MANGALAYATAN UNIVERSITY, ALIGARH

CENTRE FOR DISTANCE AND ONLINE EDUCATION

PROGRAMME PROJECT REPORT

MASTER OF SCIENCE (PHYSICS)

M.Sc. (Physics)

2023-24

Introduction

Master of Science in Physics (M.Sc. Physics) is a postgraduate program that focuses on advanced physical concepts and theories. This program is designed to help students develop a deep understanding of various physical principles and their applications in diverse fields such as engineering, physics, computer science, and finance. The curriculum includes topics such as classical Mechanics, Mathematical Physics, Quantum Mechanics, Electronics, Condensed Matter Physics, Classical Electrodynamics, Nuclear and Particle Physics, Statistical Mechanics in addition to discipline, electives, and computational courses. Students pursuing M.Sc. in Physics learn how to use physics to solve real-world complex problems and develop critical thinking and analytical skills. After completion of the program, students shall be well-equipped to pursue careers in academia, research, and many other fields.

M.Sc. Physics students are trained to work independently and collaboratively on research projects, helping them to develop valuable teamwork and communication skills. They are exposed to modern Physical tools and techniques, such as computer simulations and programming languages, which further enhances their problem-solving abilities. This program also encourages students to apply their knowledge in practical settings, allowing them to develop innovative solutions of complex problems and students may proceed to build their career in the research. This is a challenging and rewarding program that provides students with a strong foundation in Physics and prepares them for a wide range of exciting career opportunities.

A. Programme's Mission and Objectives

Mission

- To cater and ensure excellent theoretical and practical training through teaching, counseling, and mentoring with a view to achieve professional and academic excellence.
- To connect with industry and incorporating knowledge for research enhancement.
- To generate, disseminate and preserve knowledge for the benefit and betterment of society.

Objectives

M.Sc. in Physics programme aims to provide students with advanced classical Mechanics, Mathematical Physics, Quantum Mechanics, Electronics, Condensed Matter Physics, Classical Electrodynamics, Nuclear and Particle Physics, Statistical Mechanics in addition to discipline, electives, and computational courses. The programme also aims to provide students with the skills required to carry out independent research in Physics, including skills in literature review, mathematical modelling, data analysis, and technical writing. Furthermore, the program prepares students for further studies in Physics, including Ph.D. programmes.

B. Relevance of the Programme with HEI's Mission and Goals

The vision and mission of HEI, Mangalayatan University, Aligarh are:

Vision:

To be an institution where the most formative years of a young mind are spent in the guided pursuit of excellence while developing a spirit of inquisitive questioning, an ability to excel in the pressure of a fast-changing professional world, and a desire to grow into a personality rather than a person, in an environment that fosters strong moral and ethical values, teamwork, community service and environment consciousness.

Mission:

- To be the enablers of the confluence of academic rigor and professional practicality.
- To bring global best practices to students through widespread use of technology.
- To empower our faculty to constantly develop new skills and excel professionally.

- To provide the best campus environment to students and faculty with all facilities to nurture their interest.

M.Sc. (Physics) programme of the University strives to realize its vision and mission by rectifying student centric issues on priority and also to empower local community with the help of various social clubs running in University like NSS, KADAM and Alumni association. The University promotes multidisciplinary and allied research in various fields that supports and harnesses joyful learning environment. The goals of ODL(Open Distance Learning) program is to provide educational facilities to all qualified and willing persons who are unable to join regular courses due to personal or professional reasons. There are many potential learners who cannot afford to join regular courses due to professional responsibilities and personal commitments. For such cases M.Sc. (Physics) through ODL modecan be helpful in increasing knowledge base and skill up-gradation. The program aims to provide alternative path to wider potential learners who are in need of refresher courses to update their skills.

C. Nature of Prospective Target Group of Learners

Distance Education of Mangalayatan University (MU) shall target the working professional's executives as well as those who cannot attend a full-time program due to prior occupation or other assignments. The candidates desirous of taking admission in M.Sc. (Physics) program shall have to meet the eligibility norms as follows-

1. To obtain admission in M.Sc. (Physics) program offered through ODL mode.
2. The learner must have completed graduation in science stream (PCM/PCMB)

D. Appropriateness of Programme to be conducted in ODL mode to acquire specific skills and competence

The University has identified the following **Programme Outcomes** and **Programme Specific Outcomes** as acquisition of specific skills and competence in M.Sc. (Physics) Program.

Programme Outcomes (PO's)

After completing the M.Sc. (Physics) programme, students will be able to:

a. PO1: Knowledge outcomes: Acquire knowledge and ability to develop creative solutions, and better understanding of the future developments of the subject. Also, evolve analytical and logical thinking abilities.
b. PO2: Skill Outcomes: Learn and understand the new concepts and get prepared for placement by developing scientific skills. Further ability to communicate scientific information in a clear and concise manner.
c. PO3: General Competence: Be able to understand the role of science in solving real life problems and get an ability to participate in debates and discussions constructively.
d. PO4: Scientific Aptitude and Innovation: Know the recent developments, future possibilities and able to gather, assess, and make use of new information and applying this knowledge to find creative solutions.

Programme Specific Outcomes:

After completing the M.Sc. (Physics) programme through ODL Mode, students will be able to:

a. PSO1: Evaluate hypotheses, theories, methods and evidence within their proper contexts.

b. PSO2: Select, interpret and critically evaluate information from a range of sources that include books, scientific reports, journals, case studies and the internet.
c. PSO3: Develop proficiency in the analysis of complex problems and the use of mathematical techniques to solve them.
d. PSO4: Provide a systematic understanding of the concepts and theories of Physics and their application in the real world – to an advanced level, and enhance career prospects in a huge array of fields.

E. Instructional Design

The program is divided into four semester sand minimum credit requirement is 76 to get M.Sc. (Physics) degree in ODL mode from Mangalayatan University. Minimum time period for acquiring M.Sc. (Physics) degree will be two years and maximum time period to acquire is 4 years.

Evaluation Scheme

Semester-I						
S. No.	**Course Code**	**Course Name**	**Credit**	**Continuous Assessment**	**Term End Exam**	**Grand Total**
				MM	**MM**	
1	PHO-6111	Mathematical Physics-I	4	30	70	100
2	PHO-6112	Classical Mechanics	4	30	70	100
3	PHO-6113	Quantum Mechanics-I	4	30	70	100
4	PHO-6115	Classical Electrodynamics	4	30	70	100
5	PHO-6151	Physics Lab-I (General Lab-I)	4	0	100	100
Total			20	120	380	500

Semester-II						
S. No.	**Course Code**	**Course Name**	**Credit**	**Continuous Assessment**	**Term End Exam**	**Grand Total**
				MM	**MM**	
1	PHO-6211	Statistical Mechanics	4	30	70	100
2	PHO-6212	Quantum Mechanics-II	4	30	70	100
3	PHO-6213	Nuclear and Particle Physics	4	30	70	100
4	PHO-6214	Programming in C	4	30	70	100

5	PHO-6251	Physics Lab-II (General Lab-II)	4	0	100	100
6	PHO-6252	Programming in C Lab	2	0	100	100
Total			22	120	480	600

