BHAGWANT UNIVERSITY
Sikar Road, Ajmer
Rajasthan

Syllabus

Institute of Life sciences & Applied Sciences
M. Phil
(Physics)

ANNUAL SCHEME OF EXAMINATION:

1. Every candidate shall be required to offer three written papers and one dissertation (equivalent to one paper). Within this frame work the Board of Studies shall recommend the course of study for the M. Phil examination.
2. The course of study for the M. Phil degree shall extend over a period of one academic year. There shall be a continuous internal assessment and as external assessment. The proportion of internal and external assessment shall be 30:70. There will be no internal assessment in the dissertation. Total marks for M. Phil will be 400. Dissertation may be written by the candidates under the supervision of any teacher who is registered as M. Phil Supervisor. Supervisor can guide normally five dissertations. However, the maximum limit may be relaxed by the permission of Vice-Chancellor on the recommendation of Head. The internal Supervisor can guide five candidates and workload of six hours is admissible for each M. Phil course for dissertation. The Supervisor will sign and issue a certificate counter signed by the Head of department concerned.
3. The internal assessment may be evaluated on the basis of:
   (a) Mid Terms : 15 Marks
   (b) Assignments /Seminar Presentation /Group Discussion: 15 Marks
4. Each theory paper shall consist of 100 marks. The dissertation shall also consist of 100 marks. For a pass, a candidate shall be required to obtain (a) at least 40% marks in each paper separately (b) a minimum of 50% marks in the aggregate of all the papers prescribed for the examination. In the mark sheet, successful candidates shall be classified as under

First Division	65% or more.
Second Division	50-65%

6- A candidate will have to pass individually both in the Internal as well as external examination and it should be shown separately in the marks sheet.

7- The placement of every candidate under a Supervisor/Guide shall be decided within two months from the last date for admission.

8- A candidate who fails at the examination even in one paper/dissertation shall be required to reappear at the examination in a subsequent year in all the papers/dissertation prescribed for the examination, provided that a candidate who obtains at least 50% marks in dissertation shall be exempted from the submitting a fresh dissertation and the marks obtained by him shall be carried forward for working out his result.

9- For each theory paper 10 questions will be set for the final examination and the candidate will have to attempt at least five questions. All the questions will carry equal marks.

10- Workload distribution: There will be a teaching of four periods of one hour duration per week for each theory paper and six hours for dissertation.
i.e. 4X3 = 12 hours for theory papers and six hours for dissertation per week.

Papers Number	**Paper Code**	**Papers Name**	TEACHING PERIOD			**External Marks**	**Internal**		**G. Total**
			L	T	P		**Mid Terms carrying** 15 **marks**	**Assignments /Seminar Presentation /Group Discussion**	
Paper I	01MPL17101	Research Methdology	3	1	0	70	15	15	100
(ANY TWO) Paper II,	01MPL17102	Techniques in Experimental Physics							
Paper III	01MPL17103	Techniques in Theoretical Physics	3	1	0	70	15	15	100
	01MPL17104	Computational Techniques							
Paper IV	01MPL17201	Dissertation	4	2	0	100	--	--	100
		TOTAL	13	5	0				400

PAPER I RESEARCH METHODOLOGY

01MPL17101

UNIT – I

Research methods – Identification of the Problem – Determining the mode of attack -Literature survey – Mode of approach of actual investigation – Abstraction of a research paper – Drawing inferences from data - Qualitative and Quantitative analysis

UNIT – II

Internet and its applications – e-journals- Assessing the status of the problem – Results and Conclusions – Presenting a Scientific seminar – Publication of Research paper

- Art of writing a Thesis.

UNIT – III

Survey of literature including patents - chemical nomenclature and literature primary sources - secondary sources including reviews. Treatise and monographs, literature

searching, Review of work relevant to the chosen problems.

UNIT – IV

Writing a thesis or paper - General formation - page and chapter formation. The use of quotation - footnotes - tables and figures - referencing - appendixes - revising the paper

or thesis - editing and evaluating and the final product - proof reading - the final types copy.

UNIT – V

Iterative methods: Newton Raphson iterative method – Secant Method; Interpolation: Newton's forward and backward difference formulae; Differentiation and Integration: Numerical differentiation with interpolation polynomials – Numerical Integration by Trapezoidal and Simpson's rule- Ramberg integration.

Books for Reference

1. Thesis and Assignment Writing – J Anderson, B.H. Dursten and M. Poole, Wiley Eastern (1977).
2. A Hand Book of Methodology of Research – P. Rajammal and P. Devadoss, R.M.M Vidya Press (1976).
3. Computer Oriented Numerical Methods – V. Rajaraman, Prentice Hall of India.
4. Numerical Methods for Scientific and Engineering Computation – MK Jain, SRK Iyengar and RK Jain, Wiley Eastern publn.

