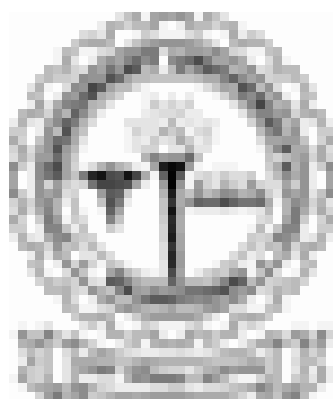# BHAGWANT UNIVERSITY

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 - 01

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 hypothesis - review of literature

Unit - 02

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 - 03

Statistics in research - measure of central tendency - dispersion - skewness and kurtosis in research. Hypothesis - fundamentals of hypothesis testing - standard error - point and interval estimates - important non-parametric tests : sign, run, kruskal - wallis tests and mann-whitney test.

Unit - 04

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 - 05

Research report: types of reports - contents - styles of reporting - steps in drafting reports - editing the final draft - evaluating the final draft.

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.

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 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 andexclusive principle correlations, Bethe-Goldstone equation and G-matrix, heavy-ion physics at low and intermediate energies, simulations and QMD model, hot and densematter 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 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: 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, Comptonsuppressed 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 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

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 vechicles ,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 .

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SEMESTER II

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ADVANCED RESEARCH METHODOLOGY (02MPHY101)

UNIT I
Basic concepts: Research process, problem identification, research designs, informal experimental designs. Completing randomised design, randomized block design, latinsquare design, factorial designs

UNIT II
Sampling and testing of hypothesis: Concept of probability, probability distribution, Normal, Poisson, χ-square, t-test. Sampling distribution, central limit theorem, Sandler's A-test, standard error, population mean, population proportion, sample size, confidence intervals, null hypothesis and alternative hypothesis, level of significance, two tailed and one tailed tests, Z-test, t-test, x2-test, F-test, testing of correlation coefficients, ANOVA one way ANOVA, two way ANOVA Tukey's HSD.

UNIT III
Non-parametric tests: Sign test, Fisher-Irwin test, Mc Nemer test, Wilcoxon Mali test, Wilcoxon, Mann-Whitnery test, Kruskal-Wallis test, one sample runs test. Spearman's rank correlation, Kendall's coefficient of concordance.

UNIT IV
Multivariate analysis: Multiple regression, multiple discriminant analysis, multiple analysis of variance, canonical correlation analysis, Factor analysis cluster analysis, path analysis. Computational techniques.

UNIT V
Computer Application, Basic of computer, System Software & application Software. Computer as a tool of Research: Application in Data Analysis, related software. MS Office, SPSS, Data Communication, LAN & WAN Data Exploration using internet tools, e-journal, e-books, basic concept of tele-conferencing & related configuration.

References:
1. Kothari, C.R.(2004). Research Methodology: Methods and Techniques, New Age
International Publishers, New Delhi.
2. Arya., P.P. and Pal, Y.(2001) Research Methodology in Management: Theory and
Case Studies. Deep and Deep Publishers Pvt. Ltd., New Delhi.

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: Stain gauge – variable resistance – capacitive – inductive – potentiometric resistance type – Piesoelectric – LVDT – Thermistores – thermocouple – Pyrometers – Solar Batteries – Acceler-meters – Selsyns – Tachogenerators – Differentian transformer – microsyn – Servomotors – eddy current clutches – Electronic aided measurement (blockdiagram) – 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 – Digita tachnometer – 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 – PC 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 Mc Graw Hill, 1995 (unit I (Transducters), Unit IV).

2. H.S. Kalsi, electronic (Instrumentation, Tata McGraw Hill, 1995)(unit I Signal Consitioning) unit II, Unit III).

3. Leslia 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, Deutron 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-Winger 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(TI) 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

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DISSERTATION

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