Semester-III						
S. No.	**Course Code**	**Course Name**	**Credit**	**Continuous Assessment**	**Term End Exam**	**Grand Total**
				MM	**MM**	
1	PHO-7111	Research Methodology	6	30	70	100
2	PHO-7112	Atomic and Molecular Physics	4	30	70	100
3	PHO-7113	Electronics	4	30	70	100
4	PHO-7114	Condensed Matter Physics	4	30	70	100
5	PHO-7151	Physics Lab-III	4	0	100	100
Total			22	120	380	500

Semester-IV						
S. No.	**Course Code**	**Course Name**	**Credit**	**Continuous Assessment**	**Term End Exam**	**Grand Total**
				MM	**MM**	
1	PHO-7211	Mathematical Statics	4	30	70	100
2	PHO-7212	MOOC	4	30	70	100
4	PHO-7291	Dissertation	8	0	100	100
Total			16	60	240	300

MOOCs

The University shall give flexibility in opting for MOOCs (Massive Online Open Courses) by the students pertaining to the prescribed curriculum and also the credits earned in the MOOCs may be

dealt as part of the evaluation scheme as per UGC (Open and Distance Learning Programmes and Online Programmes) Regulations,2020.

Syllabi and Course Materials

Syllabi, PPR and self-learning materials are developed mostly by experienced faculty members of Mangalayatan University in consultation with contents experts and the same will be forwarded to CIQA and BoS/Academic Council/ Executive Council for further suggestions and approval.

Semester: I

Course Code: PHO-6111 Credit: 4

Course: Mathematical Physics-I

Course Objectives: The primary objective is to teach the students basic mathematical methods that will be used in many of the other courses in the M.Sc. syllabus.

Block-1: Theory of Functions of a Complex Variable:

Unit-1: Analyticity and Cauchy-Reimann Conditions, Cauchy's integral theorem and formula

Unit-2: Taylor's series and Laurent's series expansion, Zeros and singular points, Multivalued functions, Branch Points and Cuts

Unit-3: Reimann Sheets and surfaces, Residues, Cauchy's Residue theorem, Jordan's Lemma

Unit-4: Evaluation of definite integrals, Principal Value, Bromwitch contour integrals.

Block-2: Fourier Transform:

Unit-5: Fourier transform, Sine, Cosine and Complex transforms with examples, Definition, Properties and Representations of Dirac Delta Function

Unit-6: Properties of Fourier Transforms, Transforms of derivatives

Unit-7: Parseval's Theorem, Convolution Theorem, Momentum representation, Applications to Partial differential equations,

Unit-8: Discrete Fourier transform, Introduction to Fast Fourier transform

Block-3: Laplace Transforms:

Unit-9: Laplace transform,

Unit 10: Properties and examples of Laplace Transform,

Unit-11: Convolution theorem and its applications,

Unit-12: Laplace transform method of solving differential equations.

Block-4: Group Theory:

Unit-13: Concept of a group (additive and multiplicative, isomorphism and homomorphism)

Unit-14: Matrix representation of a group, Reducible and irreducible representation of a group,

Unit-15: The Great Orthogonality Theorem (without proof), Continuous,

Unit-16: Lie groups.

Course Outcomes: Students will learn the required mathematical techniques that may have not been covered in the courses in B.Sc. CBCS programme and which will be useful in many other

courses in M.Sc.

Text and References Books:

1. *Arfken G.,Mathematical method for Physicists, Academic Press*
2. *Kreyszig.E., Advanced Engineering Mathematics, Wiley-India*
3. *Bell.W.W, Special Functions, Courier Dover Publication*
4. *Churchill. R.V., Functions of complex variable, McGraw-Hill Book Co.*
5. *Ghatak, A.K, Goyal, I.C. and Chau, S.J. , Mathematical Physics, Ubs-Bangalore*

Course Code: PHO-6112 Credit: 4
Course: Classical Mechanics

Course Objectives: Students will be equipped for advanced and specialized courses. The student learns to deal with particle mechanics at an advanced level and to learn the foundations of the classical theory of fields.

Block I: Classical Mechanics Fundamentals and Principles

Unit 1: General idea of Newtonian physics; Mechanics of a particle, mechanics of a system of particles

Unit 2: Constraints, generalized coordinates, D'Alembert's principle and Lagranges equations

Unit 3: Hamilton's principle, derivation of Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-holonomic systems

Unit 4: Conservation theorems and symmetry properties, Generalized momenta, cyclic co-ordinates

Block II: Canonical Transformations and Hamilton-Jacobi Method

Unit 5: Equation of canonical transformation, examples of canonical transformation

Unit 6: Poisson and Lagrange brackets and their invariance under canonical transformation, Jacobi's Identity, Poisson's Theorem

Unit 7: Equations of motion infinitesimal canonical transformation in the poisson bracket formulation

Unit 8: Hamilton Jacobi Method, Generating functions.

Block III: Celestial Mechanics and Small Oscillations

Unit 9: Two body central force problem: bound state, reduction of two-body problem to one body problem

Unit 10: Motion in a central force field, The virial theorem, the inverse square law of force

Unit 11: The motion in central force in the Kepler problem

Unit 12: Concept of small oscillations, eigen value equation, simple application (CO_2), Normal coordinates and modes

Block IV: Relativistic mechanics

Unit 13: Four dimensional representation of the Lorentz transformations, covariance of the laws of nature
Unit 14: Four vectors; velocity momentum, force and their transformation,
Unit 15: Equation of motion of a point particle in four vector form
Unit 16: Relativistic Lagrangian and Hamiltonian of a charged particle in an em field

Course Outcomes: Students who have completed this course will have deep understanding of Lagrangian and Hamiltonian formulation of Mechanical systems and would be able to formulate and solve the Lagrangian and Hamiltonian equations of motion for different mechanical systems. The students will have deep understanding of variational principle, rigid body motion and theory of small oscillation.

Books Recommended/Suggested Reading:

1. *Goldstein H.; Classical Mechanics, 2nd edition, Narosa Publishing House.*
2. *Rana N.C. and Joag P. S.; Classical Mechanics, McGraw-Hill Education.*
3. *Gupta K. C.; Classical Mechanics, Wiley Publication.*
4. *Moller, M.C.; Theory of relativity, Oxford University.*

Course Code: PHO-6113 Credit: 4

Course: Quantum Mechanics-I

Course Objectives: The primary objective is to equip the students with the knowledge of fundamental concepts and tools of quantum mechanics.

Block 1: Introduction of Quantum Mechanics
Unit 1: Mathematical tools and brief introduction to origins of quantum Physics.
Unit 2: Review of quantum postulates. Properties of linear vector space,
Unit 3: Dirac notation. Operators, their Eigen values and Eigen functions, orthonormality, completeness and closure.
Unit 4: Generalized Uncertainty Principle. Unitary transformations, change of basis.

