

**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 approach – 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 – Preparation and presentation of Scientific reports; need and methods – publication in peer reviewed journals-Plagiarism- Power point and poster – Writing of synopsis-dissertation -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.

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.

Unit IV : High Performance Computing

High performance computing basics – Elements of Fortran – 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, Gaussian, 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- TG/DTA, DSC analysis – SEM, TEM, EDAX, AFM, EPMA – Instrumentation – Sample preparation – Analysis of materials.

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).
5. K.Ravichandran, K.Swaminathan, A.T.Ravichandran and C.Ravidhas, *Research Methodology and Scientific Writing* (Jazam Publication,Tiruchirappalli, 2017)
6. S. Rajasekar, P. Philominathan and V. Chinnathambi, *Research Methodology*, arXiv: physics/0601009 physics.ed-ph (2009)

Unit II

1. P. K. Chattopadhyay, *Mathematical Physics*, (Tata McGraw Hill, New Delhi,2007).
2. B.D.Gupta, *Mathematical Physics*, (Vikas Publishing house, 2009).

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, *Computer Programming in Fortran 90/95* (PHI Learning, New Delhi, 1997)
3. V. Rajaraman and C. Siva Ram Murthy, *Parallel computers – Architecture and Programming*, Prentice Hall of India, New Delhi.
4. H. K. Dass, *Mathematical Physics*, S. Chand & Company, New Delhi (2003).
5. 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).
2. K.Ravichandran, K.Swaminathan, B.Sakthivel and C.Ravidhas, *Introduction to Characterization of Nanomaterials and Thin Films* (Jazam Publication,Tiruchirappalli, 2016)

Course Outcomes :

Students are expected to acquire clear knowledge of literature survey, finding a suitable research problem, problem solving skills and preparation of dissertation.

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 : 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 II : Crystal Growth and Thin Film Physics

Nucleation – Spherical and cylindrical nucleation – Solution growth methods : Slow cooling , slow evaporation and temperature gradient methods - Melt growth : Bridgman method – Czochralski method – Thin film preparation : Physical methods - thermal evaporation - electron beam evaporation - sputtering method - Chemical methods : chemical bath deposition - spray pyrolysis.

Unit III : Nano-materials

Introduction to nano technology - Importance of nanomaterials – Types of nanostructures (1D, 2D, 0D) - Self-assembled monolayers (SAM) – Vapour Liquid Solid (VLS) – Chemical Vapour Deposition(CVD) – Carbon nanotubes (CNT) – Metals (Ag, Au) – metal oxides (TiO₂, ZnO) - Semi-conductors (CdS, ZnSe).

Unit IV : Nonlinear Dynamics

Regular and Chaotic motions – Linear and nonlinear oscillators – Phase trajectories – Fixed points and limit cycles – Period doubling phenomenon and onset of chaos in Logistic map.
Linear and nonlinear waves – Solitary waves – Numerical experiments of Kruskal and Zabusky – Solitons – KdV equation (no derivation) – one soliton solution by Hirota's direct method.

Unit V : Energy Resources

Nuclear fuel source – Enrichment – Energy production –Waste disposal – safety measures- prospects of renewable energy sources – Solar Cells : Solar cell parameter – characteristics – Efficiency – Single crystal silicon solar cells – Polycrystalline silicon solar cells – Dye Sensitized Solar Cells(DSSC)- Applications of solar energy – photo voltaics -Wind energy: Wind power – Principle – Generation – Distribution – Efficiency.

Books for study and references

Unit I

1. V.K. Thankappan, *Quantum Physics*, (New Age International (P) Limited Publishers, 2nd Edition New Delhi, 2006)

Unit II

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. K.Ravichandran, K.Swaminathan, B.Sakthivel and A.T.Ravichandran, *Introduction to Thin Films* (Jazam Publication, Tiruchirappalli, 2017)

Unit III

1. G. Cao, *Nanostructures and Nanomaterials : Synthesis, properties and applications*, Imperial College Press, 2004.

Unit IV

1. M. Lakshmanan and S. Rajasekar, *Nonlinear Dynamics* (Narosa Publications, New Delhi, 2003).

Unit V

1. Kreith and kreider, *Principles of Solar Engineering*, Tata McGraw Hill Publication.
2. M.P.Agarwal, *Solar Energy*, S.Chand & Co.
3. S.P. Sukhatme *Solar Energy*
4. G. D. Rai *Non-conventional energy sources*, Khauna Publications Delhi
5. G.D. Rai, *Solar Energy Utilization* , (Khanna Publishers, 5th Edition New Delhi, 1997).
6. <http://www.euronuclear.org/info/energy-uses.htm>
7. www.theiet.org/factfiles/energy/nuclear-principles.cfm?type=pdf
8. <http://paksnuclearpowerplant.com/download/1216/Fast%20breeder%20reactors.pdf>
9. http://en.wikipedia.org/wiki/Nuclear_fuel

Course Outcomes :

Students should be able to choose experimental problem and solve it independently. Design the necessary tools with a fair degree of validity and reliability.

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, 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 Weart, 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.
