

NEHRU MEMORIAL COLLEGE (AUTONOMOUS) PUTHANAMPATTI

M.Phil. PHYSICS (FT/PT) PROGRAMME

(For the candidates to be admitted from the academic year 2018-19 onwards)

Eligibility: M.Sc. Physics

PROGRAMME OBJECTIVES :

- To equip students with essential knowledge and skills required for taking up multidimensional responsibilities in research.
- To prepare students through systematic study and research towards contributing to the development of educational literature and leading to the growth of education as a discipline.
- To develop a set of core skills in students to work with efficiency in the areas of teaching and learning.
- To train students to conduct field based research studies including selection of research problems, sampling and preparation of research tools and adoption of statistical methodologies.
- To prepare professional administrators and supervisors for the position of responsibilities in the context of emerging perspectives in educational planning and research.

PROGRAMME STRUCTURE

Sem-ester	Course	Title of the Course	Exam. Hours	Credits	Marks		
					IA	UE	Total
I	Course - I	Research Methodology	3	4	25	75	100
	Course - II	Advanced Physics	3	4	25	75	100
	Course - III	Teaching and Learning skills (Common Paper)	3	4	25	75	100
	Course - IV	Paper on Topic of Research (The syllabus will be prepared by the Guide and the examination will be conducted by the COE)	3	4	25	75	100
II	---	Dissertation and Viva-Voce Viva Voce 50 marks Dissertation 150 marks	--	8	--	--	200
Total				24	--	--	600

PROGRAMME OUTCOMES :

- Transformation of Post Graduate students into research scholars.
- Understanding of research process, its design and ethical issues involved in research.
- Sharpened abilities to analyse information.
- Ability to critically examine research documentation and publication in SCI/SCI expanded journals.
- Submission of a thesis at the end of the programme.

COURSE I

RESEARCH METHODOLOGY

Course Objectives :

1. To understand the techniques, and a thorough knowledge of the literature
2. To develop skills about data analysis and application of software's
3. To impart knowledge about highly sophisticated analytical equipments.

Unit I : Working on a Research Problem

Scientific research – Aim and motivation – Principles and ethics – Identification of research problem: Determining the mode of attack – Current status – Literature survey – Abstraction of a research paper – Access using Internet web tools – Impact and usefulness of the research problem – Role of research guide – Guidance and rapport - Preparation and presentation of Scientific reports; need and methods – Power point and poster – Writing of synopsis and dissertation and thesis.

Unit II : Mathematical Methods

Hypergeometric function – Confluent Hypergeometric function – Series solution of Gauss Hypergeometric equations – Elementary properties - Symmetry property – Differential and Integral representations – Linear transformation of Hypergeometric function.

Elliptic functions and elliptic integrals – The Binomial, Poisson and Gaussian distributions – General properties and fitting experimental data.

Unit III : Data Analysis

Introduction – Statistical description of data - Mean , variance, skewness, median, mode – Distributions : Binomial, Poisson and Gaussian distributions – Student's t-test, F-test, Chi-square test – Linear and rank correlations – Modelling data: Least-squares, Fitting data.

Unit IV : High Performance Computing

High performance computing basics – Elements of Fortran 90/95– Constants and variables – Arithmetic expressions – I/O statements – Logical expressions – Conditional and control statements - Arrays – Functions and subroutines – Format statements – Advanced features: Procedures, modules, recursive functions and generic procedures – Applications Software and Libraries: MATLAB, MATHEMATICA, GNU PLOT, LATEX, LAPACK, BLAS, and FFTW (basics only).

Unit V : Analytical techniques and Instrumentation

Analytical Techniques – principles of single crystal and powder X-ray diffraction , FT-IR, Raman and UV-visible spectrometers- SEM, TEM, EDAX, AFM, EPMA – Instrumentation – Sample preparation – Analysis of materials – Study of dislocation – ion implantation uses.