Block 2: Abstract Formulation
Unit 5: Matrix Representation of operators.
Unit 6: Continuous basis, position and momentum representation and their connection.
Unit 7: Change of basis and unitary transformation,
Unit 8: expectation values and Ehrenfest theorem

Block 3: Quantum Dynamics
Unit 8: Schodinger picture
Unit 9: Heisenberg picture and equation of motion
Unit 10: Clsssical limit, solution of harmonic oscillator by operator method

Unit 11: Symmetries in quantum mechanics, general view of symmetries,
Unit 12: Spatial transition, continuous and discrete, time transition, parity and time reversal

Block4: Angular Momentum
Unit 13: Angular Momentum, commutation relations of angular momentum
Unit 14: Orbital, Spin and total angular momentum operators.
Unit 15: Pauli spin matrices, their Commutation relations.
Unit 16: Eigen values and Eigen functions of L2 and Lz. Clebsch-Gordon coefficients

Course Outcomes: Students will learn the basic concepts of Quantum mechanics which applies to all the physical systems irrespective of their size and can be beautifully perceived at atomic and subatomic level. Students will be able to understand the various operators used to represent dynamic variables. The eigen values and eigen functions of linear harmonic oscillator and Hydrogen atom will help students to understand the behaviour of microscopic systems.

Text and References Books:

1. Franz Schwabl : Quantum Mechanics.
2. J. J. Sakurai : Modern Quantum Mechanics.
3. N. Zettili : Quantum Mechanics.
4. P. A. M. Dirac :Priciples of Quantum Mechanics.
5. Bohm : Quantum Mechanics.

Course Code: PHO-6114 Credit: 4

Course: Classical Electrodynamics

Course Objectives: The primary objectives of this course aim at acquiring the stimulating knowledge of dynamical inter-relationship of electric and magnetic fields and their unification in creating electromagnetic waves, in an interesting way. Students must understand the concepts of electromagnetic wave propagation in vacuum, conducting and non-conducting media and also must be able to identify, formulate and solve fields equations and handle various problems of transporting energy or information in vacuum and through guided structures

Block 1: Review of Maxwell's Equation
Unit 1: Review of Maxwell's equations, propagation of EM waves in conducting medium, linear, circular, elliptical polarization.
Unit 2: Propagation of EM waves in conducting medium. Skin depth, Reflection and refraction from metallic surface.
Unit 3: Propagation of waves between perfectly conducting planes, waves in hollow-conductors,
Unit 4: TE and TM modes. Rectangular waveguides, resonant cavity

Block 2: Particle Dynamics in EM field

Unit 5: Relativistic Charged particle motion in uniform statics E and B fields
Unit 6: Cross E & B fields
Unit 7: Particle drifts in (velocity and curvature) in non-uniform statics B field.
Unit 8: Adiabatic invariance and magnetic mirror.

Block 3:Radiation
Unit 9: Lienard Weichert potential, field produced by charged particle in motion,
Unit 10: Radiation from accelerated charged particle, Larmor formula and its relativistic generalization,
Unit 11: Scattering of EM radiation by free charges. Thomson scattering,
Unit 12: Scattering by a system of charges, dipole radiation.

Block 4: Lagrangian formulation of Electrodynamics:
Unit 13: Lagrangian and Hamiltonian formulation for a free relativistic particle, for a charged particle in EM field
Unit 14: Interacting charged particle and fields
Unit 15: Energy-momentum tensor and related conservation laws
Unit 16: Canonical and Symmetric Stress Tensors, Solution of the wave equation in covariant form

Course Outcomes: After attending this course, students would be able to apply knowledge of mathematics and physics in understanding the coupled nature of electromagnetic fields. The role of different coordinate systems and vector calculus to describe the electromagnetic quantities as functions of space and time will be understood. Students will be able to explain fundamental laws governing electromagnetic fields and evaluate the physical quantities of electromagnetic fields (Field intensity, Flux density etc.) in different media. They would appreciate that the Maxwell's equations as field equations do not include the equation of motion of charged particles

Text and Reference Books:

1. *Jackson J.D., Classical Electrodynamics, Wiley India.*
2. *Marion J..B., Classical Electromagnetic Radiation, Academic Press.*
3. *Griffiths D. J., Introduction to Electromagnetics, Prentice Hall.*

Course Name: Physics (General) Lab-I Credit: 4

List of Experiments

1. To determine the wavelength of the sodium light and the wavelength difference between D1 and D2 lines using Michelson interferometer.
2. To measure the thickness of thin wire using He-Ne laser.
3. To measure wavelength of He-Ne laser using diffraction grating.
4. To determine Hall coefficient and mobility of charge carriers in a given sample of semiconductor.
5. To measure wavelengths of the Balmer lines of hydrogen spectrum and to determine the Rydberg constant for hydrogen atom from the measurement of these lines.

6. To determine the wavelength of sodium light and D1 and D2 lines by Febry Perot interferometer.
7. To Study of losses in optical fiber.
   (a) Measurement of propagation loss.
   (b) Measurement of bending loss.
8. To measure Numerical Aperture of Optical Fibre.
9. Demonstrate the Faraday-Effect using Flint Glass.
10. To determine the e/m ratio using Zeeman Effect.

Semester-II

Course Code: PHO-6211 Credit: 4

Course: Statistical Mechanics

Course Objectives: Statistical mechanics is an indispensable tool for studying physical properties of matter "in bulk" on the basis of the dynamical behavior of its "microscopic" constituents. This course is designed to teach the phenomenological postulates and theories of the matter and their relationship with the quantum mechanics.

Block 1: Classical ensemble theory

Unit 1: Quantum statistical mechanics of identical particles, Condition for statistical equilibrium,

Unit 2: Symmetry of wave function, Postulate of equal a prior probability, Random walk, Ensemble in quantum statistics,

Unit 3: Grand Canonical Ensemble, Partition function, Quantum distribution functions (Bose-Einstein and Fermi- Dirac),

Unit 4: Derivation of distribution laws using grand partition function.

Block 2: Quantum ensemble theory

Unit 5: Phase space and Liouville's theorem, Microcanonical ensemble theory and its application to ideal gas of monatomic particles

Unit 6: Canonical ensemble and its thermodynamics, partition function, classical ideal gas in canonical ensemble theory, energy fluctuations,

Unit 7: Gibbs paradox and its solution, Sackur-Tetrode equation, a system of quantum harmonic oscillators as canonical ensemble, Grand canonical ensemble,

Unit 8: Significance of statistical quantities, classical ideal gas in grand canonical ensemble theory.

Block 3:Ideal Bose systems

Unit 9: Basic concepts and thermodynamic behaviour of an ideal Bose gas, Bose-Einstein condensation,

Unit 10: Black body radiation-Planck's formula, Ideal Fermi systems: thermodynamic behaviour of an ideal Fermi gas,

Unit 11: Discussion of heat capacity of a free-electron gas at low temperatures,

Unit 12: Electron gas in metals, H-theorem.

Block 4: Phase transition

Unit 13: Phase transitions, Ising model, Thermodynamic fluctuations, Critical exponents,
Unit 14: Thermodynamic limit and its importance Random walk
Unit 15: Brownian motion, Diffusion equation, Fluctuation-Dissipation theorem.
Unit 16: Concepts of universality of phase transitions, Ising and Heisenberg models

Course Outcomes: On completion of the course students will have understanding of Physics of equilibrium systems, Fermi and Bose systems, Bose-Einstein condensation and Phase transitions, magnetism and super fluids, and critical phenomena.

