Annexure – 7

PERIYAR UNIVERSITY
Salem – 636 011.

Periyar Institute of Distance Education
(PRIDE)

M.Sc. BRANCH III (B)-PHYSICS
REGULATION AND SYLLABUS
(For the candidates admitted from 2007-2008 onwards)
PERIYAR UNIVERSITY, SALEM-636011

PERIYAR INSTITUTE OF DISTANCE EDUCATION (PRIDE)
M.Sc. BRANCH III (B)-PHYSICS

REGULATION AND SYLLABUS
(For the candidates admitted from 2007-2008 onwards)

01. OBJECTIVES OF THE COURSE

The recent developments in physical sciences, has been included in the enriched M.Sc., (Physics) Syllabus to meet out the present day needs of academic and Research, Institutions and Industries.

02. DURATION OF THE PROGRAMME

Two-years post-graduate program under non-semester pattern.

03. ELIGIBILITY

A candidate who has passed the B.Sc., Degree Examination in Branch III Physics Main or B.Sc., in Applied Physics or B.Sc., Physics-(Vocational) of this University or an examination of some other university accepted by the syndicate as equivalent thereto shall be permitted to appear and qualify for the M.Sc. Physics Degree Examination of this University after a course of two academic years.

04. COURSE OF STUDY

The course of study for the degree shall be in BRANCH III (B)-Physics under non-semester system without internal assessment according to a syllabus prescribed from time to time.

<table>
<thead>
<tr>
<th>Total marks</th>
<th>-1000</th>
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<tbody>
<tr>
<td>For each paper</td>
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<td>Project</td>
<td>-100 Marks</td>
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05. STRUCTURE OF THE COURSE

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<tr>
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<tr>
<td>1</td>
<td>I</td>
<td>Paper 1</td>
<td>Mathematical Physics</td>
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<tr>
<td>2</td>
<td></td>
<td>Paper 2</td>
<td>Classical and Statistical Mechanics</td>
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<tr>
<td>3</td>
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<td>Electronics</td>
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<td>Condensed matter Physics</td>
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<td>5</td>
<td></td>
<td>Practical</td>
<td>Practical I General Experiments</td>
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<td>6</td>
<td>II</td>
<td>Paper 5</td>
<td>Electro Magnetic Theory</td>
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<td>Paper 6</td>
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<td>Practical II Electronics Experiments</td>
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<td>Project</td>
<td>Project 75 and Viva 25</td>
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06. EXAMINATION

The theory examination shall be three hours duration to each paper at the end of each year. The candidates failing in each subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination.

The practical examination for P.G. Course should be conducted at the end of each year.
07. QUESTION PAPER PATTERN

Question paper pattern for University Examinations

Time - 3 Hours
Maximum - 100 Marks
Passing Minimum - 50 Marks

Part – A (5x5=25 Marks)  Part – B (5x15=75 Marks)

Answer all questions
(Either or Type)

08. PASSING MINIMUM

In order to pass a paper 50 % Minimum is compulsory

09. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who obtain not less than 75 percent of the marks in the aggregate shall be deemed to have passed the examination in First class with Distinction provided they pass all the examinations prescribed for the course at the first appearance.

Candidate who secure not less than 60 percent of the aggregate marks in the whole examination shall be declared to have passed the examination in the First class provided they pass all the examinations prescribed for the course within the period of two academic years from the year of completion of the course.

Candidates who secure not less than 50 percent of the aggregate marks in the whole examination but below 60 percent shall be declared to have passed the examination in the second class provided they pass all the examinations prescribed for the course within a period of two academic years from the year completion of course.

Candidates who pass all the examinations prescribed for the course in the first appearance only are eligible for ranking.
10. COMMENCEMENTS OF THIS REGULATION

These regulation and syllabus shall take effect from the academic year 2007 – 2008, that is, for students who are admitted to the first year of the course during the academic year 2007-2008 and there after.

11. TRANSITORY PROVISION

Candidates who are admitted to the P.G. Course of study before 2007 – 2008 shall be permitted to appear for the examinations under those regulation for a period for three years i.e. up to and inclusive of the examination of April / May 2010. Thereafter they will be permitted to appear only under regulations then in force.
FIRST YEAR

MATHEMATICAL PHYSICS

PAPER 1

UNIT-I  Vector space and Tensors
Vector Space-Definitions-Linearity independence of Vector-Bilinear and quadratic forms-change of basis-Schmidt’s orthogonalisation processes-Swartz inequality-Application of vectors to hydrodynamics the equation of flow in solids.

