# MANONMANIAM SUNDARANAR UNIVERSITY -TIRUNELVELI
# PG PROGRAMMES

**OPEN AND DISTANCE LEARNING (ODL) PROGRAMMES**

**(FOR THOSE WHO JOINED THE PROGRAMMES FROM THE ACADEMIC YEAR 2023-2024 ONWARDS)**

**M.Sc. Physics**

| Semester | Course | Title of the Course | Course Code |
|---|---|---|---|
| IV | Core XI | Nuclear and Particle Physics | SPHM41 |
| | Core XII | Electromagnetic Theory | SPHM42 |
| | Elective VI | Practical – IV | SPHP41 |
| | Skill Enhancement Course III | Solid Waste Management | SPHS41 |
| | Project | Project with Viva-Voce | SPHR41 |
| | Extension Activity | | SPHX41 |

# NUCLEAR AND PARTICLE PHYSICS

| UNIT | Details |
|------|---------|
| I | **NUCLEARMODELS**<br>Liquid drop model – Weizacker mass formula – Isobaric mass parabola – Mirror Pair - Bohr Wheeler theory of fission – shell model – spin-orbit coupling – magic numbers – angular moment a and parity of ground states– magnetic moment–Schmidt model–electric Quad rupole moment-Bohrand Mottelson collective model – rotational and vibrational bands. |
| II | **NUCLEARFORCES**<br>Nucleon – nucleon interaction – Tensor forces – properties of nuclear forces – ground state of deuteron –Exchange Forces-Meson theory of nuclear forces–Y ukawapotential – nucleon- nucle on scattering– effective range theory– spin dependence of nuclear forces –charge independence and charge symmetry – is ospin formalism. |
| III | **NUCLEARREACTIONS**<br>Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – four factor formula. |
| IV | **NUCLEARDECAY**<br>Betadecay – Continuous Beta spectrum – Fermi theory of bet Adecay - Comparative Half - life – Fermi Kurie Plot–mass of neutrino – allowed and for bid dendecay —neutrino physics – Helicity - Parity violation - Gamma decay – multi pole radiations – Angular Correlation - internal conversion – nuclear isomerism – angular momentum and parity selection rules. |
| V | **ELEMENTARY PARTICLES**<br>Classification of Elementary Particles – Types of Interaction and conservation laws – Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks –SU (2) and SU (3) groups-Gell Mannmatrices–Gell Mann Okuba Mass formula-Quark Model. Standard model of particle physics – Higgs boson. |
| VI | **PROFESSIONAL COMPONENTS**<br>Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism. |

## TEXT BOOKS

1. D.C.Tayal –Nuclear Physics –Himalaya Publishing House (2011).
2. K.S. Krane–Introductory Nuclear Physics –John Wiley & Sons (2008).
3. R.Roy and P. Nigam–Nuclear Physics –New Age Publishers (1996).
4. S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011).
5. S.Glasstone–Source Book of Atomic Energy–Van NostrandReinholdInc.,U.S.-3rdRevised edition (1968).

# ELECTRO MAGNETIC THEORY

| UNIT | Details |
|------|---------|
| **I** | **ELECTROSTATICS**<br>Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems. Polarization and displacement vectors – Boundary conditions-Dielectric sphere inauniformfield–Molecular polarizability and electrical susceptibility–Electro static energy in the presence of dielectric – Multi pole expansion. |
| **II** | **MAGNETOSTATICS**<br>Biot-Savart's Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution-Magnetic moment, force and torque on acurrent distribution in an external field-Magneto static energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetized sphere. |
| **III** | **MAXWELL EQUATIONS**<br>Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials-Gaugeinvariance-Wavee quation and plane wave solution-Coulom band Lorentz gauges-Energy and momentum of the field - Poynting's theorem - Lorentz force - Conservation laws for a system of charges and electro magnetic fields. |
| **IV** | **WAVEPROPAGATION**<br>Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface-Waves in a conducting medium-Propagation of waves in a rectangular wave guide. Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole. |
| **V** | **ELEMENTARY PLASMA PHYSICS**<br>The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations - The Debyeshieldingproblem-Plasmaconfinementinamagneticfield-Magneto-hydrodynamicwaves-Alfven waves and magneto sonic waves. |
| **VI** | **PROFESSIONALCOMPONENTS**<br>Expert Lectures, Online Seminars-Web inarson Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism. |

| TEXT BOOKS |
|------------|
| 1. D. J.Griffiths , 2002, Introduction to Electrodynamics, 3rd Edition, Prentice-Hall of India, New Delhi. |
| 2. J.R.Reitz, F.J.Milford and R.W.Christy,1986,Foundation sofElectromagnetic Theory, 3rd edition, Naros a Publishing House, New Delhi. |
| 3. J.D.Jackson, 1975,Classical Electrodynamics, Wiley Eastern Ltd. New Delhi. |
| 4. J.A.Bittencourt,1988,Fundamentals ofPlasmaPhysics,PergamonPress,Oxford. |
| 5. Gupta, Kumar and Singh, Electrody namics, S.Chand & Co., New Delhi |

**Practical–IV**

**ADVANCED PHYSICS EXPERIMENTS – II AND NUMERICAL METHODS IN C++**

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### Section A: Advanced Physics Experiments – II (Any 6 Experiments)

1. Investigate the equilibrium points of the logistic map equation $X_{n+1} = aX_{n(1-X_n)}$ for various parameter values and initial conditions:
    a) Determine the equilibrium points for 'a' ranging from 0.5 to 2.5 with a step size of 0.1 considering x0=0.1.
    b) Explore the behavior of the logistic map for 'a' values between 3.5 and 4.0 with a step size of 0.05 for x0=0.2.
    c) Analyzethedynamicsneartheperiod-doublingbifurcationpointata≈3.828,considering x0=0.3.
    d) Plot $x_n$ versus for each scenario and generate bifurcation diagramsto visualize the system's behavior.