Text and Reference Books:

1. *Landau and Lifshitz, Statistical Physics, Reed Educational & professional publication Ltd.*
2. *Pathria R.K., Statistical Mechanics (2nd edition), Butterworth-Heinemann, Oxford.*
3. *Huang K., Statistical Mechanics, Wiley Eastern, New Delhi.*
4. *Agarwal B.K. and Eisner M., Statistical Mechanics: Wiley Eastern, New Delhi.*

Course Code: PHO-6212 Credit:4

Course: Quantum Mechanics-II

Course Objectives: The primary objective is to teach the students the concept of commutation relations of angular momentum and symmetry along with Relativistic Quantum mechanics. The important topic of non relativistic scattering is also dealt with.

Block 1: Approximation methods for stationary systems

Unit 1: Time independent perturbation theory. Perturbation of non-degenerate states: first and second order perturbation.
Unit 2: Perturbation of a harmonic oscillator.Perturbation of degenerate states, removal of degeneracy.
Unit 3: Zeemaneffect, isotopic shift and Stark effects.
Unit 4: Variational and WKB methods.

Block 2: Approximation methods for time dependent problems

Unit 5: Interaction picture andTime dependent perturbation theory
Unit 6: Equations of Motion. Constant and harmonic perturbation.
Unit 7: Discrete and continuous case,transition probability.Fermi golden rule.
Unit 8: Adiabatic and sudden approximations.

Block 3: Scattering Theory

Unit 9: Scattering Theory Scattering of a wave packet.
Unit 10: The differential and total Cross section. The Born approximation.

Unit 11: Partial waves and phase shifts, The Lippman Schwinger equation.
Unit 12: Definition and properties of S-matrix, T matrix.Optical theorem.

Block 4: Relativistic Quantum Mechanics
Unit 13: Klein-Gordon and Dirac equations, properties of Dirac matrices.
Unit 14: Plane wave solution of Dirac equation. Spin and magnetic moment of the electron
Unit 15: Non-relativistic reduction of the Dirac equation.Central forces and the hydrogen atom.
Unit 16: Hydrogen atom in Dirac's theory, Dirac electron in constant magnetic field,

Course Outcomes: Students will learn the basic ideas of angular momentum and symmetry .Relativistic Quantum Mechanics will provide an exposure to how special relativity in quantum theory leads to intrinsic spin angular momentum as well as antiparticles approximations methods along with scattering theory shall presumably equip the student with sufficient knowledge to solve related problems.

Text and Reference Books:

1. Franz Schwabl : Quantum Mechanics.
2. Eugen Merzbacher : Quantum Mechanics.
3. N. Zettili : Quantum Mechanics.
4. P. M. Mathews and K. Venkatesan: Quantum Mechanics.
5. P. A. M. Dirac :Priciples of Quantum Mechanics.

Course Code: PHO-6213 Credit: 4

Course: Nuclear and Particle Physics

Course Objectives: The primary objective is to introduce the basic ideas and concepts of Nuclear Physics and impart knowledge about nuclear basic properties, nuclear decays and nuclear reactions.

Block 1:General properties of atomic nuclei
Unit 1: General properties of atomic nuclei and nuclear forces (qualitative), binding energy,
Unit 2: Types of nuclear potential, Ground and excited states of deuteron,
Unit 3: Tensor force S & D states, spin dependence of nuclear force,
Unit 4: n-p scattering and p-p scattering at low energies.

Block 2: Review of barrier penetration of alpha decay
Unit 5: Review of barrier penetration of alpha decay & Geiger-Nuttal law.
Unit 6: Beta decays, Fermi theory, Allowed and forbidden transitions,
Unit 7: Experimental evidence for Parity-violation in beta decay, Idea of electron capture,
Unit 8: Multipolarity of gamma transitions and selection rules, internal conversion, idea of Coulomb excitation.

Block 3: Nuclear models
Unit 9: Extreme particle model with square-well & harmonic oscillator potentials
Unit 10: Spin-orbit coupling, shell model predictions, magnetic moment-Schmidt lines,

Unit 11: Single particle model, Total spin 'J' for various configurations,
Unit 12: Electric quadrupole moment. Collective modes of motion, nuclear vibrations and rotations.

Block 4: Introduction of elementary particles
Unit 13: Introduction of elementary particles.Quantum numbers and conservation laws,
Unit 14: Charge conjugation, time reversal invariance, CPT theorem.The Baryon decuplet, meson octet, quark spin and color.
Unit 15: Pion parity, helicity of neutrino, K-decay,CPviolation in K- decay and its experimental determination, resonances,
Unit 16: Special symmetry groups SU(2) and SU(3) classification of hadrons, quarks, Gell Mann-Okubu mass formula.

Course Outcomes: The present course in nuclear physics revolves around many important and crucial aspects of science satisfying the natural human curiosity about the nature. The study regarding the properties of matter at the nuclear scale will provide better insight for understanding of the stability of matter and evolution of the Universe as such. The knowledge of energetics of the nuclear reactions gives not only the insight regarding the feasibility of reaction yield at different energies but could be extended to the Planks Scale also. Many of the scientific advancements related to human health, energy production and industrial requirement etc., are inevitably linked to the basic research in nuclear physics at all levels.

Text and Reference Books:

1. *Enge H. A, Introduction to Nuclear Physics, Addison-Wesley Pub. Co.*
2. *Ghoshal S. N., Nuclear Physics , S. Chand & Company Limited*
3. *Evans R. D., Atomic Nucleus, McGraw-Hill*
4. *Perkins D. H., Introduction to High Energy Physics, Cambridge University Press.*

Course Name: Programming in C Credit: 4
Code: PHO-6214

Course Objectives: To equip students with a solid foundation in the C programming language, enabling them to understand programming paradigms, utilize fundamental programming constructs, manipulate data structures, and perform file processing operations.

Block I: Basics of C programming

Unit 1: Introduction to programming paradigms, Applications of C Language, Structure of C program.

Unit 2: C programming: Data Types, Constants, Enumeration Constants, Keywords.

Unit 3: Operators: Precedence and Associativity, Expressions, Input/Output statements, Assignment statements**.**

Unit 4: Decision making statements, Switch statement, Looping statements, Preprocessor directives, Compilation process.

Block II:Arrays and Strings

Unit 5: Introduction to Arrays: Declaration, Initialization, One dimensional array, Two dimensional arrays.

Unit 6: String operations: length, compare, concatenate, copy**.**
Unit 7: Selection sort, linear and binary search**.**

Block III: Functions and pointers

Unit 8: Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions).
Unit 9: Recursion, Binary Search using recursive functions, Pointers, Pointer operators, Pointer arithmetic, Arrays and pointers, Array of pointers.
Unit 10: Parameter passing: Pass by value, Pass by reference.

Block IV:Structures and union

Unit 11: Structure, Nested structures, Pointer and Structures, Array of structures.
Unit 12: Self referential structures, Dynamic memory allocation.
Unit 13: Singly linked list, typedef, Union, Storage classes and Visibility.

Block V: File processing

Unit 14: Files, Types of file processing: Sequential access, Random access, Sequential access file.
Unit 15: Random access file.
Unit 16: Command line arguments.