OPTIONAL ANY TWO

Paper II

Techniques in Theoretical Physics

Paper Code: 01MPL17103.

Unit I

Solitons and Chaos:

Discovery of solitary waves and soliton interactions, Importance of solitons, KdV equation and its elementary solutions. Solitons in field theories. Chaos and its examples, parameters, one dimensional maps.

Unit II

Theoretical Techniques in Particle Physics:

Covariant Perturbation theory, Feynman Rules for spin 0 and spin ½ particles and their applications /Like groups: SU(2), SU(3) and SU(5) and their applications : Higgs Mechanism and Goldstone theorem and its application in gauge theories.

Unit III

Theoretical Techniques In Nuclear Physics

Review of static properties, binding energy, density, nuclear forces, and potentials, shell model, collective models and energy levels, Hartree-Fock theory of nuclear shape and states with good J Quantum number and applications, correlations in nuclear matter and exclusive principle correlations, Bethe-Goldstone equation and G-matrix, heavy-ion physics at low and intermediate energies, simulations and QMD model, hot and dense matter and multi fragmentation.

Special Topics * Models for multi-bound complex systems Nuclear structure at higher angular momentum.

* to be covered depending upon the availability of relevant experts.

Unit IV

Theoretical Techniques in Condensed Matter Physics:

Theory of NMR techniques, Theory of Anharmonic solids, Theory of Liquid state. BCS theory.

Books recommended:

1. Solitons an Introduction by P.G. Drazin and R.S. Johan (Cambridge Univ. Press, 1989)
2. Chaos in Dynamical Systems by E. Ott (Cambridge Univ., Press, 1993)
3. Solitons and Instantons byR. Rajaraman (North Polland. 1989)
4. Gauge theory of Elementary Particles by T.P. Cheng and Li (Oxford)2000
5. Structure of the Nucleus by M.A. Preston and R.K. Bhadhuri.
6. Quantum Theory of Solids by C.Kittel
7. Liquid State Physics by N.H. March and M.P. Tosi
8. Liquid State Physics by Engelsta
9. Quantum field theory by Lahiri and Pal

Paper - III

Techniques in Experimental Physics

Paper Code: 01MPL17102

Unit-I

Particle physics:

Relativistic kinematics, Four vectors & invariants, some practical examples for use of invariants. Transformation of differential cross-section. Monte Carlo calculations and its applications, typical uses of Monte Carlo techniques to High Energy particle physics.

Unit II

Collider Physics:

Collisions in colliders: Reconstruction of events-examples LHC collider, CMS detector, ALICE detector, Belle detector(brief), Extraction of signal – top Higgs, QGP, CP violation.

Unit III

Experimental methods for probing nuclear structure:

Experimental methods for gamma-ray, conversion-electron and charged-particle spectroscopy associated with nuclear reactions and Coulomb excitation, Comptonsuppressed Ge detectors, multiplicity filter, Neutron detectors, Sector field electron spectrometer, mini-range spectrometer, Recoll mass-separator, Advanced detector arrays-GAMMASPHERE and EUROBALL. Lifetime measurements – DSAM and RDM techniques, coincidence method, pulsed beam method. Hyperfine interactions – Static magnetic and quadrupole Interactions, Time differential orientation easurements. Photon – atom Interactions – interaction processes in X-ray energy region, inner-shell photoionisation and subsequent processes, Elastic and inelastic scattering.

Unit IV

Solid State Physics:

High Vacuum: Diffusion Pump, Turbo Molecular Pump, Gauges for measuring high vacuum.

Preparation of Materials: Crystal Growth, Amorphous materials, Nano materials, Polymers by different techniques.

Device Fabrication: Oxidation Diffusion, Ion Implantation, Metallization, Lithography and Etching, Bipolar and MOS device fabrication.

Characterization Techniques: Impedance, TEP, AFM, TEM, SIMS, micro-Raman, Luminescence, Ellipsometry.

Books recommended:

1. Relativistic Kinematics by R. Hagedon.
2. Statistics for Nuclear and Particle Physicists by Louis Lyons. 500726
3. CMS – Technical Proposal
4. ALICE – Technical
5. In beam gamma-ray spectroscopy by II, Morinaga and T. Yamazaki.
6. Nuclear spectroscopy and reactions (part A & C) edited by Joseph Cerny.
7. Radiation detection and measurements by Glenn. F. Knoll.
8. Gamma-ray and electron spectroscopy in Nuclear Physics by H. Ejiri and M.J.A. de Voigt.
9. The electromagnetic interaction in Nuclear Spectroscopy, Edited by W.D.

