M.Phil. Physics

SEM	SUB CODE	COURSE	SUBJECT TITLE	HRS / WEEK	CREDIT	CIA Mark	SE MARK	TOTAL MARK
I	20MPPH1CC1	Core I	Research Methodology	4*	4	25	75	100
	20MPPH1CC2	Core II	Advanced Physics	4*	4	25	75	100
	20MPPH1CC3	Core III	Teaching and Learning Skills	4*	4	25	75	100
	20MPPH1CC4	Core IV	Guide Paper (Based on Research Topic)	4*	4	25	75	100
		*One hour library for each course						
	TOTAL			16*	16	100	300	400
II	20MPPH2PD		Dissertation ##	-	8	-	-	200
GRAND TOTAL				-	**24**	-	-	**600**

##Evaluation of the Dissertation and Viva Voce shall be made jointly by the Research Supervisor and the External Examiner.

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC1	Core – I	RESEARCH METHODOLOGY	4	4	100	25	75

Course Outcomes:

1. understand and identify the research problems and find their solutions

2. acquire knowledge to the preparation of research paper writing

3.acquire knowledge of hypergeometricfunctions and Data analysis

4. apply the mathematical tools learnt to physical problems

5. understand the principle, instrumentation and applications of the analytical instruments

UNIT – I: Research Problems and Methodology 12 hours

Identification of the problem – determining the mode of attack – literature survey – #usage of ENDNOTE software#- references – awareness of current status of the art – possible way of getting oneself abreast of current literature –internet – and its applications-assessing the status of the problem – guidance from the supervisor — presenting a scientific seminar-art of writing the thesis.

UNIT – II: Procedure of research paper writing 12 hours

Structure of a research paper –first page preparation–effective writing of an abstract-past and current research work –experimental materials and methods –results of the research work-discussion of research results–role of authors and co-authors -format of correct references – #good quality drawings(usage of MS EXCEL, Origin Pro)#of table and figures–understanding the method of paper submission to various journals – writing of good covering letter -procedure to write a review paper –English language and grammar checking – #plagiarism checking and related softwares#.

UNIT – III: HYPERGEOMETRIC FUNCTIONS 12 hours

Series solution of gauss hypergeometric equation – elementary properties of hypergeometric function – symmetry property – differentiation of hypergeometric function – integral representation – linear transformation of hypergeometric functions.

UNIT – IV: ERRORS AND DATA ANALYSIS 12 hours

Approximate numbers and Significant figures – Rounding of Numbers – Absolute, Relative and Percentage errors – Relation between relative error and the significant figures – The general formula for errors

Dispersion – Standard deviation and Variance – Skewness - Pearson's coefficient – Correlation – Karl Pearson's coefficient - Regression – fitting a straight line by least square method – t-test for paired observation – F-test to test of equality of two variances – chi square test – test of independent attributes

UNIT – V: ADVANCED COMPUTATION 12 hours

MATLAB Fundamentals and Applications: MATLAB basic operations- matrix operations - array operations- the colon symbol (:) - m-files- plotting commands - graph functions- x-y plots and annotations - logarithmic and polar plots - control statements - loops - IF statement - WHILE loop - INPUT/OUTPUT commands - applications of MATLAB - transient analysis – RL - RC circuits.

BOOKS FOR STUDY AND REFERENCE

1. J.Anderson ,B.H.Durston&M.Poole,Thesis and Assignment Writing ,Wiley Eastern (1997).
2. G. Vijayalakshmi and C. Sivapragasam, Research Methods (Tips and techniques) MJP publishers, Chennai (2008).
3. J. Mathews and R.L Walker, Mathematical Methods of Physics W.A. Benjamin INC (1973).
4. P.R. Vittal, Business Mathematics and Statistics, Margham publications (2006)
5. Thomas C Bartee, Digital Computer Fundamentals 6thed.Tata McGraw Hill, New Delhi (1992).
6. Internet: An Introduction, Cistern School of Computing Jaipur Tata McGraw Hill New Delhi (1999).
7. Electronic Circuit and Analysis using MATLAB, John O. Attia, CRC Press,1999.
8. Basics of MATLAB and Beyond - Andrew Knight, CRC press, 2000.
9. MATLAB Primer (7th Ed) - Timothy A. Davis & Kermit Sigmon, CRC press, 2005.
10. Essential MATLAB for Engineers and Scientists - Brian D. Hahn & Daniel T. Valentine, Elsevier Publications, 2007