Course Outcomes: On successful completion of this course, students shall be able to:

1. Understand the basics of C programming, including program structure, data types, operators, decision-making and looping statements, and the compilation process.
2. Apply their knowledge of arrays and strings to declare, initialize, manipulate, and search for elements, using sorting algorithms and string operations effectively.
3. Analyze the concepts of functions and pointers to modularize programs, implement recursion and binary search, work with pointers and arrays, and comprehend parameter passing mechanisms.
4. Create and design structures and unions, including nested structures, pointers to structures, self-referential structures.

Books Recommended/Suggested Reading:

1. Kamthane A. N. and Kamthane A. A.; Programming in C, Pearson Education India.
2. Reema Thareja; Computer Fundamentals and Programming in C, Oxford University Press.
3. Dey P. and Ghosh M.; Programming in C, Oxford University Press.
4. Kernighan B. W. and Dennis M. R.; The C Programming Language, Pearson Education India.
5. Kanetkar Y. P.; Let us C, BPB Publications.
6. Jones J. A. and Harrow K.; Problem solving with C, Pearson Education India.

Course Name: Physics (General) Lab-II Credit: 4
Course Code: PHO-6251

List of Experiments

1. To study of 8085 and 8086 Microprocessor training kit.
2. To perform addition of two 8 bit numbers; sum 8 and 16 bit.
3. To perform addition and subtraction of two 8 bit numbers; sum 16 bit.
4. To perform the decimal addition of two 8 bit number, sum 16- bit.
5. To find the largest number from a given number of string.
6. To perform multiplication of 8 bit data; product should be 16 bit.

7. To move a block of data from one memory location to another memory location.
8. To write an assembly language program to shift 8 bit no.(left shift).
9. To interface 8255 PPI to microprocessor and set port A as input port in Mode 0.
10. To interface ADC card to microprocessor & generate the digital output.
11. To interface DAC card to microprocessor & generate a square wave on CRO.
12. To study the plateau characteristics of a G-M counter
13. To determine the range of beta-rays
14. To study the energy dependence of the absorption coefficient of aluminum for gamma-rays.

Course Name: Programming in C Lab Credit: 2
Code: PHO-6252

Course objectives: This course aims to provide students with the fundamental knowledge and practical skills necessary for programming in the C language. Through hands-on programming exercises, students will develop proficiency in solving computational problems using C programming constructs and techniques.

Programs:

1. Write a C program to find roots of a quadratic equation.
2. Write a C program to find the total no. of digits and the sum of individual digits of a positive integer.
3. Write a C program to generate the Fibonacci sequence of first N numbers.
4. Write a C program to compute sin(x) using Taylor series approximation given by

   $$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + ...$$

   Compare output of the program with the built- in Library function. Print both the results with appropriate messages.
5. Write a C program to input two matrices and perform matrix multiplication on them.
6. Write a C program to check whether the given string is palindrome or not without using Library functions.
7. Write a C program to count the number of lines, words and characters in a given text.
8. Write a C program to generate prime numbers in a given range using user defined function.
9. Write a C program to find factorial of a given number using recursive function.
10. Write a C program to maintain a record of n student details using an array of structures with four fields - Roll number, Name, Marks and Grade. Calculate the Grade according to the following conditions.

Marks	Grade
>=80	A
>=60	B
>=50	C
>=40	D
<40	E

Print the details of the student, given the student roll number as input.

Course Outcomes:

On successful completion of this course, students should be able to:

1. Apply understanding of C programming concepts to develop C programs that solve specific computational problems, such as finding roots of a quadratic equation, generating the Fibonacci sequence, performing matrix multiplication, checking for palindromes, counting lines/words/characters in a text, generating prime numbers, and calculating the grade of a student based on their marks.
2. Analyze and compare the output of their C programs with the results obtained from built-in library functions or other reference solutions. They will also be able to evaluate the efficiency and correctness of their programs by examining the logic, syntax, and algorithmic design employed.

Semester-III

Course Name: Research Methodology Credit: 6
Code: PHO-7111

Course Objectives: To familiarize students with basic of research, research process and enable the participants in conducting research work and formulating research synopsis and report.

Block I: Research Formulation

Unit 1: Introduction, meaning of research,

Unit 2: Types, Role of research in important area and Process of Research,

Unit 3: Defining research Problems, Hypothesis Formulation.

Block II: Research Elaborated

Unit 4: Research Design, Research plan, Concept of sample, Sample size, various types of sampling techniques.

Unit 5: Types of Data and Methods of its Collection**;** Questionnaire Design,

Unit 6: Precautions in preparation of questionnaire, Measurement scales.

Block III: Data Analysis and Interpretation-1

Unit 7: Processing and Analysis of Data by application of statistical tools

Unit 8: various kinds of charts and diagrams used in data analyses

Unit 9: Application of Data Analysis

Block IV: Data Analysis and Interpretation-2

Unit 10: Hypothesis Testing (F-test, ANOVA, Chi –square test, t-test)

Unit 11: Multivariate Statistical techniques- Multiple regression, discriminate analysis, Factor analysis, Multivariate analysis of variance

Unit 12: Conjoint analysis, Cluster analysis, Multidimensional Scaling, Role of computer in research, Excel- A tool for statistical analysis, SPSS, Interpretation and conclusion

Block V: Report Writing

Unit 13: Report Writing, Significance of report writing, Steps in report writing

Unit 14: Layout of research report, Types of reports; Appendices

Unit 15: Bibliography, Characteristics of a good report; Precautions for report writing; Ethics in business research.

Books Recommended/Suggested Reading:

1. *Kothari C. R.: Research Methodology, New Age International Publishers.*
2. *Sinha S. C. and Dhiman A. K.; Research Methodology, EssEss Publications.*
3. *Anderson T. W.; An Introduction to Multivariate Statistical Analysis, Wiley.*
4. *Garg B. L., Karadia R., Agarwal F. and Agarwal U. K.; An Introduction to Research Methodology, RBSA Publishers.*

Course Outcomes: After the completion of the course, student shall be able to:

1. Elaborate various concepts related to research.
2. Enumerate various kinds of research design & process.
3. Develop adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis.
4. Demonstrate various techniques of data analysis-and hypothesis testing procedures.
5. Articulate appropriate research ethics for doing meaningful research.

Course Code: PHO-7112 Credit: 4

Course: Atomic and Molecular Physics

Course Objectives: To impart the knowledge about the fundamentals of atomic and molecular Physics of the systems, and to describe the structure of atoms and molecules on the basis of quantum mechanics.

Block 1: Atomic structure

Unit-1: Quantum Mechanical Treatment of one-electron Atom, Spin-Orbit interaction and fine structure of hydrogen atom,

Unit-2: Spectra of alkali elements. Singlet and triplet States of Helium, Central field approximation, Thomas-Fermi field,

Unit 3: Atomic wave function, Hartree and Hartree –Fock approximations, Spectroscopic Terms: L S and J J coupling schemes for many electron atoms,

Unit 4: Wave functions and energies of multiplets., Electric dipole and Electric Quadrupole.

