

M.Phil PHYSICS

Course Structure and Syllabus

(For the candidates admitted from the academic year 2018-2019 onwards)

CHOICE BASED CREDIT SYSTEM (CBCS)



THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

(Approved by NAAC, Affiliated to Bharathidasan University)

ELAMBALUR, PERAMBALUR – 621 220





THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

ELAMBALUR, PERAMBALUR – 621 220

PG & RESEARCH DEPARTMENT OF PHYSICS



VISION

To blossom as an institution of excellence, enabling, empowering and enlightening the youth and shaping them as fully developed human beings with the capacity to unfold their full mental potentiality resulting in the attainment of the wisdom to live constructively and meaningfully.

MISSION

- To provide congenial and stress- free environment and opportunities for the enhancement of knowledge and acquisition skills through the best exposure and training possible.
- To offer multifaceted and need-based academic programmes and to promote extension activities.
- To adopt technology-enabled new methods, approaches and techniques so that the teaching-learning process becomes learner-centred and learner-friendly.
- To maximize the participation of all the stakeholders in the development of the institution and the region.
- To sensitize the youth towards inclusive growth for socio-economic change, sustainable development, gender equality, eco-friendliness, etc.
- To enable the youth to experience the effects of globalization and facilitate them to grow as responsible citizens and leaders.
- To inspire them, through value-based education, to embrace the entire humanity while firmly rooted in the Indian ethos.
- To provide regular placement training and placement opportunities.
- To kindle the spirit of creativity and enhance research activities and enable them to attain international standards.

PROGRAMME OUTCOMES

Upon completion of the programme, the Master of Philosophy will be able to

1. Gain advanced knowledge resulting in entrepreneurship; innovation and newer opportunities for being employable in public and private sectors, research and development organizations.

2. Apply enhanced new techniques and adopt new technologies needed in the respective disciplines.
3. Appreciate the diversity of behavior in professional practice and act in accordance with the core values of chosen profession.
4. Demonstrate the knowledge, values and skills to be critical consumer of research practice and possess investigative skills to evaluate the practice.
5. Engage in lifelong learning process, have the ability to communicate the findings of Languages / Commerce / Management studies / Social Work / Computing Sciences / Physical Sciences / Biological Sciences / Life Sciences with the current knowledge.

PROGRAMME SPECIFIC OUTCOMES

1. Develop employability skills and explore problem solving skills.
2. Adopt new technology focusing on instrumentation skills.
3. Launch projects and model designs.
4. Ensure effective communication and promote experimental skills.
5. Adopt teaching and research skills towards social relevance.



THANTHAI HANS ROEVER COLLEGE, PERAMBALUR – 621220
(AUTONOMOUS)
M.Phil., PHYSICS – COURSE STRUCTURE UNDER CBCS
(For the candidates admitted from the academic year 2022-2023 onwards)



Semester	Course	Course code	Title of the Course	Exam. Hours	Credits	Marks		
						IA	UE	Total
I	Course - I	22MPPH1CC1	Research Methodology	3	4	25	75	100
	Course - II	22MPPH1CC2	Advanced Physics	3	4	25	75	100
	Course – III	22MPPH1CC3	Teaching and Learning skills (Common Paper)	3	4	25	75	100
	Course - IV	22MPPH1CC4	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	---	20MPPH2DW	Dissertation and Viva-Voce Viva Voce 50 marks Dissertation 150 marks	- - -	8	--	--	200
TOT AL					24	--	--	600

RESEARCH METHODOLOGY

Course: I
Course Code: 22MPPH1C1
Credit: 4
Hours : 5

Semester : I
Max. Marks : 100
Internal Marks : 25
External Marks : 75

Objectives:

- ✓ To know about the different steps in doing a research problem
- ✓ To have a idea about data analysis through various test
- ✓ To understand the advanced analytical techniques

Course outcomes:

After completing the course, the students will:

- Understand the Research problem and presentation of thesis
- Learn the mathematical methods for research problems.
- Understand the various data analysis techniques.
- Study the Advanced software for high performance computing
- Understand the various analytical techniques and Instruments.

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. Vidyalaya 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)

Relationship Matrix for course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits				
I	22MPPH1C1	Research Methodology					5	4				
Course Outcomes	Programme Outcomes					Programme Specific Outcomes						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓			✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓			
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 46, Relationship: Very High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

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ADVANCED PHYSICS

Course: II
Course Code: 22MPPH1C2
Credit: 4
Hours : 5

Semester: I
Max. Marks : 100
Internal Marks : 25
External Marks : 75

Objectives:

- ✓ To understand the different methods of preparation of crystal growth, nanomaterials and thin films
- ✓ To know about the linear and nonlinear oscillations
- ✓ To have an idea of various energy sources.

Course Outcomes:

After completing the course, the students will:

- Students will be able to choose experimental problem and solve it independently.
- Design the necessary tools with a fair degree of validity and reliability.
- Understand the properties of nano materials.
- Learn the nonlinear applications.
- Understand the various energy resources.

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

Relationship Matrix for course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	22MPPH1C2	Advanced Physics					5	4			
Course Outcomes	Programme Outcomes					Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 47, Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

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TEACHING AND LEARNING SKILLS

Course: III
Course Code: 22MPPH1C3
Credit: 4

Semester: I
Max. Marks : 100
Internal Marks : 25

Objectives:

- ✓ To know the different parts of computer system and their functions
- ✓ To understand the operations and use of computers and common Accessories
- ✓ To develop different teaching skills for putting the content across to targeted audience

External Marks : 75

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.
- Understand the different types of teaching skills.

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.

Relationship Matrix for course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	22MPPH1C3	Teaching and Learning Skills					5	4			
Course Outcomes	Programme Outcomes					Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 47, Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

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