Books for Study and References

Unit I

1. J. Anderson, B.H. Durston and M. Poole, *Thesis and Assignment writing* (Wiley Eastern, New Delhi, 1977).
2. Rajammal Devadas, *Hand Book of Methodology of Research* (R.M.M. Vidyalyaya Press, 1976).
3. *Internet: An Introduction*, CI Systems School of Computing, Jaipur (Tata McGraw Hill, New Delhi, 1999).
4. C.R. Kothari, *Research methodology: Methods and Techniques*, (New age International, New Delhi, 2006).

Unit II

1. P. K. Chattopadhyay, *Mathematical Physics*, (Tata McGraw Hill, New Delhi, 2007).

Unit III & IV

1. Troy Baer, *An Introduction to FORTRAN 90*, Ohio Supercomputer Centre, Columbus, OH, USA Internet Tutorial URL: <http://oscinfo.osc.edu/training/f90/html/bsld.002.html>
2. V. Rajaraman and C. Siva Ram Murthy, *Parallel computers – Architecture and Programming*, Prentice Hall of India, New Delhi.
3. H. K. Dass, *Mathematical Physics*, S. Chand & Company, New Delhi (2003).
4. C.R. Kothari, *Research methodology: Methods and Techniques*, (New age International, New Delhi, 2006).

Unit V

1. M. William and D. Steve, *Instrumental Methods of Analysis* (CBS Publishers, New Delhi, 1986).

COURSE- II
ADVANCED PHYSICS

Course Objectives :

1. To familiarize the learners with concepts and techniques of certain Quantum mechanical models and sub atomic particles.
2. Students are expected to understand the concepts of theoretical and experimental research.
3. To impart knowledge about nonlinear dynamics.

UNIT-I: BASICS OF CRYSTAL GROWTH AND THINFILMS

Nucleation – Different kinds of nucleation – Formation of crystal nucleus – Energy formation of nucleus – Spherical and cylindrical nucleus- Thermodynamics of nucleation – growth kinetics of thin films-crystal growth process of thin films – Epitaxial growth of thin films (Basic concept only).

UNIT-II: SOLUTION GROWTH TECHNIQUES Low temperature solution growth: Solution – Solubility and supersolubility – Expression of supersaturation –Moier’s T-C diagram-constant temperature bath and crystallizer –Seed preparation and mounting- Slow Cooling, solvent evaporation method-Gel growth-structure of gel-Importance of gel technique-Chemical reaction method- Single and double diffusion methods-Chemical reduction method-Advantages of gel method.

Phase diagram and phase rules(basic concept) - Melt techniques: Bridgman technique – Basic process –thermal consideration–vertical Bridgman technique- experimental arrangement- Czochralski technique – experimental arrangement- growth process-growth rate – Vapour growth – Physical vapour deposition (PVD) – Chemical vapour deposition (CVD).

UNIT – III : THIN FILM PREPARATION TECHNIQUE Thin Films – Introduction to Vacuum Technology –Deposition Techniques –Physical methods – Resistive Heating, Electron Beam method – sputtering - Reactive sputtering -RF sputtering –pulsed laser deposition-chemical Methods –electrodeposition-spray pyrolysis deposition.

UNIT IV : QUANTUM FIELD THEORY

Lagrangian field theory – Canonical quantization – Classical field equations – Hamiltonian formulation quantization of field – Non-relativistic field – System of Bosons – System of Fermions – Relativistic fields – Klein Gordon fields – Dirac fields.

UNIT V : NEMATIC LIQUID CRYSTALS

Introduction-Isotropy and Anisotropy phases-Order parameter-Phase diagram of cholesteryl –myristate and PAA-Nematic phase-deformatio in Nematic liquid crystals-liquid crystal display(Introductory concepts).

BOOKS FOR STUDY AND REFERANCE:

1. J.C. Brice, Crystal Growth Processes, John Wiley and Sons, New York (1986).
2. P. Santhana Raghavan and P.Ramasamy, 'Crystal Growth Processes and Methods', KRU Publications Kumbakonam (2000).
3. A. Goswami, Thin film Fundamental, New Age International (P) Ltd, New Delhi (2006).
4. M.Ohring, Material science of Thin films, second EDITION, Academic press, Elsevier,New Delhi(2002).
5. V.K. Thankappan, *Quantum Physics*, (New Age International (P) Limited Publishers, 2nd Edition New Delhi, 2006)
6. H.H.Williard,L.L Merrit, J.Dean and F.A settle, Instrumental methods of Analysis-Sixth Edition,CBS publishers& Distributors, Delhi(1986)
7. Pefer J.collings, liquid crystals,New international(P)Limited publishers(2007).