Block 2: Molecular structure

Unit 5: Born - Oppenheimer approximation, Heitler-London theory of H_2

Unit 6: Rotation, vibration and electronic structure of diatomic molecules

Unit 7: Molecular orbit and valance bond methods for H_2^+ and H_2

Unit 8: Correlation diagram for heteronuclear molecules

Block 3: Molecular spectra

Unit 9: Rotation, vibration and electronic spectra of diatomic molecules

Unit 10: The Franck-Condon principle, electron spin and Hund's cases

Unit 11: Idea of symmetry elements and point groups and diatomic and polyatomic molecules

Unit 12: Infrared Spectroscopy and Raman spectroscopy, Photoelectron Spectroscopy

Block 4: Spectroscopy

Unit 13: Nuclear Magnetic Resonance, Chemical Shift, and Electron Spin Resonance (Introduction and their principles only).
Unit 14: General description and working of infra-red Spectrophotometer,
Unit 15: Photoelectron Spectrometer, Simple Raman Spectrometer,
Unit 16: NMR Spectrometer and ESR Spectrometer.

Course Outcomes: After completion of the course students will be able to understand thespectra produced by one and two valence electron systems, intensity of spectral lines and effect of magnetic field on one electron systems as well as origin of hyperfine structure. Students will acquire knowledge of rotational, vibrational and electronic spectra of molecules in addition to acquaintance with the principle of electron spin and nuclear magnetic resonance, nuclear quadrupole spectroscopy and their applications. They will also the Laser principle, basic Lasers and its applications.

Text and Reference Books:

1. *White H.E.: Introduction to atomic spectra, McGraw-Hill book company.*
2. *Weissbluth M.: Atoms and molecules, Academic Press Inc.*
3. *Barrow G.M.: Introduction to molecular spectroscopy, McGraw-Hill book company.*

Course Code: PHL-7213 Credit: 4

Course: Electronics

Course Objectives: To gain a deeper understanding of linear and digital electronic circuits, to be able to conceptualize, implement and actualize both linear and digital electronics circuits. The course will enable students to study the design and implementation of digital circuits and also the microprocessor architecture as a basis for computers.

Block 1: Linear Wave Shaping

Unit 1: High Pass and Low Pass RC Networks: Detailed Analysis; Response to Sinusoidal, Step, Pulse, Square wave, Exponential and Ramp Inputs;
Unit 2: RC circuits applications, High pass RC circuit as a differentiator, Low Pass RC circuit as an Integrator; Unit 3: Criterion for good differentiation and integration.
Unit 4: Laplace Transforms and their application to circuit elements.

Block 2: Amplifiers

Unit 5: Difference Amplifiers; Broadband Amplifiers,
Unit 6: Methods for achieving broad-banding
Unit 7: Emitter Follower at High Frequencies;
Unit 8: Operational Amplifiers and its Applications

Block 3: Power Supplies

Unit 9: Electronically Regulated Power Supplies; Converters and Inverters; High and Low Voltage Supplies, Application of SCR as Regulator; SMPS;
Unit 10: Elements of Digital Circuit Technology: Transistor as a Switch – Switching times: Definition and Derivation
Unit 11: Rise Time, Fall Time, Storage Time, Delay Time, Turn On Time, Turn Off Time Charge Control Analysis
Unit 12: Multivibrators: Astable, Monostable and Bistable; Schmitt Trigger. (10 Lectures)

Block 4: Flip Flops
Unit 13: Flip Flops: RS, RST, JK, T, D, JK M/S Flip flops, Race problem, Preset and Clear functions;
Unit 14: Binary Codes: Gray, 8421, 2421. Arithmetic Circuits. Boolean Variables and Operators, Simplification of Boolean Expressions.
Unit 15: Karnaugh Maps; Registers and counter: Shift registers, types of synchronous and asynchronous, ring counter modulus and UP/DOWN counters;
Unit 16: D/A converter and A/D converter. Simultaneous and Counter method of A/D converter, Successive Approximation method

Course Outcomes: The course aims to develop a deep understanding of amplifier circuits. It will also serve as a foundation for understanding computer architecture. The student will be able to design and troubleshoot simple digital circuits.

Reference Books:
1. Integrated Electronics: Millman and Halkias.
2. Pulse Digital and switching waveforms: Millman & Taub
3. Digital Technology: WH Gothman
4. Digital Electronics: Principles and Practice- Virender Kumar
5. Digital Principles and Applications: Malvino & Leach
6. Digital Fundamentals: TL Floyd

Course Code: PHO-7114 Credit: 4
Course: Condensed Matter Physics

Course Objectives: Knowledge of the role of Solid State Physics in important technological development.
At the end of the Condensed Matter Physics, student will be able to

COs No.	Course Outcomes (COs)	Cognitive Level
1.	**Tell** the basic symmetry operations performed in crystals and various types of defects that exist in crystals**.**	Remember
2.	**Explain** the band theory and different types of band structures.	Understand

3.	**Demonstrate** the transport properties in bands.	Understand
4.	**Illustrate** lattice and its thermal properties.	Understand

Block 1: Bonding in crystals

Unit 1: Bonding in crystals: covalent, ionic, metallic, hydrogen bond, van der Waal's bond and the Madelung constant.

Unit 2: Crystalline solids, unit cell, primitive cell, Bravais lattices, Miller indices, closed packed structures. Atomic radius, lattice constant and density.

Unit 3: Connection between orbital symmetry and crystal structure.Scattering from periodic structures, reciprocal lattice, Brillouin Zones.

Unit 4: Free electrons in solids, density of states, Fermi surface, Fermi gas at T=0 K, Fermi statistics, specific heat capacity of electrons in metals, thermionic emission of electrons from metals.

Block 2: Electronic band structure in solids

Unit 5: Electronic band structure in solids, Electrons in periodic potentials,

Unit 6: Bloch's Theorem, Kronig-Penney model, nearly free electron model,

Unit 7: Tight-binding model: density of states, examples of band structures.

Unit 8: Fermi surfaces of metals and semiconductors.

Block 3: Transport properties

Unit 9: Transport properties: Motion of electrons in bands and the effective mass,

Unit 10: Currents in bands and holes, scattering of electrons in bands,

Unit 11: Boltzmann equation and relaxation time, electrical conductivity of metals,

Unit 12: Thermoelectric effects, the Wiedemann-Franz Law.

Block 4: Lattice dynamics of atoms in crystals

Unit 13: Vibrations of monoatomic and diatomic linear chains,

Unit 14: Acoustic and optical phonon modes, density of states, thermal properties of crystal lattices,

Unit 15: Thermal energy of the harmonic oscillator, specific heat capacity of the lattice,

Unit 16: Debye theory of specific heats.

Text and Reference Books:

1. Hook and Hall : Solid State Physics (Manchester Physics Series).

2. Kittel : Introduction to Solid State Physics (John-Wiley).

3. Ibach and Luth : Solid State Physics (Springer-Verlag Berlin).

4. H. M. Rosenberg : Introduction to the Theory of Solids (Prentice Hall).

5. Blakemore : Solid State Physics (Pergamon).

6. J. P. Srivastava: Element of Solid State Physics (Prentice Hall).

Course Name: Physics Lab-III Credit: 4

Course Code: PHO-7151

List of Experiments

1. To Study of Basic Op-Amp circuits and perform the Inverting & Non- Inverting Amplifier Using OP- Amp.
2. To perform the Differentiator & Integrator Using OP- Amp.
3. To calculate the Frequency of Wein- bridge Oscillator Using Op Amp.
4. To perform the Schmitt trigger Using OP-Amp.
5. Draw the frequency Response curve of Low pass filter & High pass filter Using OP Amp.
6. Draw the frequency Response curve of Band pass filter & Band stop filter Using OP Amp.
7. To perform the Square Wave generator and Triangular Wave generator Using OP Amp.
8. Voltage Regulator using Op-Amp.
9. To perform the zero-crossing detector (sine wave to square wave convertor) using Op-Amp.
10. To measure the magnetic susceptibility of given samples and calculate their effective Bohr magneton number.
11. To measure the Lande' g factor for electrons using Electron Spin Resonance (ESR) technique.
12. Measurement of junction capacitance of p-n Junction and to determine the barrier potential and doping profile of depletion region.

