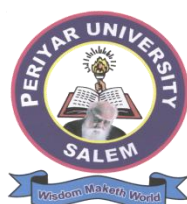# PERIYAR UNIVERSITY

(Accredited with 'A' Grade by NAAC)

PERIYAR PALKALAI NAGAR
SALEM - 636 011

M.Phil. DEGREE
PHYSICS
[Choice Based Credit System (CBCS)]

REGULATIONS AND SYLLABUS

(Effective from the academic year 2018-2019 and thereafter)

DEGREE OF MASTER OF PHILOSOPHY (M.Phil)
REGULATIONS

1. Objectives of the course

The M.Phil course offered by the college/Department is intended to give the opportunity to students to understand the advances in physics subjects, research methodologies and essentials, and to perform focused research in one or more areas of Physics. Further to develop research skills and technical expertise, which are relevant to their research interests.

2. Eligibility

Candidates who have qualified for post graduate degree of this University or any other University recognized by the Syndicate as equivalent thereto shall be eligible to register for the Degree of Master of Philosophy (M.Phil.) in their respective subject and undergo the prescribed course of study in an approved institution or department of this University.

Candidates who have qualified their postgraduate degree on or after 1st January 1991 shall be required to have obtained a minimum of 55 % of marks in their respective postgraduate degree to become eligible to register for the Degree of Master of Philosophy (M.Phil) and undergo the prescribed course of study in an approved institution or department of this University.

In the case of teachers (or) others registering for part-time registration, the minimum percentage of marks for registration is 50 %.

For the candidates belonging to SC / ST community and those who have qualified for the Master's degree before 01.01.1991 the minimum eligibility marks shall be 50 % in their Master's Degree.

3. Duration

The duration of the M.Phil course shall extend over a period of one year from the commencement of the course. The one year period consists of two semesters.

4. Course of Study

The course of study for the degree shall consist of (a) Part-I comprising three written papers according to the Syllabus prescribed from time to time; and (b) Part-II Dissertation.

Part-I shall consist of Paper-I Research Methodology and Paper-II an advanced paper in the main subject. There shall also be a third paper (Paper-III), which shall be the research background paper relating to the proposed Dissertation work carried out internally by the College/Departments. The syllabus of this paper will be framed by the supervisor and handover to the M.Phil student at the beginning of semester-I.

5. Structure of the Course

Semester	Part	Name of the paper	Hours/ week	L	T	P	C
I	Part-I	**Paper-I** Scientific Research and Methodology	5	4	0	0	4
		Paper-II Advanced Physics	5	4	0	0	4
		Paper-III Optional Paper (Name of this paper is related to the area of dissertation work chosen by the candidate under a supervisor)	5	4	0	0	4
		Seminars	5	-	-	-	-
		Library	5	-	-	-	-
II	Part-II	Dissertation	25	12	0	0	12

Total Credit: 24

6. Scheme of Examinations

Part-I Written Examination: Paper I, II & III

  The examination of papers I, II and III shall be held at the end of first semester. The duration for each paper shall be 3 hours carrying a maximum of 75 marks. The internal assessment mark shall be 25 marks (The mark is distributed as Test : 15 marks, Seminar: 5 marks and Attendance : 5 marks). The maximum marks for each paper shall be 100 (End semester examination : 75 marks + Internal assessment: 25 marks = 100 Marks).

  Paper - III examination will be conducted by the College / Departments and the marks obtained by the candidate along with the question paper and valued answer scripts shall be sent to the University at least 15 days before the commencement of the examinations of paper I and II.

  The examiners will be appointed from the panel of four names of each paper (I and II) submitted by the College / Departments concerned. If one examiner awards a pass mark and the other fail mark the, paper will be valued by a third examiner whose award of marks will be final.

Semester	Part	Name of the paper	Exam Hours	I	E	T	C
I	Part-I	**Paper-I** Scientific Research and Methodology	3	25	75	100	4
		Paper-II Advanced Physics	3	25	75	100	4
		Paper-III Optional Paper (Name of this paper is related to the area of dissertation work chosen by the candidate under a supervisor)	3	25	75	100	4
II	Part-II	Dissertation	-	-	-	*200	12
					Total	500	24

** * 50 Marks for Viva-Voce * 150 Marks for Dissertation**

I - Internal assessment marks; **E** - End semester examination marks; **T**-total marks; **C** - credit.

Part - II : Dissertation

The exact title of the Dissertation shall be intimated within one month after the completion of the written examination. Candidates shall submit the Dissertation to the University through the Supervisor and Head of the Department at the end of the year from the commencement of the course which shall be valued by internal examiner (supervisor) and one external examiner appointed by the University from a panel of four names sent by the Supervisor through the Head of the Department / Principal at the time of submitting the dissertation.

The examiners who value the Dissertation shall report on the merit of candidates as "Highly Commended" (75 % and above) or "Commended" (50 % and above and below 75 %) or "Not Commended" (below 50 %).