Online References:

1. https://www.aje.com/arc/materials-and-methods-7-writing-tips/
2. https://wordvice.com/writing-the-results-section-for-a-research-paper/
3. https://www.scribbr.com/dissertation/discussion/
4. https://www.editage.com/insights/tips-on-effective-use-of-tables-and-figures-in-research-papers
5. https://www.ncbi.nlm.nih.gov/pubmed/19352565
6. https://www.sciencemag.org/careers/2016/09/how-review-paper
7. https://www.reverso.net/spell-checker/english-spelling-grammar/
8. https://windowsreport.com/plagiarism-software/

Semester	Code			Title of the Paper				Hours		Credits
I	20MPPH1CC1			RESEARCH METHODOLOGY				4		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔		✔	✔		✔	✔	✔	✔	✔
CO2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO3	✔		✔	✔	✔	✔		✔	✔	
CO4	✔		✔		✔	✔	✔	✔	✔	✔
CO5	✔		✔		✔	✔		✔	✔	✔
Number of Matches= 39 , Relationship : HIGH										

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

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC2	Core – II	ADVANCED PHYSICS	4	4	100	25	75

Course Outcomes:

1. acquired a foundation for advanced courses in physics, especially those involving energy and physical environment based on fundamental principles of statistical and quantum physics.
2. the ability to perform quantitative calculations on ideal systems and formulate models of more realistic systems.
3. the ability to identify and understand the kinds of experimental results which are incompatible with classical physics and thus interpret the statistical and quantum function and apply it to construct an approximate quantum mechanical models
4. learnt the framework of quantum computation, and how that may be useful for implementation of quantum computers and classify the schemes for implementation of quantum computers
5. will be able to use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanation.

Unit – I: Classical Statistics **12 hours**

Ensembles – statistical equilibrium - equipartition theorem and its application to harmonic oscillator– connection between partition function and thermodynamic quantities – properties of partition function – phase transition - phase transition of first and second kind – critical exponent – Bragg Williams approximation.

Unit – II: Quantum Statistics **12 hours**

Ideal bosons – condensation of ideal Bose gas – thermodynamic properties of B-E gas – two fluid model of He-II – ^{3}He- ^{4}He mixtures - Landau's spectrum of phonons and rotons– electrons in metals – thermionic emission – magnetic susceptibility of free electrons - white dwarfs–nuclear matter.

Unit – III: Symmetry and conservation laws **12 hours**

Symmetry transformation – translation in space: conservation of linear momentum, translation in time: conservation of energy, rotation in space: conservation of angular momentum – space inversion: parity conservation – time reversal.

Unit – IV: Elements of Field Quantization **12 hours**

Concepts of classical mechanics – classical field equation – Lagrangian form – Hamiltonian form – quantization of the field – quantization of the Schrödinger equation – Dirac field - classical theory of electromagnetic fields – quantization of electromagnetic field.

Unit – V: Quantum Computing **(12 Hours)**

Introduction to quantum computing- quantum bits (qubits) – multiple qubits – geometrical representation of a qubit (Bloch sphere)- quantum gates: single and multiple qubit gates – bell states- quantum half adder and subtractor- applications of quantum computing: teleportation – parallelism - communication – Fourier transform.

Books for Study:

1. Statistical Mechanics – Gupta and Kumar, PragatiPrakashan Educational publishers, 24th edition (2010).
2. Statistical Mechanics – B.K. Agarwal& Melvin Eisner, Newage International, Publishing, 3rd edition (2013).
3. Quantum Mechanics - G. Aruldhas, PHI Learning Private Limited 2nd edition (2009).
4. Quantum Computing - Vishal Sahni, Tata McGraw Hill, (2011).