COURSE III

Teaching and Learning Skills

Course Objectives :

- Acquaint different parts of computer system and their functions.
- Understand the operations and use of computers and common Accessories.
- Develop skills of ICT and apply them in teaching learning context and Research.
- Appreciate the role of ICT in teaching, learning and Research.
- Acquire the knowledge of communication skill with special reference to its elements, types, development and styles.
- Understand the terms communication Technology and Computer mediated teaching and develop multimedia /e- content in their respective subject.
- Understand the communication process through the web.
- Acquire the knowledge of Instructional Technology and its Applications.
- Develop different teaching skills for putting the content across to targeted audience.

Unit I : Computer Application Skills

Information and Communication Technology (ICT): Definition, Meaning, Features, Trends – Integration of ICT in teaching and learning – ICT applications: Using word processors, Spread sheets, Power point slides in the classroom – ICT for Research: On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations-- **ICT for Professional Development:** Concept of professional development; institutional efforts for competency building; individual learning for professional development using professional networks, OERs, technology for action research, etc.

Unit II : Communications Skills

Communication: Definitions – Elements of Communication: Sender, Message, Channel, Receiver, Feedback and Noise – Types of Communication: Spoken and Written; Non-verbal communication – Intrapersonal, interpersonal, Group and Mass communication – Barriers to communication: Mechanical, Physical, Linguistic & Cultural – Skills of communication: Listening, Speaking, Reading and Writing – Methods of developing fluency in oral and written communication – Style, Diction and Vocabulary – Classroom communication and dynamics.

Unit III : Pedagogy

Instructional Technology: Definition, Objectives and Types – Difference between Teaching and Instruction – Lecture Technique: Steps, Planning of a Lecture, Delivery of a Lecture – Narration in tune with the nature of different disciplines – Lecture with power point presentation - Versatility of Lecture technique – Demonstration: Characteristics, Principles, planning Implementation and Evaluation – Teaching-learning Techniques: Team Teaching, Group discussion, Seminar, Workshop, Symposium and Panel Discussion.

Unit IV : E- Learning, Technology Integration and Academic Resources in India

Concept and types of e-learning (synchronous and asynchronous instructional delivery and means), m-learning (mobile apps); blended learning; flipped learning; E-learning tools (like LMS; software's for word processing, making presentations, online editing, etc.); subject specific tools for e-learning; awareness of e-learning standards- Concept of technology integration in teaching- learning processes; frameworks guiding technology integration (like TPACK; SAMR); Technology Integration Matrix- Academic Resources in India: MOOC, NMEICT; NPTEL; e-pathshala; SWAYAM, SWAYAM Prabha, National academic depository, National Digital Library; e-Sodh Sindhu; virtual labs; eYantra, Talk to a teacher, MOODLE, mobile apps, etc.

Unit V : Skills of Teaching and Technology based assessment

Teaching skills: Definition, Meaning and Nature- Types of Teaching Skills: Skill of Set Induction, Skill of Stimulus Variation, Skill of Explaining, Skill of Probing Questions, Skill of Black Board Writing and Skill of Closure – Integration of Teaching Skills – Evaluation of Teaching Skills- **Technology for Assessment:** Concept of assessment and paradigm shift in assessment; role of technology in assessment 'for' learning; tools for self & peer assessment (recording devices; e-rubrics, etc.); online assessment (open source software's; e-portfolio; quiz makers; e- rubrics; survey tools); technology for assessment of collaborative learning like blogs, discussion forums; learning analytics.