Tensors-N-dimensional space-superscripts-subscripts-coordinate transformations kronecker delta symbol-properties of kronecker generalized kronecker delta Tensors of higher ranks-Algebraic operation of Tensors-symmetric and asymmetric Tensors-Application of Tensors-Dynamics of a particle-Elasticity-Rigid bodies

UNIT-II  Fourier’s and Laplace’s integral transforms.

UNIT-III Complex variable

UNIT – IV  Special function and differential equations
Gamma and Beta functions-Liouville problem-solution for Bessel-Legendre-Laguerre and Hermite differential equation-properties-Generating functions-Rodrique’s formula-orthogonal properties-recurrence relation

UNIT-V  Dirac delta function and green’s function
Direct-Delta function-Three dimensional delta function-Green’s function – for one dimensional case-Symmetry properties of green function-Green’s function for poisson equation-Quantum mechanical scattering problem.

Books for Reference:

Books for Study:
5. H.Anton, Elementary linear Algebra
7. S.S.Rajput, Mathematical Physics, Pragati Pragasam, Meerut,

CLASSICAL AND STATISTICAL MECHANICS

PAPER 2

A. CLASSICAL MECHANICS

UNIT – I

Elementary Principles – D’Alembert’s principle – Lagrange’s equation – Hamilton’s equation – Lagrangian and Hamiltonian

Two body central Force Problem
Equations of motion and first integrals – Kepler’s laws – scattering by a central potential – transformation from center of mass to laboratory frame.

Special relativity in classical mechanics
Relativistic Lagrangian and Hamiltonian for a particle – space, time and energy – momentum – four vectors – center of mass system for relativistic particles – invariance of Maxwell’s equations.

UNIT II

Kinematics of Rotation
Orthogonal transformations – Euler poles – Rotating frames of reference and coriolis force

Mechanics of Rigid bodies
Angular momentum and kinetic energy – moment of inertia tensor – Euler’s equations of motion – Torque free motion – Motion of a symmetric top under gravity.
UNIT III

Canonical Transformations
Canonical transformations and their generators – simple examples – poisson brackets

Hamilton Jacobi Theory
Hamilton – Jacobi equations – Action angle variables – Application to kepler problem

Small oscillations
Formulation of the problem – Transformation to normal coordinate – Linear triatomic molecule

B. STATISTICAL MECHANICS

UNIT IV

Classical Statistical Mechanics:

Quantum Statistical Mechanics
Liouville’s equation – Postulates of quantum statistical mechanics – Bose-Einstein, Fermi-Dirac distributions

UNIT V

Ideal Bose gas:
Equation of state – Bose-Einstein condensation – Landau’s theory of liquid Helium II – Black body radiation – Phonons

Ideal Fermi gas
Books for Study:

Books for Reference:
2. Landau & Lifshitz, Mechanics.
4. K.Huang ,Thermal Physics.

ELECTRONICS

PAPER 3

UNIT – I

Operational amplifier and analog computation

UNIT – II

Wave form generators and Active filters
Sine wave oscillation with phase shift and wein’s networks-Comparator-Schmitt Trigger-Astable and Monostable operations-Triangular wave generator.
Active filters-Butterworth filters design-Second order law-Low,High and Band pass filters-Band notch filter.

UNIT – III

Data Converters


UNIT –IV

Memories and Measuring Instruments


UNIT V:

Architecture of Microcontroller 8051

Introduction – comparison between microcontroller and microprocessors – architecture of 8051 – key features of 8051 – Memory organization – data memory and program memory – internal RAM organization – special
function registers – control registers – I/O ports – counters and timers – interrupt structure.

**Programming the Microcontroller 8051**

Instructions set of 8051 – arithmetic, logical, data move, jump and call instructions - addressing modes – immediate, register, direct and indirect addressing modes – assembly language programming – simple programs to illustrate arithmetic and logical operations (sum of numbers, biggest and smallest in an array) – software time delay.

**Books for study:**

3. Linear Integrated Circuits – D. Roy Choudry, Shail Jain.
Books for Reference:

4. Operational amplifier – Gayakwad – TMG Hill
5. Rajkamal, Microcontroller Architecture, Programming interfacing and system design, Pearson edition
CONDENSED MATTER PHYSICS

PAPER 4

UNIT – I

Lattice Dynamics:

Imperfections in Crystals

UNIT – II

Transport phenomena and Band theory
UNIT – III

**Semiconductor Physics**

Concept and importance of Fermi surface-Construction of two dimensional fermi surface-Crystal momentum and origin of effective mass-Experimental methods of Fermi surface studies-Quantization of orbits in a magnetic field.

Expression for position of Fermi levels and carrier concentrations-
Variation of Fermi level with temperature- Carrier mobility, Conductivity and their variation with temperature-Direct and Indirect band gap semiconductors-Differences and examples-Hall effect continuity equation-Drift and Diffusion-Einstein relation-Generation, Recombination and life of non-equilibrium carriers-Heyness-Schockley experiment.