UNIT I: Sections 1.3, 1.10, 2.12, 2.14, 3.1-4, 13.1 to 13.3, 13.6, 13.7 (T.B 1)
UNIT II:Sections6.1 to 6.7, 7.3 to 7.7 (T.B 2)
UNIT III: Sections 7.1 to 7.6 (T.B 3)
UNIT IV Sections 16.1 to 16.5, 16.8 – 16.10 (T.B 3)
UNIT V Sections1.1, 1.2, 2.2.1, 3.1, 3.2, 3.4, 3.7, 4.1, 4.2, 4.4, 5.2 (T.B 4)

References:

1. Fundamentals of Statistical and Thermal Physics – F.Reif published by Levant Books (2010).
2. Statistical Mechanics – R.K.Pathira& Paul D. Beale published by ELSEEVIER, Academic Press (2011).
3. Quantum Mechanics theory and problems, S.L.Kakani, H.M.Chandalia, Sultan Chand & Sons (2007).
4. Quantum Mechanics, N.Devanathan, Narosa Publishing House (2005).
5. Quantum Mechanics, G. Aruldhas, 7.1 – 7.6, PHI Learning Private Limited.(2018).

Online references:

1. https://web.stanford.edu/~peastman/statmech/
2. http://www2.oberlin.edu/physics/dstyer/StatMech/book.pdf
3. https://www.universityphysicstutorials.com/thermodynamics-statistical-mechanics/?v=883db7bf76f7

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

Semester	Code			Title of the Paper				Hours		Credits
I	20MPPH1CC2			ADVANCED PHYSICS				4		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔	✔		✔	✔		✔	✔	✔
CO2	✔	✔	✔			✔		✔	✔	
CO3	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO4	✔		✔		✔			✔	✔	✔
CO5	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Number of Matches= 40 , Relationship : HIGH										

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC3	Core – III	TEACHING AND LEARNING SKILLS	4	4	100	25	75

Course Outcome:

1: acquired the knowledge in principle of communication technology in teaching and learning methods
2: learnt the usage of electronic media for teaching physics principles
3: acquired the knowledge in the utilization of the online teaching in higher education
4: developed skills in Virtual Learning and usage computer network in education
5: developed the art teaching with technical aids in social media.

Unit – I: Communication Technology 12 hours

Convergence of information technology – communication policies and development – uses of communication technology – barriers of communication technology – contribution of communication technology to education and limitations.

Unit – II: Media in Physics 12 hours

Electronic media: factors influencing media selection – audio and video medium: strengths and limitations – educational television: types of formats – kinds – merits and limitations – digital library services: meaning – features – objectives – advantages and problems.

Unit – III: Online Teaching in Higher Education 12 hours

Online learning – online delivery system – multimedia in teaching-learning – computer media in education – satellite and education: communication satellite – EDUSAT – teleconferencing: organization – advantages and limitations.

Unit – IV: Virtual Learning 12 hours

Meaning – significance – virtual learning environment – elements – education through e-learning: importance – mobile learning – information and communication technology in education (ICT): factors responsible for the growth of ICT – designing, development, production and application of ICT in education.

Unit – V: Computer Networking Skills 12 hours

Meaning – significance – internet: keywords – developing internet skills – internet in education – internet services – Telnet, File Transfer Protocol (FTP) – E-mail – internet chatting – Cu-See Me – World Wide Web: Developing web-based courses – connecting to the internet.

Reference Books:

1. Eyre E C, Effective Communication, William Heinemann Ltd., London, 1979.
2. Hawkridge D, New Information Technology in Education, Croom Helm, London, 1983.
3. Rogers Everett M, Communication Technology, The New Media in Society, The Free Press, New York, 1986.
4. Schramm W, Men, Message and Media: A Look at Human Communication, Harper and Row Publ, New York, 1986.
5. Victoria L. Tinio, ICT in *Education*, ICT for DevelopmentUnited Nations Development ProgrammeBureau for Development Policy, NewYork
6. GoranaCelebic, Dario IlijaRendulic, Basic Concepts of Information and Communication Technology, handbook, *ITdesk.info*
7. David Moursund, Introduction to Information andCommunication Technology inEducation,Teacher Education, University of OregonEugene, Oregon 97405

Online Course Reference:

1. https://www.classcentral.com/course/swayam-ict-in-teaching-and-learning-17639
2. http://www.apdip.net.