Semester-IV

Course Name: Mathematical Statistics Credit: 4

Code: PHO-7211

Course Objectives: To provide students with a solid foundation in statistical methods, focusing on data collection, representation, descriptive statistics, probability distributions, bivariate data analysis, and hypothesis testing. Through theoretical concepts and practical applications, students will develop skills in analyzing data, making informed decisions, and drawing meaningful conclusions.

Block I: Data Collection and Representation
Unit 1: Data Types and Collection
Unit 2: Scales and Classification of Data
Unit 3: Diagrammatic Representation of Data

Block II: Descriptive Statistics
Unit 4: Measures of Central Tendency
Unit 5: Measures of Dispersion
Unit 6: Elementary Probability and Random Variables

Block III: Probability Distributions
Unit 7: Standard Probability Distributions
Unit 8: Bernoulli and Binomial Distributions
Unit 9: Poisson Distributions
Unit 10: Normal Distributions

Block IV: Bivariate Data Analysis
Unit 11: Scatter Diagram and Correlation

Unit 12: Regression Lines and Coefficients
Unit 13: Fitting of Polynomials and Exponential Curves

Block V: Hypothesis Testing and Analysis of Variance
Unit 14: Testing of Hypothesis
Unit 15: Z-test, t-test, and F-test
Unit 16: Chi-square Test and Goodness of Fit
Unit 17: Introduction to Analysis of Variance

Books Recommended/Suggested Reading:

1. *Spiegel, M. R. Theory and Problems of Statistics, Schaum Publishing Company.*
2. *Gupta S. C. and Kapoor V. K.; Fundamentals of Mathematical Statistics, S. Chand and Sons.*
3. *Hogg R. V., Mckean J. and Craig A. T.; Introduction to Mathematical Statistics, Pearson.*
4. *Miller I. and Miller M.; John E. Freund's Mathematical Statistics with Applications, Pearson.*
5. *Rohatgi V. K. and Saleh A. K. Md. E.; An Introduction to Probability and Statistics, Wiley.*
6. *Kapoor J. N. and Saxena H. C.; Fundamentals of Mathematical Statistics, S. Chand and Sons.*

Course Outcomes: On successful completion of this course, students shall be able to:

1. Apply appropriate methods to collect and classify different types of data,
2. Analyze data sets using measures of central tendency and dispersion to summarize and interpret the distribution and variability of the data.
3. Demonstrate an understanding of elementary probability concepts and random variables to analyze and predict outcomes in statistical situations.
4. Interpret and apply standard probability distributions, including Bernoulli, binomial, Poisson, and normal distributions, to model and analyze real-world scenarios.

Course Name: Any Advanced MOOC course Credit: 4
Code: PHO-7212

Source: SWAYAM/NPTEL

Faculty and Support Staff

The University has identified the requisite faculty and support staff as mandated by UGC and formally they shall be allocated the required positions from amongst the existing faculty exclusively for ODL mode or fresh appointments as required so, shall be initiated for which Letter of Intent have been issued to the prospective faculty and staff. The course material prepared by this university will be on par with any open university/Distance education centre in the country.

List of Faculty associated with MSc- Physics program is as follows:-

S. No.	Name of Faculty	Designation	Nature of Appointment	Qualification	Subject

1	Dr. Yatendra Pal Singh	Professor	Full Time	Ph.D	Physics
2	Dr. Pooja Mishra	Assistant Professor	Full Time	Ph.D	Physics

Delivery Mechanism

The ODL of MU follows a modern ICT (Information & Communication Technology) enabled approach for instruction. The methodology of instruction in ODL of MU is different from that of the conventional/regular programs. Our ODL system is more learner-oriented and the learner is an active participant in the teaching-learning process. ODL of MU academic delivery system comprises:

A. Print Material

The printed material of the programme supplied to the students will be unit wise for every course.

B. Counselling Sessions

Normally, counselling sessions are held as per a schedule drawn beforehand by the Subject Coordinator. There will be 6 counselling/ contact classes for 4 credit course will be held on the campus on Saturday and on Sunday of 2 hour duration for each course in face to face mode (In case of 2 credit course contact hours are required 6 hours and in case of 6 credit course contact hours required 18 hours). Contact classes will be held in the campus on Saturdays and on Sundays.

C. Medium of Instruction

Medium of Course Instruction: English

Medium of Examination: English

Student Support Systems

Universities Study Centres or Learner Support Centre shall be headed by a coordinator, not below the rank of Assistant professor and shall be augmented with academic and non-academic staff depending on the learner.

The university has made appropriate arrangements for various support services including counselling schedule and resource-oriented services evaluation methods and dates both online and offline modes for easy and smooth services to the students of distance mode.

At present the university have only one study centre on the campus. The institution is not promoting any study centres outside the campus. All student support services will be provided to the student through a single window method/mode onsite and online.

F. Procedure for Admissions, Curriculum, Transaction and Evaluation

Admission Process

Admission to the M.Sc. (Physics) Programme will be done on the basis of screening of candidate's eligibility on first come first serve basis. The University will follow the reservation policy as per norms of the Government. Admission shall not be a right to the students and MU, CDOE shall

retain the right to cancel any admission at any point of time if any irregularity is found in the admission process, eligibility etc..

Maximum Duration

A. The maximum duration of the M.Sc. (Physics) Programme is four years. Thereafter, students seeking completion of the left-over course(s) will be required to seek fresh admission.
B. The student can complete his programme within a period of 4 years failing which he/she shall seek fresh admission to complete the programme.

Eligibility

Science (PCM) Graduate from a recognised University is eligible for admission into M.Sc. (Physics) programme.

Fee Structure

Name of the Program	Degree	Duration	Year	Tuition Fee/Year	Exam Fee/Year	Total (in Rs.)
Master of Science (Physics)	PG	2 to 4 Years	1	15000	2000	17000
			2	13500	2000	15500
					Total	32500

Activity Schedule

S. No.	Name of the Activity	Tentative months schedule (specify months) during year			
		From	To	From	To
1	Admission	Jul	Sep	Jan	Mar
2	Assignment submission (if any)	Sep	Oct	Mar	Apr
3	Evaluation of Assignment	Oct	Nov	Apr	May
4	Examination	Dec		Jun	
5	Declaration of Result	Jan		Jul	
6	Re-registration	Jul		Jan	
7	Distribution of SLM	Jul	Sep	Jan	Mar
8	Contact Programmes (counseling, Practicals.etc.)	Sep	Nov	Mar	May

Credit System

MU, CDOE proposes to follow the ‘Credit System’ for most of its programs. Each credit amounts to 30 hours of study comprising all learning activities. Thus, a 8 credit course requires 240 hours,

6 credit course requires 180 hours , 4 credit course requires 120 hours and 2 credit course requires 60 hours of study. This helps the student to understand the academic effort to complete a course. Completion of an academic programme requires successful clearing of both, the assignments and the term-end examination of each course in a programme.

