

BHAGWANT UNIVERSITY

Sikar Road, Ajmer

Rajasthan



Syllabus

Institute of Applied Sciences & Life Sciences

M. Phil I Semester

Physics

Course Category

MPhy : M.Phil in Physics

CCC: Compulsory Core Course

ECC: Elective Core Course

Contact Hours:

L: Lecture

T: Tutorial

P: Practical or Other

Marks Distribution :

IA: Internal Assessment (Test/Classroom Participation/Quiz/Presentation/Assignment etc.)

EoSE: End of Semester Examination

M. Phil (Physics)

(Course Structure)

Subject code	Subject Name	Teaching hours			Marks		
		L	T	P	External	Internal	Total
01MPhy101	Research Methods	3	0	0	70	30	100
01MPhy102	Techniques in Theoretical Physics	3	0	0	70	30	100
01MPhy103	Techniques in Experimental Physics	3	0	0	70	30	100
01MPhy104	Energy	3	0	0	100		100
Total		12	0	0	280	120	400

SEMESTER II

Subject code	Subject Name	Teaching hours			Marks		
		L	T	P	External	Internal	Total
02MPhy101	Advanced Research Methodology	3	0	0	70	30	100
02MPhy102	ELECTRONICS AND INSTRUMENTATION	3	0	0	70	30	100
02MPhy103	NUCLEAR PHYSICS	3	0	0	70	30	100
02MPhy201	DISSERTATION	3	0	0	50	50	100
Total		12	0	0	260	140	400

PAPER I RESEARCH METHODOLOGY

01MPhy101

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 publ.

Paper II

Techniques in Theoretical Physics

Paper Code: 01MPhy102.

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 $\frac{1}{2}$ 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.

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 by R. 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: 01MPhy103

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, Compton-suppressed Ge detectors, multiplicity filter, Neutron detectors, Sector field electron spectrometer, mini-range spectrometer, Recoil 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 measurements. 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. Hagedorn.
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 H. 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. Hamilton.
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-rays 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

Energy

Paper Code: 01MPhy104

Unit I

Solar Energy :Basic ideas of black body absorption and radiation , Solar radiation ,solar radiation data ,Solar radiation geometry ,Empirical relation for predicating the availability of solar radiation ,solar energy collectors : Flux plate solar collector ,Application of solar collector ,(1) Solar water heating system –Introduction ,heat exchanger and heat collector ,2) Solar Air Heater ;Introduction ,performance analysis of conventional air heater ,testing procedure ,3)Concentrating Collector :- Flatl plate collector ,Cylindrical parabolic collector ,compound parabolic collector ,parabolic dish collector ,Thermal dish storage ,Introduction sensible heat storage , latent heat storage Thermo chemical storage.

Unit II

Hydrogen Energy : Intoduction : Hydrogen production ,electrolysis ,thermo chemical methods ,fossil fuel methods ,solar energy methods ,bio hydrogen production ,Storage :Gaseous storage ,Liquid storage ,Solid state storage ,New ways of hydrogen storage ,Hydrogen Utilisation ,Hydrogen as an alternatives for motor vehicules ,safety .

Unit III

Wind Geothermal Ocean and Other Energies: Basic principle :The nature of wind ,power in wind ,forces on blades wind energy conversion ,components of wind energy ,conversion systems ,classification of WECS ,Advantages and disadvantages of wind energy .

Introduction ,Geothermal sources ,Prime movers of geothermal energy conversion ,advantages and disadvantages , applications of geothermal energy .

Tidal energy : Introduction ,Basic principle ,tidal power plants ,advantages and disadvantages of wind energy .

Wave energy :Introduction ,energy and power from waves ,wave energy conversion devices ,advantages and disadvantages.

Unit IV

Atomic energy : Slowing down of neutrons ,elastic scattering and energy change in scattering ,estimation of number of collisions ,logarithmic energy decrement (lethargy) ,macroscopic cross section ,moderation of neutrons by bulk ,water ,graphite and heavy water ,Fermi age ,slow down length ,attenuation of neutrons ,capture of neutrons by bulk ,I/E law resonances ,fission cross section in case of Th , U-235 and U-238 , evaluation of flat and spectrum average cross sections ,fission energy ,prompt neutrons and delayed neutrons .

Unit V

Critical and sub critical reactors and nuclear waste: Four factor formula ,critically ,neutron multiplication in a reactor and its relation with power ,kinds of critical reactors (based on fuel ,moderator ,fast breeder reactors ,heat exchange or conversion processes and materials ,power of thermal reactors (both electric and magnetic) , build up of actinides and isotopes in reactors ,problems of nuclear waste , build up of isotopes and actinides in reactor ,problem of nuclear reactor ,problem related to thorium as fuel ,elementary idea of repository ,Status of reactors in india .

High energy and spallation neutron sources ,sub critical system and possibility of solution of nuclear waste problem , thorium fuel and prospects in india .

SEMESTER II

ADVANCED RESEARCH METHODOLOGY (02MPHY101)

UNIT - I

Research: Definition, Importance and Meaning of research, Characteristics of research, Types of Research, Steps in research, Identification, Selection and formulation of research problem, Research questions – Research design – Formulation of Hypo Dissertation, Review of Literature.