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

Semester	Code			Title of the Paper				Hours		Credits
I	20MPPH1CC3			TEACHING AND LEARNING SKILLS				4		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔	✔		✔	✔		✔	✔	✔
CO2	✔	✔	✔			✔		✔	✔	
CO3	✔	✔	✔	✔		✔	✔	✔	✔	✔
CO4	✔		✔		✔			✔	✔	✔
CO5		✔	✔	✔	✔	✔	✔	✔	✔	
Number of Matches=37, Relationship : HIGH										

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC4	Core – IV	NANOSCIENCE AND ITS APPLICATIONS	4	4	100	25	75

Course Outcome:

1. have acquired knowledge in fundamental concepts and properties of nanomaterials.
2. conversant with the preparation/synthesis techniques of nanomaterials.
3. have developed skills in characterization of the nanomaterials and result analysis.
4. have equipped themselves to interpret the results and present/publish their research findings.
5. have gained knowledge in applications of nanomaterials according to the needs of the society.

Unit – I :Fundamentals Nanomaterial **12 hours**

Classification of nanomaterialsbased on dimensions and materials –Properties of nanomaterils - Effect of surface area-to-volume ratio on the properties of materials – Quantum dots – Excitons confinement in quantum dots – production and applications of quantum dots - Quantum wires – Quantum well – nanocomposites – nanoclusters and nanoparticles

Unit- II: Methods of Preparation of Nanomaterials **12 hours**

Top-Down Techniques - ball milling - combustion synthesis – Self propagating-High temperature synthesis (SHS) – solution combustion method (SCM)

Bottom-UP Techniques - Co-precipitation process/soft chemical method - Hydrothermal method – Sol-Gel synthesis

Unit -III : Fundamentals of thin films **12 hours**

Introduction - Thin film growth stages – thin film photovoltaic cells – dye sensitised solar cell (DSSCs) – Transparent Conducting Oxide (TCO) thin films – applications of TCOs – thin film deposition techniques – vacuum evaporation technique – DC sputtering – electrochemical deposition

Unit IV:Characterisation **12 hours**

Structural studies - Determination of structural parameters – crystallite size – dislocation density micro strain – XRD profile –optical studies – absorption coefficient – optical band gap -Surface morphology - Atomic Force Microscopy (AFM) –Transmission Electron Microscope (TEM) – X-ray photoelectron spectroscopy (XPS)

Unit – V: Applications **12 hours**

Photocatalytic degradation of organic pollutants in water - Organic field effect transistors (OFET) - Organic light emitting devices (OLED) -Single Electron Transistor (SET) –Biosensors – main components – nanobiosensor – nanonose – types of nanosensors – applications of nanosensors

References

1. K. Ravichandran, K. Swaminathan, P.K Praseetha and P.Kavitha, *Introduction to Nanotechnology*, Jazym Publications, 2019.

2. K. Ravichandran, K. Swaminathan, B. Sakthivel and C.Ravidhas, *Introduction to Characterisation of Nanomaterials and thin films*, Jazym Publications, 2015.

3.W. R. Fahrner (Editor), *Nanotechnology and Nanoelectronics*, Springer (India) Pvt.Ltd,2006

4. M.A.Shah and Tokeer Ahmad, *Principles of Nanoscience and Nanotechnology*, Narosa Publishing House. 2013.

5. Guzhong Cao, *Nanostructure and Nanomaterials Synthesis*, Properties and Applications, Imperial College Press, London, 2004

6. S. Shanmugam, *Nanotechnology*, mip publishers, 2011

7. book.department@intechopen.com

8. NPTEL __ Nanotechnology - Nanostructures and Nanomaterials_ Characterization and Properties [https://nptel.ac.in/courses/118104008/]

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

Semester	Code			Title of the Paper			Hours		Credits
I	20MPPH1CC4			NANOSCIENCE AND ITS APPLICATIONS			4		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2		✓	✓	✓			✓	✓		✓
CO3		✓			✓	✓		✓		✓
CO4	✓		✓		✓		✓		✓	✓
CO5	✓	✓			✓	✓	✓	✓	✓	✓
Number of Matches=35, Relationship : HIGH										