References

1. Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi
2. Brandon Hall , E-learning, A research note by Namahn, found in: [www.namahn.com/resources/ .../note-e-learning.pdf](http://www.namahn.com/resources/.../note-e-learning.pdf), Retrieved on 05/08/2011
3. Don Skinner (2005), Teacher Training, Edinburgh University Press Ltd., Edinburgh
4. Information and Communication Technology in Education: A Curriculum for schools and programmed of Teacher Development, Jonathan Anderson and Tom Van Weert, UNESCO, 2002.
5. Jereb, E., & Šmitek, B. (2006). Applying multimedia instruction in e-learning. Innovations in Education & Teaching International, 43(1), 15-27.
6. Kumar, K.L. (2008) Educational Technology, New Age International Publishers, New Delhi.
7. Learning Management system : https://en.wikipedia.org/wiki/Learning_management_system , Retrieved on 05/01/2016
8. Mangal, S.K (2002) Essential of Teaching – Learning and Information Technology, Tandon Publications, Ludhiana.
9. Michael,D and William (2000), Integrating Technology into Teaching and Learning: Concepts and Applications, Prentice Hall, New york.

10. Pandey,S.K (2005) Teaching communication, Commonwealth Publishers, New Delhi.
11. Ram Babu,A abd Dandapani,S (2006), Microteaching (Vol.1 & 2), Neelkamal Publications, Hyderabad.
12. Singh,V.K and Sudarshan K.N. (1996), Computer Education, Discovery Publishing Company, New York.
13. Sharma,R.A., (2006) Fundamentals of Educational Technology, Surya Publications,Meerut
14. Vanaja,M and Rajasekar,S (2006), Computer Education, Neelkamal Publications, Hyderabad.

Course Outcomes

After completing the course, the students will:

- Develop skills of ICT and apply them in Teaching Learning context and Research.
- Be able to use ICT for their professional development.
- Leverage OERs for their teaching and research.
- Appreciate the role of ICT in teaching, learning and Research.
- Develop communication skills with special reference to Listening, Speaking, Reading and Writing.
- Learn how to use instructional technology effectively in a classroom.
- Master the preparation and implementation of teaching techniques.
- Develop adequate skills and competencies to organize seminar / conference / workshop / symposium / panel discussion.
- Develop skills in e-learning and technology integration.
- Have the ability to utilize Academic resources in India for their teaching.
- Have the mastery over communication process through the web.
- Develop different teaching skills for putting the content across to targeted audience.
- Have the ability to use technology for assessment in a classroom.

CC-III(f) CRYSTAL GROWTH TECHNOLOGY

UNIT-I CRYSTAL PHYSICS AND PHYSICAL PROPERTIES OF CRYSTALS:

Representation of physical quantities by scalars, vectors and tensors Effect of crystal symmetry on crystal properties Neumann's principle-Magnitude of a property in a given direction-Geometrical properties of the representation quadric-Equilibrium properties represented by second-rank tensor: Electric polarization: relation between D,E, and P in a parallel plate condenser-Stress tensor homogeneous and inhomogeneous stresses-strain tensor homogeneous three-dimensional strain.

UNIT-II CRYSTAL OPTICS AND NON-LINEAR AND ELECTRO-OPTICAL EFFECTS IN CRYSTALS:

Double refraction: optical indices-Effects of crystal symmetry on optical indices-Wave surface: Uniaxial and Biaxial crystals-Non-linear optics: Harmonic generation-:Second harmonic generation-phase matching-Third harmonic generation-optical mixing: Sum and difference frequencies-parametric generation of light-Focusing of intense light beams-Electro-optic Effect.

UNIT-III NANOMATERIALS AND THEIR APPLICATIONS:

Properties of metallic and semiconducting Nanoparticles-Various physical and chemical methods of preparation-Synthesis of carbon nanostructure and their applications-Nanostructured ferromagnetism-size and dimensionality effects in nanostructures-Biological application of nanomaterials.

UNIT-IV: SURFACE ANALYSIS TECHNIQUES:

Atomic collision and Backscattering spectrometry: Energy loss of light ions and Backscattering Depth profiles-Sputter depth profile and secondary ion mass spectroscopy-Channelling: Basis and its application in thin Film analysis-X-ray photoelectron spectroscopy-Electron Micro analysis of surface-Nonradioactive Transitions and Auger Electron spectroscopy.