UNIT – II

Sampling techniques: Sampling theory, types of sampling – Steps in sampling – Sampling and Non-sampling error – Sample size – Advantages and limitations of sampling.

Collection of Data: Primary Data – Meaning – Data Collection methods – Secondary data – Meaning – Relevances, limitations and cautions.

UNIT – III

Statistics in Research – Measure of Central tendency, Dispersion, Skewness and Kurtosis in research, Hypo Dissertation, Fundamentals of Hypo Dissertation testing, Standard Error, Point and Interval estimates, Important Non-Parametric tests: Sign, Run, Kruskal, Wallis tests and Mann, Whitney test.

UNIT – IV

Para metric tests: Testing of significance, mean, Proportion, Variance and Correlation, testing for Significance of difference between means, proportions, variances and correlation co-efficient. Chi-square tests, ANOVA, One-way and Two-way.

UNIT– V

Research Report: Types of reports, contents, styles of reporting, Steps in drafting reports, editing the final draft, evaluating the final draft.

Reference Books:

1. Statistical Methods - S.P. Gupta
2. Research Methodology Methods and Techniques - C.R. Kothari
3. Statistics (Theory and Practice) - B.N. Gupta
4. Research Methodology Methods and Statistical Techniques - Santosh Gupta

PAPER-II

ELECTRONICS AND INSTRUMENTATION (02MPHY102)

UNIT – I

Transducers And Signal Conditioning

Basic Measurement System – Classification of Transducers in instrumentation and control Systems – Selection – Types – Transducers: Strain gauge – variable resistance – capacitive – inductive – potentiometric resistance type – Piezoelectric – LVDT – Thermistors – thermocouple – Pyrometers – Solar Batteries – Accelerometers – Selsyns – Tachogenerators – Differential transformer – microsyn – Servomotors – eddy current clutches – Electronic aided measurement (block diagram) – Basic Instrumentation amplifiers and applications – Chopped and modulated dc amplifier – modulators.

UNIT – II

Data Acquisition, Conversion And Transmission

Data acquisition system – Signal conditioning of the inputs – Single Channel data acquisition System – Multichannel DAS. Sensors based computer data system – Data transmission system. Digital modulation – Pulse Code format – modems.

UNIT – III

Electronic Measuring Instruments

Digital multimeters – Digital frequency meter – Digital measurement of time – Digital tachometer – Automation in digital instruments – Digital phase meter – Digital capacitance meter – Microprocessor based instruments – Electrocardiography – ECG amplifiers – electrodes and leads – ECG recorder principles.

UNIT – IV

Electronic Control Instrumentals

Advantage of Electronic control of Devices – DC Motor speed control – Over voltage and overload protection of DC motors – speed control of a single phase and three phase induction motors – Speed control of synchronous motors –

UNIT- V

Temperature Control

Temperature control – Illumination control – Automatic water level indicator using SCR – Battery operated in vector circuit using power transistor.

References:

1. S.K. Bhattacharya, S. Chatterjee, Industrial Electronics and Control, Tata McGraw Hill, 1995 (unit I (Transducers), Unit IV).
2. H.S. Kalsi, electronic (Instrumentation, Tata McGraw Hill, 1995)(unit I Signal Conditioning) unit II, Unit III).
3. Leslie Crom Well, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and measurements, Prentice Hall of India, 1997 (Unit III Electrocardiography).

PAPER-III

NUCLEAR PHYSICS

UNIT-I

Nuclear Properties

Survey of some nuclear properties, Nuclear radius, Nuclear masses and abundances, Binding energy, Electric and magnetic moments and nuclear shapes, Nuclear angular momentum and parity, Nuclear spin, Nuclear moments.

UNIT II

Nuclear Forces

Nuclear stability and the forces between nucleons, Deuteron problem, n-p scattering at low energies, Scattering length, Spin dependence of n-p scattering, Effective range in n-p scattering.

UNIT III

Nuclear Models

Liquid drop model, Semi-empirical mass formula, Magic numbers, Shell model, The collective model.

UNIT IV

Nuclear Reactions

Types of nuclear reactions, Reaction cross-section, Conservation laws, Q-values and its significance, Breit-Wigner formula, Compound nucleus, Optical model, Direct reactions.

UNIT V

Radiation Detectors

Interaction of radiation with matter, G.M. counter: Basic principle, working, quenching and mechanism of pulse formation; Gamma Ray Spectrometer: Basic principle and working of NaI(Tl) detector, Pulse formation mechanism, Basic idea of pulse processing unit, Concept of energy resolution and efficiency; Semiconductor detectors: Basic principle, Construction and working of Si Surface barrier, Lithium drifted and high purity Germanium detectors.

References:

1. Introductory Nuclear Physics - K.S.Krane
2. Nuclear Physics - Roy and Nigam (9th Edition), New Age Int.
3. Nuclear Physics - Irving Kaplan (2nd Edition), Narosa Pub.
4. Introductory Nuclear Physics - K S Krane, John Wiley
5. Nuclear Physics - D C Tayal, Himalaya Publication
6. Radiation Detectors - S S Kapoor

PAPER-IV

DISSERTATION