UNIT – IV

**Ferro magnetism and Superconductivity:**


**Super Conductivity:**

UNIT – V

Crystal growth and Nano crystalline solids


Books for Study and Reference:

1. C.Kittel-Introduction to Solid state Physics(John Wiley and Sons)
7. Subrahmanyam – High Temperature super conductors (Wiley Eastern)
8. Merlin D.M. – Magnetism in solids
12. Narlikar and Ekbote – Introduction to super conductivity
13. Solid state Physics, MacMilan......A.J.Dekker
15. Elementary Solid State Physics, Addison Wesley...M.Ali Omar
16. Introduction to Superconductivity, Pergamon......A.C.Rose Innes and E.H.Rhoderic
PRACTICAL – I

GENERAL EXPERIMENTS

(Any Ten experiments to be done)

1. Young’s modules – Elliptical and Hyperbolic fringes
2. Stefan’s constant
3. Coefficient of Linear expansion – Airwedge method.
4. B – H Loop using Anchor Ring
5. Susceptibility – Guoy and Quincke’s methods
6. Hydrogen spectrum – Rydberg’s constant
7. Solar spectrum – Rydberg’s constant
8. F.P. Etalon
9. L.G Plate
10. Michelson’s Interferometer
11. Arc Spectra Fe-Hg (or) Cu-Hg (or) Brass-Hg
12. Molecular spectra ALO band or CN band
13. Viscosity of liquid – Meyer’s Disc
14. Solar constant
15. Ultrasonic interferometer - compressibility
16. Temperature coefficient of thermister
17. Semiconductor – Band gap energy
18. Hall effect - semiconductor
19. GM Counter
20. Laser experiments:
   i) Diffraction at straight edge
   ii) Interference – Lloyda single mirror method
   iii) Interference using optically plane glass plate and laser
   iv) Diffraction at a circular aperture
21. Experiments on optical fiber
22. Microwave test bench – Dielectric measurements of liquid / solid
Books for Reference:

Second Year

ELECTROMAGNETIC THEORY

PAPER 5

UNIT-I

ELECTROSTATICS
Gauss Law – Poisson & Laplace equations- Solution of Laplace equation in spherical polar coordinate- conducting sphere-multipole expansion-
Electrostatic energy-Dielectrics-Polarization and Displacement vectors-
Boundary conditions-Dielectric sphere in a uniform field- Molecular polarisability and electric susceptibility-Electrostatic energy in dielectric medium- Clausius- Mossotti equation.

UNIT-II

MAGNETOSTATICS
Biot- Savart’s law-divergence and curl of magnetic induction-magnetic vector potential-Ampere’s circuital law-magnetic field of a localized current distribution-magnetic moment and force on a current distribution in an external field- magneto static energy-magnetic induction and magnetic field in macroscopic media-boundary conditions-uniformly magnetized sphere.

UNIT-III

ELECTROMAGNETICS
Faraday’s law of induction-Maxwell’s equation-Maxwell’s displacement current-vector and scalar potential-Gauge transformation-Lorentz gauge-Coulomb gauge-Conservation laws for a system of changes-Poynting theorem.
UNIT-IV
WAVE PROPAGATION
Propagation of e.m wave in free space-non conducting medium- conducting medium-skin depth-reflection and transmission at dielectric boundaries-polarization-Guided waves-Wave guides-Propagation of waves in a rectangular wave guide-inhomogeneous wave equation and retarded potentials-field and radiation due to an oscillating electric dipole.

UNIT-V
PLASMA PHYSICS
Plasma-Debye length-plasma oscillations-plasma behavior in a magnetic field-Boltzmann equation- magneto hydrodynamic equations-electron plasma oscillations-Debye shielding problem- plasma confinement in a magnetic field- pinch effect- magneto hydrodynamic waves- Alfven waves

Books for Study

**Books for Reference:**


QUANTUM MECHANICS

PAPER 6

Unit-1

Wave mechanical Concepts and formalism of quantum mechanics

Unit-2

Matrix formulation of quantum theory, identical particles and angular momentum
Angular momentum operators-commutation relations-Eigen values and Eigen functions of \( L_2 \) and \( L_z \) –Eigen functions of \( J^2 \) and \( J_z \) – addition of angular momenta-Clebsch Gordan coefficients.
Unit -3

**Time- independent perturbation theory and Approximation methods**

Basic concepts-Nondegenerate energy levels-Anharmonic oscillator: First order correction-ground state of Helium- stark effect- Spin orbit interaction Zeeman effect.


