

**ASSAM UNIVERSITY SILCHAR
DEPARTMENT OF PHYSICS**

APPROVED IN 49TH A.C. HELD ON 13.02.2009

DEPARTMENTAL COURSES IN M.PHI./ Ph.D.

PS-501 : CONCEPTS IN PHYSICAL SCIENCES: (Common to Physical Sciences)

- (i) Methodology of research : Literature review and data collection, selection of Problem for research, synopsis: concepts, scope and components, techniques of referring and bibliography report, writing, summary and over view.

OR

Numerical Methods : Computer Arithmetic, errors, numerical instability, Machine computation, computer software, Bisection method for single equation, partition method, Gaussidel interaction, method, jacobi method, Householder's method Hermite interpolation, Bivariate interpolation, least square approximation, chemyshev approximation, methods based on interpolation, integration methods of Gauss ligendra, Labatto Gauss-Chebyshev, Gauss-Legendre, Gauss-Hermite Romberg integration, predictor corrector, method, shooting method, difference, Dirichlet's problem.

- (ii) Network and data communication: Network, TYMNET, APPANET, ISDN, LAN, X.25, protocol, Interest communication TGP/IP, Packet, switching, different navigational tools, w.w.w. other tools for accessing documents and data through Library and other networks.
- (iii) Computer Simulations: Introduction to mathematical and simulation models, deterministic and stochastic simulation models, continuous and discrete and simulation, Random number generation techniques, sampling techniques, Monte Carlo simulations GPSS (General Purpose System Simulation).
- (iv) Theory of Errors : Definitions, classifications of errors, Random error of a measured quantity. Gaussian and poisson distributions propagation of error, special topics in the adjustment of data statistical and non-statistical samples.

Suggested Readings:

1. Research Methodology C.R. Kothari.
2. Research Methodology S.R. Bajpai.

3. M.K. Jain, S.R.K. Iyengar & R.K. Jain, Numerical Methods for Scientific and Engineering computation, Wiley Eastern Ltd.
4. Wendroff, B. Theoretical Numerical Analysis, Academic Press.
5. Roberts, S.M. and Shipman, J.S. Two points Boundary value problems shooting Methods, Elsevier.
6. Wait, R. Numerical solution of Algebraic Equations, John wiley.
7. Data and computer communications-W. Stallings, Mc Millian Pub. Co. New York (1976).
8. Queuing systems- vol.2-D, Kleinrock, John Wiley & Sons. Inc New York (1976).
9. Computer Network- A. Tanenbaum-Prentice Hall Ind. Englewood cliffs N.J. (1981).
10. Introduction to the theory of error: Yardley Beers Addison Wesley Pub. Com., New York (1967).
11. Probability, Random variables and stochastic processes: A Papoulis Mc Graw Hill Book Company (1965).
12. Statistical Methods: In experimental physics, WT Eadie, D. Drijard, F.E. James, N. Roos and B. Sadonlet, North-Holland Pub. Com. Amsterdam (1971).
13. Data reduction and error analysis: Bevington Philips R. Mc. Graw Hill New York (1969).

PS- 502 : Integrated Course (School level)
(Common to Physical Sciences)

Marks : 100

Title of the Course : Essential Topics in Physical Sciences

Unit-I : Nanotechnology : Introduction to nanotechnology, Different classes of nanomaterials and their properties. Fabrication methods and characterization techniques of nanomaterial. Applications of nanomaterials in electronics (electronic switch SET), photonic (detector/source/switch) and nonlinear optics (optical filter, frequency converter). Introduction to DFT (density functional theory).

Unit-II : Network and data communication: Network, TYMNET, ARPANET, ISDN, LAN, X.25, Protocol, Internet communication TGP/IP, Packet, switching, different navigational tools, w.w.w. other tools for accessing documents and data through Library and other networks.

Unit-III : Computer Simulations: Introduction to mathematical and simulation models, deterministic and stochastic simulation models, continuous and discrete and simulation, Random number generation techniques, sampling techniques, Monte Carlo simulations GPSS (General Purpose System Simulation).

Unit-IV : Theory of Errors : Definitions, classifications of errors, Random error of

a measured quantity. Gaussian and poisson distributions propagation of error, special topics in the adjustment of data statistical and non-statistical samples.
(b) Least-Squares fitting computer programming and application using basic FORTRAN Languages.