2. Determination resistivity of a semi conduct or by Four Probe Method
3. Examine the input-output characteristics of analog-to-digital converter ADC0804 or any ADCIC. The characteristics may include parameters such as linearity, accuracy, resolution, and dynamic range.
4. Photo Conductivity Experiment:
    a) Top lot the current-voltage characteristics of a CdS Photo Resist or (LDR) at constant irradiance.
    b) To measure the Photo current as a function of irradiance at constant voltage
5. Determination of the distance between two tracks of a CD and a DVD using a Solid state laser
6. Verification of Theven in's and Max power the orems
7. Study the Characteristics of a Load cell
8. Design of a Serial Shift Register susing necessary Flip-Flop ICs
9. Design of Encoder and Decoder Circuits using necessary ICs
10. Study of a quartz crystal (1MHz) and construction of a Pierce crystal Oscillator using digital inverters
11. UV spectral data analysis for the given spectrum
12. Simulation of satellite orbit around the earth using the universal law of gravitation in Scilab

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# Section – B :Numerical Methods in C++

## (Any SIX programs with Algorithm and Flow chart)

1.Algebraic and Transcendental equation.
 a) Solution of the given equations using Newton Raphson Method–manual calculation.
 b) C++ program to find the solution using N-R method and verification.

2. Algebraic and Transcendental equations.
 a) Solution of the given equations using Bisection Method – manual calculation.
 b) C++ program to find the solution using Bisection method and verification.

3. Curve Fitting–Linear Fit
 a) Principle of  least square and fitting a straight line.
 b) C++ program to fit a straight line using the given data related with any physics experiment.

4. Curve Fitting–Non Linear Fit
  a) Principle of fitting a second degree polynomial using method of least square
  b) C++program to fit a polynomial using the given data related with any physics experiment.

5. Interpolation
   a) Derive Lagrangian interpolation formula.
   b) C++ program to inter polate using the given data related with any physics experiment by Lagrangian Method.

6. Solution of simultaneous equations –Gauss Elimination method.
  a) Procedure to solve Simultaneous equations using Gauss Elimination(GE) Method
  b) C++ program for solving unknown branch current sin Wheat stone's bridge using GE meth

7. Numerical solution of ordinary Differential Equations.
   a) Derivation of Exponential law of Radio active decay.
   b) RK4th order method of solving a given1st order differential equation.
   c) C++program using RK method to solve radio active problem –Compare out put with the analytical result.

8. Area under the Curve-Numerical integration
   a) Derivation of Trapezoidal and Simpson's rule
   b) C++programs for Trapezoidal and Simpson1/3 rule
   c) Comparison of the program out put with direct integration.

9. Random Number Generation and Montecarlo Method
   a) Generate and scale the random numbers using the C++library functions.
   b) Evaluate the given integral using Montecarlo method.

10. Matrix Multiplication
    a) Multiplication of given matrices
    b) Rotation matrix definition.
    c) C++programtorotatethegiven2D-
       objectabouttheoriginusingrotationmatrixthroughthe given angle.

11. Inverse of a Matrix

    a) Procedure to determine the Inverse of a Matrix using Gauss elimination
       Method.

    b) C++Program to find the Inverse of the Matrix using Gauss Elimination
       Method.

12. Numerical Differentiation

    a) Numerical differentiation–related to any physical problem
    b) Derivation of Newton's law of cooling –equation
    c) C++program to verify the Newton's law of cooling from the given
       experimental data.

# Solid Waste Management (SWM)

| UNIT | Details |
|------|---------|
| I | **SOLID WASTE MANAGEMENT**<br>Introduction - Definition of solid waste - Types – Hazardous Waste: Resource conservation and Renewal act – Hazardous Waste: Municipal Solid waste and non-municipal solid waste |
| II | **SOLID WASTE CHARACTERISTICS**<br>Solid Waste Characteristics: Physical and chemical characteristics - SWM hierarchy - factors affecting SW generation |
| III | **TOOLS AND EQUIPMENT**<br>Tools and equipment - Transportation - Disposal techniques - Composting and land filling technique |
| IV | **ECONOMIC DEVELOPMENT**<br>SWM for economic development and environmental protection Linking SWM and climate change and marine litter. |
| V | **INDUSTRIAL VISIT**<br>SWM Industrial visit – data collection and analysis – presentation |
| VI | **PROFESSIONAL COMPONENTS**<br>Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism |

## TEXT BOOKS

1. **Handbook of Solid Waste Management /Second Edition, George Tchobanoglous, McGraw Hill (2002).**
2. **Prospects and Perspectives of Solid Waste Management, Prof. B BHosett, New Age International (P) Ltd (2006).**
3. **Solid and Hazardous Waste Management, Second Edition, M.N Rao, BSP /BS Publications Books (.(2020**
4. **Integrated Solid Waste Management Engineering Principles and Management, Tchobanoglous, McGraw Hill (2014).**
5. **Solid Waste Management (SWM), Vasudevan Rajaram, PHI learning private limited, 2016**