Prepared by :
1. Mr. A. Mohamed Saleem

Checked by:
Dr. M. Jamal Mohamed Jaffar

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC4	Core – IV	NONLINEAR DYNAMICS: BIFURCATIONS, CHAOS AND SYNCHRONIZATIO N	4	4	100	25	75

Course Outcomes:

1. Acquired knowledge about dynamical systems, namely discrete and continuous systems and their qualitative features such as bifurcations and chaos admitted by them.
2. Learnt to differentiate between the types of circuit elements, the circuits constructed using them, to simulate their behaviour numerically or using circuit simulators and observe them experimentally
3. Have equipped themselves to interpret the results and present/publish their research findings.
4. Have developed reasoning skills and ability to solve scientific problems which may arise.
5. Have developed a consciousness to help the problems faced by the people around them or the society at large.

Unit – I: Dynamical Systems and their Qualitative Features

Dynamical Systems-Nonlinearity and its Implications in Dynamical Systems-Linear Superposition Principle-Time Plots-Phase Plane Analysis-Classification of the Equilibrium Points of a Two Dimensional Dynamical System-Limit Cycle Motion-Periodic Attractor-Poincare-Bendixson Theorem-Torus and Chaotic behaviours.

Unit – II: Bifurcations and Onset of Chaos in Discrete Systems

Some simple Bifurcations – Saddle-Node, Pitchfork, Transcritical and Hopf Bifurcations-Logistic Map- Fixed Points and their Stability-Periodic Solutions-Period Doubling Phenomenon – Onset of Chaos-Bifurcation Diagram-Lyapunov Exponents Spectrum.

Numerical Simulation of Time Plots, Phase Portraits, Period Doubling Phenomenon, Bifurcation Diagram and Lyapunov Exponents Spectrum of a Logistic Map.

Unit – III: Bifurcations and Onset of Chaos in Time Continuous Systems

Duffing Oscillator- Fixed Points Analysis-Period Doubling Route to Chaos-Intermittency Transitions-Quasiperiodicity and Strange Non-Chaos Attractors (SNA)s, Lyapunov Exponents and Power Spectrum.

Numerical Simulation of Time Plots, Phase Portraits, Power Spectra, Period Doubling Phenomenon, Bifurcation Diagram and Lyapunov Exponents Spectrum of a Duffing Oscillator.

Unit – IV: Chaos in Nonlinear Electronic Circuits

Nonlinear Resistors- Chua's Diode, Cubic Nonlinear Resistance, Memristor-Chua's Oscillator and Murali-Lakshmanan-Chua (MLC) Circuit-Mathematical Modelling-Derivation of Circuit Equations and their Normalized Forms.

Numerical Simulation of their Dynamics-Time Plots, Phase Portraits, Power Spectra, Period Doubling Phenomenon, Bifurcation Diagram and Lyapunov Exponents Spectrum.

Unit – V: Control and Synchronization of Chaos

Algorithms for control of Chaos-Control of Chaos in Chua's Oscillator and MLC Circuit.

Synchronization of Chaos- Pecora-Caroll Method:Drive-Response Concept-Condition for Control of Chaos: Conditional Lyapunov Exponent (CLE) -Synchronization of Chaos in Chua's and MLC Oscillators.

Numerical Simulation of Control and Synchronization of Chaos in these Circuits.

References

Units I, II and III

1. M. Lakshmanan and S. Rajasekar, Nonlinear Dynamics-Integrability, Chaos and Patterns, Springer-Verlag, New Delhi,(International Students Edition),2003.

Units IV and V

1. M.Lakshmanan and K. Murali, Chaos in Nonlinear Oscillators: Controlling and Synchronization, World Scientific Co., Singapore, 1996.
2. Guo-Qung Zhong, "Implementation of Chua's Circuit with a Cubic Nonlinearity", IEEE Transactions on Circuits and Systems-I:Fundamental Theories and Applications, Vol: 41, No: 12, December 1994.
3. Leon O Chua, Memristor, "The Missing Circuit Element- IEEE Transactions on Circuit Theory", Vol CT-18, No: 5, September 1971.
4. Dmitri B. Strukov, Gregory S. Snider, Duncan R. Stewart& R. Stanley Williams, "The missing memristor found",Nature, Vol: 453,1 May, 2008.