Suggested Reading :

1. Jr P.P. Charles, Frank O.J. Quantum Will, Wires, & Dots, Introduction to Nanotechnology A John Willley & Sons Inc. 2003.
2. G. Timp, Nanotechnology, Springer-Verlag New York Inc. (2005).
3. K.E. Drexler Nano system: Molecular Machinery Manufacturing and computing, Wiley, New York (1992).
4. Data and computer communication- W. Stallings, Mc Millan Pub. Co. New York (1976).
5. Oueqeing systems- vol.2-D, kleinrock, John Wiley & Sons. Inc New York (1976).
6. Computer Network- A. Tanebaum-Prentice Hall Ind. Englewood cliffs N.J. (1981).
7. Introduction to the theory of error: Yardley Beers Addison Wesle Pub. Com., New York (1967).
8. Prabability, Random variables and stochastic processes: A papouls Mc Graw Hill Book Company (1965).
9. Statistical Methods: In experimental physics, WT Eadie, D. Drijard, F.E. James, N. Roos and B. Sadonlet, North-Holand Pub. Com. Amsterdam(1971).
- 10.Data reduction and error analysis: Beveington Philips R. Mc. Graw Hill New York (1969).
- 11.Fortran Programming Raja Ramanna Mc Graw Hill Book Company, (2004).
- 12.Text Book of research Ethics: Theory and Practice Sana haul, Kluwer Academic Plenum Publishers.

PHY-503 : Advanced Topics in Physics- I

- (I) GROUP THEORY: Definitions and theorems of group theory, Molecular Symmetry and the symmetry groups. Symmetry elements and operations, planar and reflections inversion center, proper axes and proper rotations, Improper axes and symmetry point groups. Systematic procedure for symmetry, Classes of symmetry operations representations of groups. Character tables.
- LIE-ALEGEBRA : Hilbert space, Continuous group, representations of groups, Lie group and its application.

- (II) **VIBRATIONAL SPECTRUM OF SOLIDS:** The symmetry of normal vibrations, Selection rules for fundamental vibrational transitions. Crystallographic point-groups, Site symmetry and factor group analysis, Correlation table, Internal and external vibrations in molecular crystals. Group theory and Quantum mechanics. Distortion induced activity of IR and Raman Modes.
- (III) **CURVILINEAR COORDINATES AND TENSORS :** Elements of curvilinear Co-ordinates-Classification of Tensors-Derivatives of Tensors-Parallel Transport-Christoffel symbols-Transformation laws of Christoffel symbols-Reiman Christoffel tensors-Bianchi identities-Ricci tensors-Einstein tensor.
- (IV) **GENERAL THEORY OF RELATIVITY :** Non-inertial frames-Principle of Equivalence-Line element of general relativity-Metric tensors-Distance and Time intervals-Relation between metric tensors and Christoffel symbols-Motion of particle in gravitational field-Electrodynamics in curved space; Einstein's equation-Schwarzschild solution.

PHY 504 : Advance Topics in Physics-II :

- (I) **PHASE TRANSITION :** Basic concepts and recent developments of phase transition, Classification of phase transition, Reconstructive, Distortive, martensitic, Incommensurate, Displacive, Order-disorder, Positional, Orientational spin orientation (Electron/Nuclei) response function and order parameter, Landau's theory of phase transitions, Critical behaviour and resormalization group theory.
- (II) **FERROELECTRICS :** Different types of ferroelectrics, Ferroelectric phase transition in the order-disorder limit. Transitions in the displacive limit, microscopic limit, Microscopic soft mode theory, Incommensurate ferroelectric phase transitions, Improper ferroelectric transitions, Different techniques in the study of structural phase transitions, In crystals : IR, Raman and Neutron scattering.
- (III) **OBSERVATIONAL ASTRONOMY :** Celestial sphere and co-ordinate system-stellar colour, Magnitude, spectral types- H.R. Diagram. Telescopes and observational techniques : Photometry-spectrometry and Polarimetry- ray. X-ray, UV radio astronomy.
- (III) **STARS AND GALAXIES :** Star formation, Jean's condition, Stellar evolution, Supernova, late type stars, pulsar, Neutron star and blackhole, Solar system studies.

