Kohima Science College, Jotsoma
(An autonomous Government PG College)
Department of Physics
Kohima, Nagaland

Pre-Ph.D. Course Work

(One Semester duration with a total of 16 Credits)

Course No	Course Title	Max. Marks	Credit
PHY-01	Research Methodology	100	4
PHY-02	Physics (General)	100	4
PHY-03	Physics (Elective) (i) Atmospheric Physics	100	4
PHY-04	Project work and Seminar	100	4
Grand Total		400	16

- ❖ Courses **PHY-01 and Course PHY-02** are **Compulsory**
- ❖ **Elective Course** (**PHY-03)** will be offered on availability of research position in the department. More elective papers will be introduced in the coming years depending upon the availability of the expertise of supervisors.

PHY-01: Research Methodology   **Credit: 04**

UNIT–I:

Research: Meaning, objectives, types, approaches. Criteria of good research, research problems, research design. Review of literature: Meaning, objectives, principles and procedure. Thesis writing: Meaning, significance, types, techniques.

UNIT–II:

Quantitative methods of research: Methods of data collection – experimental data, field data, data from secondary sources. Relation between variables: correlation (both continuous & binary data), regression (both linear & non-linear) for two variables. Test of significance including one-way-anova. Errors and analysis of errors.

UNIT – III:

Computer application in research: Data analysis – use of software like Excel/Mat lab/Mathemetica/SPSS/ Scilab etc., Word processing – use of software like MS Word/LATEX/End Note etc., Data bases – use of software like MS Access/My SQL etc. Introduction to Computer Network: Network Protocol and topology. Computer simulations: Introduction to mathematical and simulation models, deterministic and stochastic simulation models, continuous and discrete simulation.

UNIT – IV:

Intellectual Property Rights (IPR) – patents, copyrights and related issues. Plagiarism: concept, software, legal aspects. National Science Policies, Ethics in Research. Basic idea about the Impact factor of a journal.

Suggested readings:

1.Research Methodology-Methods and Techniques, New Age International, C. R. Kothari, 2nd Ed. (New Delhi), 2008.

2. Research Methodology: A step-by-step guide for beginners, SAGE Publications, Ranjit Kumar, 2005.

3. Mastering MATLAB by Duane C. Hanselman and Bruce L. Littlefield, 2011.

4. Queqeing system-Vol.2-D, Kleinrock, John Wiley & Sons Inc New York, 1976.

5. Computer Network by A. Tanebaum. Printice Hall Ind. Englewood cliffs N.J., 1981.

6. Data and computer communications by W. Stallings, Mc Millan Pub. Co. New York, 1976.

PHY-02: Physics (General)   **Credit: 4**

UNIT I: Mathematical Techniques: Fourier Transform: Fourier integral theorem, Fourier transform. Fourier transform of elementary function. Representation of Dirac delta function as a Fourier Integrals, Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transform. Application of Fourier transform to differential equation.

Laplace transform Laplace transform of elementary function, properties of Laplace transform, Laplace transform of 1st and 2nd order derivatives and integrals of function. Derivatives and integral of Lapalce transform, Laplace transform of unit step function, Dirac Delta function, periodic function, Inverse Laplace transform. Application of of Laplce transform to 2nd order differential equation

UNIT-II: Electromagnetic Wave Propagation in unbounded media: Review of Maxwell's equation, Displacement current. Scalar and vector potential. Plane EM wave through vacuum and isotropic dielectric media. Transverse nature of plane EM wave, refrective index and dielectric constant, ave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere. Tropospheric propagation.

UNIT III: Quantum theory of radiation: Spectral distribution of black body radiation , Planck's quantum postulates, Plancks law of black body radiation and experimental verification. Deduction of (i) Wien's Distribution law (ii) Rayleigh-Jeans Law, (iii)(Stefan Boltzmann law, Wien's displacement law from Planck's law.

UNIT IV: Computational techniques: Introduction to numerical methods and FORTRAN programming, direct solution of linear equations, interpolation, curve fitting (Linear, exponential and power), numerical integration and solution of differential equations, simple simulation.

References:

1. Mathematical methods for physicists and engineers, K. F. Riley, M.P. Hobson and S. J. Bence, Cambridge University Press.
2. Mathematical methods in the physical sciences, M. L. Boas, John Wiley and sons.
3. Intrduction to Electrodynamics, D. J. Griffiths, Prentice Hall of India.
4. Fundamentals of Electromegnetics, M. A. W. Miah, Tata Mcgraw Hill.
5. Statstical and Thermal Physics, S. Loknathan and R. S. Gambhir Prentice Hall India.
6. Modern Thermodynamics with Statistical Mechanics, C. S. Helrich, Springer.
7. Fortran 77 and Numerical methods C Xavier, New Age
8. . Numerical methods E. Balagurusamy, Tata McGraw Hill
9. Numerical recopies in Fortran W.H. Press et. al, Cambridge University Press Murry R Speigel, Vector Analysis Mc Graw Hill

PHY-03: Atmospheric Physics (Elective)   **Credit: 4**

UNIT-I:

Atmosphere: Origin of the atmosphere, Structure and composition of the atmosphere. Atmospheric Thermodynamics: Application of thermodynamics in atmospheric processes, adiabatic process, Potential temperature, Temperature lapse rate and inversion, Hydrostatic equation and atmospheric stability. Analysis of Skew T , Log P diagram

UNIT-II:

Atmospheric Dynamics: Scale analysis, fundamental forces, basic conservation laws, the vectorial form of the momentum equation in rotating coordinate systems, scale analysis of equation of motion, application of the basic equations. Circulation and vorticity. Atmospheric

oscillation, Quasi biennial oscillation, Madden-Julian oscillation, Mesoscale circulation , the general circulation

UNIT-III:

Clouds and Precipitation: Different types of clouds, Formation of clouds, cloud and rain microphysics, Mixed phase process and its implication for severe weather (lightning and hail), mesoscal convective systems.

Monsoon Circulation: Origin and mechanism of Asiatic monsoon, Some Important atmospheric circulation: El-Nino and La-Nina –mechanism of formation and impact on climate, Southern Oscillation, ENSO.

UNIT-IV:

Satellite Meteorology: Introduction, Types of satellites, Meteorological satellites, active and passive sensor for monitoring weather. Radar Meteorology: Radar equation and return signal, signal processing and detection, Rayleigh and Mie scattering of radar signal. Various type of atmospheric radar (DWR, Wind profiler, LIDARs). Application of radars to study atmospheric phenomena.

References:

1. Fundamental of Atmospheric Physics, M. L. Salby, Academic Press.
2. The Physics of Atmosphere, J. T. Hougton, Cambridge University Press.
3. An introduction to dynamic meteorology, J. R. Holton, Academic Press.
4. Doppler Weather Radar, Dovik and Zrinic, Academic Press.

PHY-04 Project work and Seminar

 The student should select a research topic and read the literature and present one talk in a seminar. This has to be done in consultancy with the Ph.D. supervisor

Examination: Viva based on presentation/seminar

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