Online Resources:

https://nptel.ac.in/courses/115/106/115106059/#

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

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
I	**20MPPH1CC4**			**NONLINEAR DYNAMICS: BIFURCATIONS, CHAOS AND SYNCHRONIZATION**				**4**		**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓		✓	✓	✓			
CO2	✓		✓			✓	✓		✓	
CO3	✓	✓	✓	✓				✓	✓	✓
CO4	✓		✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓		✓		✓	✓		✓
Number of Matches= 35, Relationship : HIGH										

Prepared by :
1. Dr. A. Ishaq Ahamed

Checked by:
Dr. M. Jamal Mohamed Jaffar

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC4	Core – IV	EXPERIMENTAL TECHNIQUES IN NUCLEAR PHYSICS	4	4	100	25	75

Course Outcomes:

1. Learned the basic principle of theoretical and experimental Nuclear Physics.
2. Enhanced their knowledge by learning the recent findings in multiple research sources.
3. Got motivation to learn the new analytical / numerical / experimental techniques to solve the identified problems.
4. Developed the communication knowledge and interpretation skill to present his findings with moral and scientific ethical values.
5. Become effective felicitations of knowledge to motivate young minds towards research with social concern.

Unit – I: A B C's of Nuclear Science **12 hours**

Nuclear Structure – Radio Activity – Alpha decay – Beta Decay – Gamma Decay – Half Life – Reactions – Fusion – Cosmic Rays – Antimatter.

Unit – II: Particle Accelerators **12 hours**

Cockcroft – Walton generator – Van De Graaf generator – betatron – cyclotron – pelletron – colliders – large Hadron Collider(LHC) – Relativistic Heavy Ion Collider (RHIC) – Circular Particle Accelerator - (Tevatron).

Unit – III: Nuclear Detectors **12 hours**

Ionisation counter – Geiger Muller tube – Spark Chamber – Proportional counter – Diamond counter – Germanium Counter – Scintillation counter – Time of flight detector – Si (Li), Ge(Li), HPGe detectors.

Unit – IV: Theory of Nuclear Reactions **12 hours**

General descriptions of Nuclear reactions – Matrix theory of Nuclear reactions – Compound Nucleus reactions – Optical model and diffraction Phenomena – Direct Nuclear reactions – Multiple diffraction scattering.

Unit – V: Experimental Techniques in Nuclear Physics **12 hours**

Radiation sources and interactions – counting statistics – general properties of radiation detectors – Gamma spectroscopy with scintillation and semiconductor detectors – Neutron detectors – detection of Charged particles – Nuclear electronics, Instrumentation and Pulse processing.

Reference:

1. D. C. Tayal, Nuclear Physics, Himalaya publishing house, 2nd edition, 2011.
2. M.L. Pandya, R.P.S. Yadav ,Elements of nuclear Physics, KedarNath Ram Nath, New Delhi, 4th edition, 2011.
3. SatyaPrakash, Nuclear & Particle Physics, Sultan Chand & Sons, New Delhi, 4th edition, 2010

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

Semester	Code	Title of the Paper	Hours	Credits
I	20MPPH1CC4	EXPERIMENTAL TECHNIQUES IN NUCLEAR PHYSICS	4	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2		✓	✓	✓			✓	✓		✓
CO3	✓		✓		✓	✓		✓	✓	✓
CO4		✓		✓			✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches= 38, Relationship : HIGH										

Prepared by :
1. Dr. N. Peer Mohamed Sathik

Checked by:
Dr. M. Jamal Mohamed Jaffar

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC4	Core – IV	LIQUID STATE PHYSICS	4	4	100	25	75

Course Outcomes:

1. Would have acquired the basic principles of molecular interactions in liquids through the concept of ultrasonic waves, understood the ultrasonic interferometer and to measure the acoustical parameter of liquids.
2. Familiarized about latest theories related to liquid mixture studies and can utilize that in laboratory.
3. Learned the concept of acoustical and thermo dynamical parameters, identify the research problems and find their solutions
4. Learned the spectroscopic instrumentation , and underlying quantum concepts of spectroscopy. Applied the mathematical tools in molecular vibrations such as DFT, molecular docking etc..
5. Motivated towards research in ultrasonics and spectroscopy. learned to measure the electrical signals from human body and analyze the recorded biopotential signals. develop a physiological assist device for monitoring and treatment proposes for society apply the ultrasonic instruments in industry.