Galaxied- AGN : Seyufert etc. Quasars. Hubbles' law, Big bang and steady state theories.

SUGGESTED READINGS :

1. Infrared and Raman selection rules for molecular and lattice vibrations; The correlation method-W.G. Fateley. FR Dollish, NT Mc. Davit and FF Bentley Wiley-interscience, New York,(1972).
2. Infrared spectroscopy and molecular structure D. Hadzi, Ed.m. David, Elsevier , Amsterdam (1963).
3. Introductory Group theory and its application to molecular structure-J.R. Ferraro and J.S. Ziomek Planum Press New York 1975.
4. Group theory and quantum mechanics, M.Tinkham, Tata Mc Graw Hill, New York (1974).
5. Infrared and Raman spectra of crystals-G. Tnrrel, Academic Press London (1972).
6. Molecular Vibrations : The theory of infrared and raman vibration spectra E.B Wilson (jr) J.E. Delins. P.C. Cross, Mc Graw Hill, New York (1955).
7. Chemical application of group theory, FA Cotton, Wiley Eastern Limited, New Delhi IInd Ed. 1971.
8. Vibrational spectroscopy of solids : PM Sherwood Cambridge Univ. Press : Cambridge (1972).
9. Elements of Group Theory for Physics, A.W. Joshi New Age International Publish, 4th Ed, (2002).
10. Vibrational spectroscopy of phase transitions Ed. Z. Iqbal and F.J. Owens, Acad. Press Inc. Orlando (1984).
11. Structural phase transition –I : K.A. Miller, Ed. K.A. Miller and H.Thomos: Springer-Verlag (1981).
12. Introduction to phase transitions and critical phenomena : H.P. Stanley, Oxford Univ. Press, London (1971).
13. Light scattering spectra of solids, C.H. Wang and P.A. Flerry Ed. G.B. Wright.Springer, New York (1968).
14. Soft models in ferroelectrics and antiferroelectrics R. Bliine and B. Zeks North Holland, Amsterdam (1974).
15. Phase transitions in solids : C.N.R. Rao and K.J. Rao, Mc Graw Hill New York (1978).
16. Structural phase transitions, A.D. Bruce and K.A. Cowley, Taylor & Francics Ltd. London (1981).
17. Physical Universe-Frank Shn, Academic Press.
18. Astrophysical Formulae. K.R. lang, Springer and Verlag Berlin,(1980).
19. Introduction to Cosmology, J.V. Narlikar, Cambridge Univ. Press (1993).
20. Physics and Chemistry of comets-Hubnir, Springer and Verlag, Berlin

- (1990).
21. Origin and Evolution of solar system-Bertoil Kluwere Academy Amsterdam.
 22. Gauge theories in particle Physics-Aitchison, JJR and Hey N.T.G. adam Hilger Ltd. Bristol (1982).
 23. The Eightfold way-Gellmans & Neeman, Benjamin, New York.
 24. Quarks and leptons : Anintroductory Course in Modern particle Physics-Halzen and Martin, John Wiley and sons, Singapore.
 25. Weak interactions-Bailin, Adam Hilger, Bristol
 26. Introduction to experimental particle Physics-Ferrow Cambridge Univ. Press, Cambridge.
 27. Hadron interactions; Collins, PDB and Martin, A.D. Adam Hilger Ltd. Bristol (1984)
 28. Barlow, R.j. “ Statistics a guide to the use of statistical method in the physical sciences” John Wiley & Sons. (ISBN 0471 922951)
 29. Starck, J.L. Martaghj, F and Bijaovi A (1998) ‘Image processing and Data Analysis’ Cambridge Univ. Press (ISBN 0521 599148)
 30. McIlean ‘Electronic Imaging in Astronomy’ Waley.
 31. K.S. Kriahnaswami, ‘Physics of comets’ Cambridge Univ. Press.
 23. “Interplanetary Dust’ (Grin etal Eds) A & A library Spprunofer. (ISBN 3540- 42067-3)
 24. “Fundamental Astromy” (Karttunen etal Eds). Springer (ISBN 3-540-609936- 9- 3rd Ed)
 25. “ The Classical Theory of Fields”- Vol 2 Landan and Lifshitz. BH.