WKB method- Connection formulas-validity of WKB method-barrier penetration.

Unit-4

**Time – independent perturbation theory and Scattering**


Scattering: scattering cross-section-scattering amplitude-partial waves-scattering by a central potential: Partial wave analysis-scattering by attractive square well potential-scattering length-phase shifts-Born approximation and its validity-Laboratory and centre of mass coordinate system.

Unit-5

**Relativistic wave equations**

Klein-Gordon equation and interpretation- Particle in a coulomb field- Dirac’s equation for free particle-Dirac matrices and its covariant form- Probability density-Plane wave solution-negative energy states-spin of the
Dirac Particle – magnetic moment of the electron-spin orbit interaction - central potential-Hydrogen atom-lamb shift.

**Books for study and reference**

   Tata McGraw –Hill Publications
2. *Quantum Mechanics* – Satya Prakash; Kedar Nath Ram Nath and Co. Publications
SPECTROSCOPY AND NUCLEARAR PHYSICS

PAPER: 7
A. Spectroscopy

UNIT-I
Vibrational Spectroscopy
Symmetry of polyatomic molecules and molecular vibrations-Group theory and Selection Rules for Raman and IR vibrational normal modes-Calculation of normal modes for Raman and IR activity to $C_2v$ and $C_3v$ point groups – Representations for molecular vibrations-Internal and symmetry coordinates-Calculation of F-G matrix-Normal coordinate analysis for $XY_2$ bent symmetrical type molecule.

IR- SPECTROSCOPY
Principle and theory of Infrared spectroscopy-Far IR and Near IR absorption spectroscopy-Mid IR. FT-IR spectroscopy-Vibrational frequencies and qualitative analysis – sampling methods – Instrumentation - Applications

RAMAN SPECTROSCOPY

UNIT-II
NMR and ESR Spectroscopy
Basic principles of interaction of spin and applied magnetic field – concept of NMR spectroscopy – high resolution continuous wave NMR spectrometer – advantage of FT-NMR – Chemical shift – simple application to structural determination – first order and second order spectrum – double resonance and spin tickling
Origin of electron spin resonance – design of ESR spectrometer – hyperfine structure study – ESR study of anisotropic systems – Triplet states study of ESR – application of ESR to crystal defects and biological studies

UNIT-III

NQR and Mossbauer spectroscopy
Principles of NQR – Energy levels of quadrupole transitions for half integral spins – design of NQR spectrometer – application of NQR to chemical bonding and molecular structures

B.Nuclear Physics

UNIT IV

Nuclear Reactions and Scattering Process:
UNIT V

**Elementary Particles:** Four types of interactions and classifications of elementary particles – isospin – isospin quantum numbers – Strangeness and Hyper charge – Hadrons Baryons – Leptons – Invariance principles and symmetries – Invariance under charge – parity (CP), Time (T), and CPT – CPT violation in neutral K meson decay – Quark model SU (3) symmetry – Gellmann – Nishijama formula – Gauge theory of weak and strong interactions – charm, bottom and top quarks.

**Books for Study**


**Books for Reference**

7. G.Herzberg, Basic Principles of spectroscopy.

Practical II
Advanced Electronics and Micro controller Experiments

Advanced Electronics Experiments (Any five experiments to be done)

1. FET characteristics and Design of FET amplifier
2. UJT characteristics and Design of Saw tooth wave oscillator
3. Design of square wave generator using IC 741 and Timer 555 ICs – 555 IC as VCO.
4. Design of Monostable multivibrator using the IC s 741 and 555 timer- study of frequency divider.
5. Design of schmidt’s Trigger using the ICs 741 and 555 timer – squarer
6. Analog computer circuit design – solving the simultaneous equations.
7. Design of second order Butterworth active filter circuits – Low pass, High pass and Multiple feed back band pass filters
8. Binary addition and subtraction – 7483 IC
9. Counters and shift registers – 7476/7473 IC
10. BCD counter – Decoding and Display

11. Design of binary weighted and R/2R Ladder DAC using the IC 741

12. Construction of ADC using DAC, comparator and counter

**Micro Controller Experiments** (Any five experiments):

1. Interfacing of ADC 0809
2. Interfacing of LED – study of counters
3. Interfacing of seven segment display – Display of Alphanumeric character
4. Stepper motor interfacing
5. Traffic light controller
6. Hex – key board interface
8. Temperature Controller

9. Microcontroller based experiments
   i) Arithmetic operations
   ii) Array operations
   iii) Code conversion
      (Option 18 compulsory)

**Project and Viva Voce**

*At the end of second year practical examinations project viva voice examinations will be held*

Project: 75 Marks, Viva voce: 25 Marks, Total: 100