Unit-I: Ultrasonic study of liquid mixture and solutions 12 hours

Ultrasonic study of molecular interactions – preparation of multicomponent liquid mixtures – measurement techniques – interferometer – continuous wave method – pulse echo overlap method – measurement of density and viscosity – behaviour of ultrasonic waves in pure liquids, mixtures and gases

Unit-II: Theories of ultrasonic velocity in mixtures and solutions 12 hours

Free length theory – Collision factor theory – Nomumoto's relation ideal mixing relation – Ideal mixing relation – Junjie's relation – thermodynamic theories – Flory's statistical theory – Scaled particle theory – Khusare's formulation

Unit – III: Properties of liquids and solutions 12 hours

Adiabatic compressibility – Intermolecular free length – Molar volume – Free volume – internal pressure – excess values – isentropic compressibility – error analysis – classical absorption – excess enthalpy - Gibb's free energy of activation of flow – interaction parameter – Gruneisen parameters – apparent compressibility – apparent molar volume

Unit – IV: Structure Determination 12 hours

Raman spectrometer – polarisation of Raman scattered light – molecules of type XY2 – molecules of type XY3 – molecules of type XY4 – Raman investigation of phase transitions – normal vibrations of CO_2 and H_2O molecules – Hydrogen bonding

Unit – V: Ultrasonics **12 hours**

Piezo-electric ultrasonic transducers – Magnetostrictive ultrasonic transducers – Interaction of Ultrasound with tissues – ultrasonic diathermy – ultrasonic continuous wave Doppler blood flowmeter – recording fetal heart moment using Doppler ultrasonic method – ultrasonic A-mode, B-mode and C-mode display.

Book for studies

1. Science and Technology of Ultrasonics – Balder Raj, V.Rajendran and P.Palanichamy , Narosa Publishing House, New Delhi (2004)
2. Molecular Structure and Spectroscopy – G.Aruldhas, Prentice Hall of India Ltd, New Delhi (2004)

Reference:

1. Science and technology of ultrasonics Baldev Raj, V.Rajendran, P.Palanichamy, Narosa Publishing House(2009)
2. Practical Non-Destructive Testing, Baldev Raj, T.Jayakumar, M.Thavasimuthu, Narosa Publishing House(2006)
3. Liquids and Liquid mixtures, 3rd Edition, Rowlison J.S. and Switon F.L. (Butterworth Scientific, London), (1982).
4. Biomedical Instrumentation, M.Arumugam, Anuradha Agencies(2005).
5. Thermodynamic Properties of non-electrolusic solutions,Acree,New York Academic Press, 1984.

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

Semester	Code			Title of the Paper				Hours		Credits
I	20MPPH1CC4			LIQUID STATE PHYSICS				4		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔		✓	✔	✔	✓	✔	✔	✔
CO2		✔	✔	✓		✔		✔		
CO3	✔	✔		✔	✔	✔	✔	✔	✓	✔
CO4	✓		✔	✓	✔		✓		✓	✔
CO5		✔	✔		✔	✔	✔	✔	✔	✔
Number of Matches= 38, Relationship : HIGH										

Prepared by :
1. Dr. R. Raj Muhamed

Checked by:
Dr. M. Jamal Mohamed Jaffar

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC4	Core – IV	ULTRASOUND AND ITS APPLICATIONS	4	4	100	25	75

Course Outcome:

1. Learned the basic principles of molecular interactions generally in liquids through the concept of ultrasound waves.
2. Familiarized about latest theories related to liquid mixture studies and can corporate them to your findings in laboratory.
3. Able to interpret the precise nature of molecular bondings in liquids of multiple components by studying various parameters.
4. Capable of understanding the types of the defects in solid materials and their classifications.
5. Leading the research in molecular studies of liquids and in ultrasound testing techniques.