If one examiner commends the Dissertation and the other examiner, does not commend, the Dissertation will be referred to a third examiner and the third valuation shall be final.

Submission or resubmission of the Dissertation will be allowed twice a year.

7. QUESTION PAPER PATTERN

Question paper pattern for University Examinations

Time : 3 Hours   Maximum Marks : 75

Passing minimum Marks : 38

Part - A (5 x 5 = 25 Marks)

Answer all questions

(One question from each unit)

(Either or Type)

Part - B (5 x 10 = 50 Marks)

Answer all questions

(One question from each unit)

(Either or Type)

8. Passing Minimum

A candidate shall be declared to have passed Part-I of the examination if he/ she secure not less than 50 % of the marks in each paper including Paper-III for which examination is conducted internally. A candidate shall be declared to have passed Part-II of the examination if his/her dissertation is at least commended. All other candidates shall be declared to have failed in the examination.

9. Restriction in number of chances

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a Dissertation more than once. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of three years from the date of commencement of the course.

10. Conferment of Degree

No candidate shall be eligible for conferment of the M.Phil degree unless he/she is declared to have passed both the parts of the examinations as per the Regulations.

Paper-I :   Scientific Research and Methodology

Objectives : • To understand the Research methodology and how to write the Research reports.
   • To study the theory of error analysis.
   • To learn the working principles and characterization techniques of different analytical instruments.

Unit - I
Research Methodology: Introduction – Meaning, objectives and motivation of research. Types of research - significance - characteristics of research - Research methods verses methodology – Research and scientific methods – Importance of knowing how it is done - Research Process - Criteria of good research - Distinction of scientific methods.

Unit - II
Research process and problems: Define research problem - concepts and type of research design- importance of experimental design - limitations of research - data collection and analysis.

Unit - III
Report writing: Structure of scientific report - types of report - significance of the report - characteristics of report - report heading and body of the report – References.
Research evaluation methods: Impact factor of journals -Various indexes: h-index, I-index - abstracting service and their calculations – Plagiarism, its significance and effects- Components of IPR, Patent and Patent Laws.

Unit - IV
Error Analysis: Errors - uncertainty- systematic and random errors- sample distribution- propagation of errors- Monte Carlo Methods- Probability distribution: properties of probability distributions Binomial distribution- Poisson distribution – Normal distribution (or) Gaussian distribution - Central limit theorem- Lognormal distribution - Lorentz distribution -Population Statistics- chi-square distribution- F-distribution - Least squares fitting**:** Fitting a straight line -Criteria for goodness of fits - Chi square test.

Unit - V
Analytical Techniques: Working principles and Characterization studies : UV-Visible, FT-IR, Scanning electron microscope, Transmission electron microscope, AFM, SPM, PL Spectrometer, Powder XRD, Hardness Tester - Hall effect, Four probe - Dielectric measurement (solid/liquid) - Thermal Analyzer (DSC & DTA) - Ultrasonic interferometer.

Books for Study
   1. Research Methods of Science - Michael M. Marda , Cambridge University Press, New York, First Edition, 2011.
   2. Probability and Error for Physical Science - S.K. Muthu, Sangam Books publications, London, 1982.

3. Instrumental methods of Analysis - Hobart H. Willard, Lynne L. Merritt, John A. Dean and Frank A. Settle, Jr. Wadsworth Publishers, USA, Seventh Edition, 1986.
4. Electron Microscopy - Prakash Trivedi, Oxford Book Publications, First Edition , 2010.

Books for Reference

1. Research Methodology: Methods and Techniques - C.R. Kothari and Gourav Garg, New Age International Publication, New Delhi, Fourth Edition, 2018.
2. Research Methodology - Priti R. Majhi and Prafill K. Khatua, Himalaya Publication House, New Delhi, 2016.
3. The Scientific Endeavor: A Primer on Scientific Principles and Practice – Jeffrey A. Lee, CreateSpace Independent Publishers, Second Edition, 2016.
4. Encyclopaedia of Research Methodology in Physical Sciences - Harmeet Kour, Anmol Publications, First Edition, 2009.
5. Research Analytics: Boosting University Productivity and Competitiveness through Scientometrics – Franciso J. Cantu-Ortiz, CRC Press, 2017
6. Data Reduction and Error analysis for the Physical Sciences - Philip R. Bevington and D. Keith Robinson, McGraw-Hill Publications, Third Edition, 2003.
7. A Practical Guide to Data Analysis for Physical Science Students-Louis Lyons, Cambridge University Press publishers, First Edition, 1991.
8. Instrumentation Measurement Analysis, B.C. Nakra, K.K. Chaudhry, Tata McGraw-Hill Publications, Second Edition, 2006.
9. Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler, and Timothy A. Nieman, Harcout Publishers, USA, Fifth Edition, 2001.
10. Scanning Electron Microscopy: Physics of image formation and Microanalysis - L. Reimer, Springer Publications, Second Edition, 1998.

