
   thermal conductivity.
7. Get introduced to the concept of work and heat and to extend the idea to acquireknowledge about adiabatic and isothermal process.
8. Have a brief idea about the laws of thermodynamics and its applications.
9. Have knowledge about phase transition and basic concept of different thermodynamicpotentials.

Paper GEP3:

Course Objective:

This course is designed to give students the experience of some traditional hand on experiments on heat and thermodynamics. These experiments are related with the theoretical knowledge that they gather from paper T3.

After completing the course the students are expected to

1. Experimentally verify the theoretical knowledge with which they were introduced incourse T3.

Outcome of the course:
After successfully completing the course the students were observed to:

1. Have the skill to carryout practical experiments related to heat and thermodynamics.
2. Comprehend the empiricism of the theoretical inputs of course T3.
3. Be familiar with the basic measuring instruments related to heat and thermodynamics.