Duration of programme	Credits	Name of programme	Level of programme
2 to 4 Yrs.	80	M.Sc. (Physics)	Master's Degree

Assignments

Distance Education learners have to depend much on self study. In order to ascertain the writing skill and level of comprehension of the learner, assignment work is compulsory for all learners. Each assignment shall consist of a number of questions, case studies and practical related tasks. The Assignment Question Papers will be uploaded to the website within a scheduled time and the learners shall be required to respond them within a specified period of time. The response of the learner is examined by a faculty member.

Evaluation**:**The evaluation system of the programme is based on two components:

A. Continuous Evaluation in the form of assignments (weightage 30%): This Component carries a weightage of 30%. There will be at least one graded assignment and test per course. These assignments are to be submitted to the Co-ordinator of the CDOE/Study Centre to which the student is assigned or attached with.

B. Term-end examination (weightage 70%): This will be held twice every year in the months of June and December. The students are at liberty to appear in any of the examinations conducted by the University during the year. A student will be allowed to appear in the Term-End Examination only after she/he has registered for that course and submitted the assignment. For appearing in the Examination, every student has to submit an Examination form through online (www.mangalayatan.in)/ or offline before the due dates as given in the schedule of operations. If a student misses any term-end examination of a course for any reason, s/he may appear for any of them or all the courses subject to the maximum of 8 courses in the subsequent term-end examinations. This facility will be available until a student secures the minimum pass grade in the courses but up to a maximum period of four semesters, since the date of registration of the course is valid for four semesters. Beyond this period s/he may continue for another four semesters by getting Re-registration by paying fee again. In that case, the score of qualified assignments and/or term-end examination will be retained and the student will be required to complete the left out requirements of such re-registered courses. Minimum requirement for passing a course will be 40% marks.

G. Laboratory Support and Library Resources

The library of Mangalayatan University aims to empower the teaching mission and intellectual culture of the community through availability through an organized collection of information as

well as instruction in its access, relevance and evaluation.
The University Library enriches advance learning and discovery by providing access to a broad array of resources for education, research and creative work to ensure the rich interchange of ideas in the pursuit of knowledge.
The Directorate of Distance Education of Mangalayatan University has initiated the process of setting up a dedicated Library for ODL program and acquiring printed books and e-books for this purpose. The required International and National subject journals are also provided. We have a full functioning community radio service onboard (90.4 FM). We already have annual journal subscriptions and the capacity can be enlarged at later stages as the University lines up with more online journals.

The collection of the Library is rich and diverse especially in terms of the breadth and depth of coverage. Collection encompasses subjects in Management, Commerce, Information Technology, Computer Applications, and other allied areas. This collection further includes Books, Research Journals, Project Reports/Dissertations and online Journals.

The University has well equipped Computer Laboratories, Lecture Capturing Systems, Audio Video facilities, ICT enabled class rooms, Wi-Fi facilities etc.

H. Cost estimate of the programme and the provisions

Initial expenses have been done by the University in terms of provision of infrastructure, manpower, printing of Self Study Material etc. The University intends to allocate expenses out of the total fee collection as per following details:

a) SLM Development and Distribution	:	20%
b) Postal and ICT Expenses	:	10%
c) Salary and other Administrative expenses	:	60%
d) Future Research development reserve	:	10%

Once programmes are operational, the programme budget from fee receipts will be planned as per the guidelines of University Grants Commission.

I. Quality Assurance

The University has established the Centre for Internal Quality Assurance (CIQA) in the University campus. The CIQA will monitor and maintain the quality of the ODL programmes. It has the following objectives in making the compliances of quality implementations.

Objectives

The objective of Centre for Internal Quality Assurance is to develop and put in place a comprehensive and dynamic internal quality assurance system to ensure that programmes of higher education in the Open and Distance Learning mode and Online mode being implemented by the Higher Educational Institution are of acceptable quality and further improved on continuous basis.

Functions of CIQA

The functions of Centre for Internal Quality Assurance would be following:

1) To maintain quality in the services provided to the learners.
2) To undertake self-evaluative and reflective exercises for continual quality improvement in all the systems and processes of the Higher Educational Institution.
3) To contribute in the identification of the key areas in which Higher Educational Institution should maintain quality.
4) To devise mechanism to ensure that the quality of Open and Distance Learning programmes and Online programmes matches with the quality of relevant programmes in conventional mode.
5) To devise mechanisms for interaction with and obtaining feedback from all stake holders namely, learners, teachers, staff, parents, society, employers, and Government for quality improvement.
6) To suggest measures to the authorities of Higher Educational Institution for qualitative improvement.
7) To facilitate the implementation of its recommendations through periodic reviews.
8) To organize workshops/seminars/symposium on quality related themes, ensure participation of all stakeholders, and disseminate the reports of such activities among all the stakeholders in Higher Educational Institution.
9) To develop and collate best practices in all areas leading to quality enhancement in services to the learners and disseminate the same all concerned in Higher Educational Institution.
10) To collect, collate and disseminate accurate, complete and reliable statistics about the quality of the programme(s).
11) To ensure that Programme Project Report for each programme is according to the norms and guidelines prescribed by the Commission and wherever necessary by the appropriate regulatory authority having control over the programme;
12) To put in place a mechanism to ensure the proper implementation of Programme Project Reports.
13) To maintain a record of Annual Plans and Annual Reports of Higher Educational Institution, review them periodically and generate actionable reports.
14) To provide inputs to the Higher Educational Institution for restructuring of programmes in order to make them relevant to the job market.
15) To facilitate system based research on ways of creating learner centric environment and to bring about qualitative change in the entire system.
16) To act as a nodal coordinating unit for seeking assessment and accreditation from a designated body for accreditation such as NAAC etc.
17) To adopt measures to ensure internalization and institutionalization of quality enhancement practices through periodic accreditation and audit.
18) To coordinate between Higher Educational Institution and the Commission for various qualities related initiatives or guidelines.
19) To obtain information from other Higher Educational Institutions on various qualitybenchmarks or parameters and best practices.
20) To record activities undertaken on quality assurance in the form of an annual report ofCentre for Internal Quality Assurance.
21) It will be mandatory for Centre for Internal Quality Assurance to submit Annual Reports to the Statutory Authorities or Bodies of the Higher Educational Institutionabout its activities at the end of each academic session. A copy of report in the formatas specified by the Commission,

duly approved by the statutory authorities of theHigher Educational Institution shall be submitted annually to the Commission.

After enrolling in M.Sc. (Physics) programme of Mangalayatan University in ODL mode, student will exhibit knowledge, skill and general competence with scientific aptitude and innovation. After completion of M.Sc. (Physics) programme, student will pursue further studies in physics for roles in academia, research, industry, finance, technology and government.