UNIT-V SPECTROSCOPIC METHODS:

Spectrometer-UV-VIS-Near IR,-Basic concepts of FTIR and Raman and its applications to various materials-NMR and ESR and its applications-Thermal analysis(TG/DTA,DSC)of different materials-ray method Diffraction Directions-Diffraction methods-Powder method-Particle size calculation-X ray scattering by electrons ,atomic and unit cells.

BOOKS FOR STUDY AND REFERENCE:

1. 'Physical properties of crystals: Their Representation by tensor and Matrices' by J.F.Nye,1985,Oxford University press, New York.
2. 'Lasers and Non-linear Optics' by B.B.Laud,Chapter 13,Wiley Eastern Ltd.,1985.
3. Introduction to Nanotechnology by C.P.Pool Jr.and P.J Owens, John wiley&sons.
- 4.Fundamental of surface and thin film analysis Leonard C.Feldman and James W.Mayer.

CC-III(c) LIQUID CRYSTALS

UNIT-I INTRODUCTION:

States of matter- The liquid crystal phase- Order parameter- Broad classification of crystals-L- yotropic, polymeric and Thermo tropic types.

UNIT-II EVOLUTION OF LIQUID CRYSTALS PHASES:

Discovery of liquid crystals- Brief history- Developments after the discovery.

UNIT-III THERMOTROPIC-TYPE LIQUID CRYSTALS:

Thermotropic types of liquid crystals- Nematic, cholesteric and smectic phases.

UNIT-IV EFFECTS OF EXTERNAL FIELDS:

Isotropy and Anisotropy nature, Liquid crystals in electric, magnetic, and optic fields. Effects on liquid crystal-nematic.

UNIT-V LIQUID CRYSTALS DISPLAYS:

Display Technique: Types of modes- Dynamic scattering mode- chiral nematic mode- Twisted nematic mode.

BOOKS FOR STUDY AND REFERENCES:

1. Peter J. Collings. Liquid crystals princeton university press, UAS(2007)
2. S. Chandrasekhar, Liquid crystals, The Cambridge university press(1977,1992)
3. P.G De Gennes and J.Prost, the physics of liquid crystals, Oxford university press(1999).

CC III(a) NONLINEAR DYNAMICS

UNIT-I INTRODUCTION TO NONLINEAR DYNAMICS:

What is nonlinearity? Linear and nonlinear force-Mathematical explanation. of nonlinearity- Linear super position and its validity-Linear and nonlinear oscillators-Autonomous and nonautonomous systems.

Phase space –equilibrium points-classification of points –limit cycle motion,Poincare bendixon theroem.

UNIT-II BIFURCATION AND CHAOS IN DISCRETE CONTINUOUS SYSTEM;

Period doubling phenomenon and onset of chaos in a logistic map-Bifurcation diagram-Some simple bifurcation scenario in a Duffing oscillator-poincare section and Lyapunov Exponents(qualitative features only).

UNIT –III NONLINEAR ELETRONIC SYSTEMS:

Necessity of nonlinear electronics simulation studies-Nonlinear circuit elements analog simulation of a duffing oscillator.

Chuas's Diode its characteristics and experimental realization-MLC oscillator-Bifurcation sequence in a MLC oscillator.

UNIT –IV SOLITIONS:

Scotl Russell phenomenon and solitary waves-kdv equation-Fermi-pastal Ulam numerical experimental.

Numerical experiments of kruskal and zabusky-Hirota's bilinearisation method for solion solutions of Kdv equation.

UNIT V APPLICATION OF NONKINEAR DYNAMICS:

Synchronization of chaotic systems method of one way coupling –illustrative, Example: synchronization of two MLC oscillators-secure communication chaotic signal masking and transmission of analog signals-using MLC Circuits.

Ubiquitous solution equation NLS equation in optic fibers, equation in long Josephson junction.

BOOKS FOR STUDY REFERENCES:

1, Nonlinear Dynamics: Integrability, Chaos and patterns (M.Lakshmanan and S.Rajasekar) Springer verlag- Indian Reprint, 2003.