Paper-II : Advanced Physics

Objectives :
- To understand the advances of different experimental spectroscopic techniques.
- To learn the theory of molecular quantum mechanics and electronic structure of molecules.
- To know about X-rays, Crystals, X-ray diffraction, symmetry and crystal structures.
- To study the principles and detailed theory of production of Lasers and non-linear optics.
- To understand the advances in solar cells and electric energy storage systems.

Unit-I
Atomic adsorption and Atomic emission spectroscopy: Principle of atomic absorption spectroscopy (AAS) - classification of atomic spectroscopic methods - measurement of atomic absorption - instrumentation for AAS - sensitivity and detection limit in analysis - applications of AAS - atomic emission spectroscopy (AES) - principle of origin of spectra - instrumentation and applications of AES - photoelectron spectroscopy (PES) - principle of ionization processes - types of X-ray PES (XPES or ESCA) - Auger electron spectroscopy - chemical shift in ESCA - instrumentation and applications.

Unit-II
Methods of quantum chemical calculations: Introduction electronic structure determination - Hartee-Fock SCF method - Formulation Hartree-Fock approach - Restricted and unrestricted HF calculations - Roothaans equations - basis sets - electron correlation - Moller-Plesset many body perturbation theory - Density functional theory - Semi-empirical methods.

Unit-III
X-rays: X-ray radiation sources - Production of X-rays - Synchrotron radiation – X-ray Laser sources.
Crystals, X-ray diffraction, symmetry and structure: Crystals - lattices - unit cell - planes - Miller indices for symmetric systems – X-ray diffraction - direct and reciprocal lattices - construction of reciprocal lattice – Braggs Law in reciprocal Lattice - crystal systems - symmetry - point group symmetry - space group symmetry - outline of crystal structure determination.

Unit -IV
Lasers : Basic principles of lasers - Nd:YAG laser - He-Ne laser - Semi-conductor diode laser - Dye laser - Co-chemical laser - Tunable laser - Colour centre lasers-applications of lasers in medicine - industry - communication and holography.
Non-Linear Optics: Harmonic generation - second and higher order harmonics generation - phase matching - optical mixing - optical parametric oscillations - multiphoton processing.

Unit -V

Solar Photovoltaic: Principle of photovoltaic conversion of solar energy - types of solar cells and fabrication - Photovoltaic applications: battery charger - domestic lighting - street lighting - water pumping - power generation schemes.

Electric energy storage systems: Batteries : primary, secondary, lithium, solid-state and molten solvent batteries - lead acid batteries - nickel cadmium batteries - role of carbon nano-tubes in electrodes – Supercapacitor : electrochemical double layer capacitor (EDLC) - principle of working, structure, performance and application, role of activated carbon and carbon nano-tubes.

Book for Study
1. Spectroscopy - H. Kaur, Pragati Prakashan Educational Publishers, Second Edition, 2017.
2. Introduction to computational Chemistry- Frank Jensen - John Wiley publications, England, Third Edition, 2017.
3. X-ray Structure Determination - George H. Stout and Lyle H. Jensen - John Wiley Interscience Publications, Second Edition, 1989.
4. Laser Spectroscopy: Basic Concepts and Instrumentations -Wolfgang Demtroder, Springer Science Publications, Third Edition, 2013.
5. Laser Fundamentals - William T. Silfvast - Cambridge University Press, Second Edition, 2008.
6. Lasers and Nonlinear Optics - B.B. Laud, Wiely Publications, Second Edition,1992.
7. Principles of Solar Engineering - D. Y. Goswami, F. Kreith and J. F. Kreider, Taylor and Francis publications, Philadelphia, USA, Second Edition, 2000.
8. Energy Storage: Fundamentals, Materials and Applications - R.A. Huggins, Springer Publications, Second Edition, 2015.

Books for Reference
1. Handbook of Spectroscopy – Gunter Gauglitz and Tuan Vo-Dinh, John Wiley Publications, 2006.
2. Molecular Quantum Mechanics - Fourth Edition, Oxford University Press, 2005.
3. Essential of Computational Chemistry: Theories and Models – Christopher J. Cramer; John Wiley & Sons, England, Second Edition,2004.
4. Fundamentals of Crystallography - C. Giacovazzo - Oxford Press, Second Edition – 2002.
5. Structure Determination by X-ray Crystallography – M.F.C. Ladd and C.A.Palmer, Springer Publications, Second Edition, 2003.
6. Lasers: Principles, Types and Applications - K.R. Nambiar, New Age International Publishers, New Delhi, First Edition, 2004.
7. Nonlinear Optics - R.W. Boyd, Academic Press, New York, Third Edition, 2008.
8. Optics - Ajoy Ghatak – Tata McGraw-Hill Publications, Third Edition, 2006.
9. Energy storage in power systems - F. Díaz-González, A. Sumper and O. Gomis-Bellmunt, John Wiley Publications, First Edition, 2016.

Paper – III : Optional Paper

The title and syllabus content of this paper is pertaining to the proposed dissertation work; this shall be decided by the respective supervisor of the M.Phil student(s) of concerned college/Department.