Hamliton.
10. Alpha, Beta-and Gamma-ray Spectroscopy, Vol 1 and 2, Edited by Kal Siegbahn.
11. X-rays in Atomic and Nuclear Physics by N.A. Dyson
12. Elastic scattering of gamma-rays and X-rays by atoms – Phys, Reports 140 (1986-75 by P.P. Kane, L. Kissel, R.H. Pratt and S.C. Roy.
13. Inelastic scattering of X-rays and gamma-rayus by Inner shell electrons-Phys. Reports 218 (1992) 67 by P.P. Kane,L. Kissel, R.H. Pratt and S.C. Roy.
14. Thin Films Phenomena by K.L. Chopra
15. Science of Engineering Materials by C.M. Srivastava and C. Srinivasan, Wiley East. Ltd.
16. Nanoparticles and Nanostructured Films-Preparation, Characterization and Applications: J.H. Fender (Wiley).
17. Microelectronic Processing by W. Scot Ruska, McGraw-Hill.
18. Characterization of Semiconductor Materials by Philips F. Kare and Greydon B. Lausbee, Mc Graw Hill.
19. Physical methods for Materials Characterization by P.E.J. Fiewitt & R.K. Wild.
20. Optical Properties of Solids by M. Fox, Oxford University Press.
21. Fractals and Chaos – Pauls Addison
22. Introduction of Chaos – H Nagashima and
Y BABA
23. Chaos, Dynamics and Fractals – J.L.McCauley
24. Chaos in dynamical systems – Edward Ott

Paper- IV

Computational Techniques

Paper Code: 01MPL17104

Unit I

Resume of Practical approach of learning operating systems (DOS,UNIX, Windows) and Graphical packages (Origin, Gnuplot), Latex. INTERNET.
Fortran Programming using Fortran 90.

Unit II

Mathematica: Running mathematica, Numerical calculations, Graphics, 3D plots. Equation solving, matrices, mathematical relations, complex numbers, simplifications, algebraic expressions, Mathematical operations, in built functions, differentiation, integration, series, limits, Advanced Mathematics: Procedural programming, loops conditional programming, producing output, linking external programme, functional programming, numerical operation on data, statistical calculations, minimization. Derivatives of unknown functions.

Unit III

Matrices: products of matrices, inversion using iterative methods and accuracy, Numerical Linear Algebra: Solution of systems of linear equations, direct methods, error

analysis, Curve Fitting: least squares fitting method etc., iterative methods.
Numerical differentiation and integration methods: Numerical methods for derivatives, minima and maxima of a function, numerical integration methods for one dimension to multi-dimensional integrations using Simpson's rule, quadrature formula and Monte Carlo methods. Interpolation: splines, Numerical methods for Ordinary and partial

Unit IV

Differential equations: Euler's method, Runge- Kutta method for ordinary differential equations: stability and convergence.
Partial differential equations using matrix method for difference equation, relaxation method, initial value problems, stability, convergence and qualitative properties and qualitative properties.
Random numbers, Monte Carlo Integral methods, Importance sampling, Fast Fourier Transform.
Physical Simulations: N body methods and particle simulations, Verlet algorithm, Molecular dynamics and Monte Carlo methods.
C: Unstructured, procedural and modular programming, data structures.
C++: Introduction to Object Oriented Programming.

Books Recommended:

1. Fortran Programming – V. Rajaraman
2. Numerical Methods: A Computer Oriented Approach, BPB Publ. 1996 R.S. Salaria
3. Computer based Numerical Methods 3rd Ed. Prentice Hall India 1980, V. Rajaraman
4. The C++ Programming Language/Addison Wesely
5. Mathematica, S. Wolfram, Addison. Wesely
6. Application of the Monte Carlo Method, K. Binder, Springer Veriag
7. Numerical Recipes in Fortran: The Art of Scientific Computing, W.H. Press et al., Cambridge Press.
8. Numerical Recipes in Fortran: the Art of Scientific Computing, W.H. Press et. al, Cambridge Press
9. An Introduction to Computer Simulation Methods, H.Gould and J. Toobochnlik, Addison Wesley, 1996.
10. Computational Physics by S.E. Koonin

M. Phil Dissertation

Paper Code: 01MPL17201.

Each student will submit dissertation on any one topic related to physics. Dissertation will be guided by supervisor of the university and will be examined by external.

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