Unit – I : Measurement techniques of ultrasound velocity 12 hours

Wave parameters and characteristics – classification of sound waves – Ultrasonic waves – pulse superposition method – pulse echo overlap method – cross correlation method – continuous wave method – Resonance ultrasound spectroscopy – Laser interferometry – comparison method – apparent method – Rayleigh surface wave method.

Unit – II : Ultrasound study of Liquid Mixtures and Solutions 12 hours

Ultrasonic study of molecular Interactions – preparation of multi component liquid mixtures – interferometer – continuous wave method – pulse echo overlap method – density – viscosity – free length theory – collision factor theory – Nomoto's relation – thermodynamic theories – scaled particle theory – Khasare's formulation.

Unit – III: Acoustical and Thermo dynamical parameters 12 hours

Acoustic impedance – relaxation time – adiabatic compressibility – Molar volume – Wada's constant – Rao's Constant – Free length – Free Volume – Internal pressure – Absorption coefficient - Molar cohesive energy - Lenard-Jones potential – Vander wall's constants – Enthalpy – Gibb's free energy – apparent molar compressibility – Apparent molar volume

Unit – IV: Ultrasound Non – Destructive Testing 12 hours

Classification of ultrasonic testing – flaw detector – different types of scans - calibration of the testing system – commonly used calibration blocks – ultrasonic inspection of welds – ultrasonic inspection of forgings – ultrasonic inspection of castings – Ultrasonic testing – advantages and disadvantages.

Unit – V: Ultrasound in Medicine 12 hours

Piezo-electric ultrasonic transducers – Magnetostrictive ultrasonic transducers – Interaction of Ultrasound with tissues – ultrasonic diathermy – ultrasonic continuous wave Doppler blood flowmeter – recording fetal heart moment using Doppler ultrasonic method – ultrasonic A-mode, B-mode and C-mode display.

Reference:

1. Science and technology of ultrasonics Baldev Raj, V.Rajendran, P.Palanichamy, Narosa Publishing House(2009)
2. Practical Non-Destructive Testing, Baldev Raj, T.Jayakumar, M.Thavasimuthu, Narosa Publishing House(2006)
3. Liquids and Liquid mixtures, 3rd Edition, Rowlison J.S. and Switon F.L. (Butterworth Scientific, London), (1982).
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Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
I	**20MPPH1CC4**			**ULTRASOUND AND ITS APPLICATIONS**				**4**		**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓	✓		✓	✓
CO2	✓	✓	✓	✓		✓	✓	✓		✓
CO3	✓		✓	✓	✓	✓		✓	✓	
CO4		✓	✓		✓		✓	✓	✓	
CO5	✓		✓	✓		✓		✓		✓
Number of Matches= 35, Relationship : HIGH										

Prepared by :
1. Mr. F.S. Muzammil

Checked by:
Dr. M. Jamal Mohamed Jaffar

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC4	Core – IV	GROWTH OF CRYSTALLINE MATERIALS	4	4	100	25	75

Course Outcome:

1. Understand the principle of various nucleation methods and nonlinear optical crystals.
2. Learn the different crystal growth methods.
3. Learn the methods of crystal growth from melt.
4. Understand the thin film techniques and apply to various fields.
5. Develop the skills to synthesis nanomaterials and analyze the materials by various optical characterization techniques.

Unit I: Introduction to crystal growth and nonlinear optics **12 hours**

Nucleation – Theories- Spherical and cylindrical nucleation - Nonlinear optics- basic concepts – First, second and third order harmonic generation- Nonlinear optical (NLO) materials- applications.

Unit II: Solution growth **12 hours**

Solution and solubility - Measurement of supersaturation - Meir's solubility diagram - Slow cooling, slow evaporation and temperature gradient methods – Gel growth - Properties of gel - U–tube and straight tube methods- Flux growth – Phases of matter – Principles of flux growth – Choice of flux.

Unit III: Melt growth **12 hours**

Different growth techniques**:** Bridgeman method – Czochralski method- Vapour growth**:** Physical vapour deposition-– Chemical vapour deposition.

Unit IV: Thin films and deposition techniques **12 hours**

Definitions and concepts - Growth of thin films - Various deposition techniques: sol-gel, spin coating, electro-deposition - spray pyrolysis, sputtering- Measurement of film thickness, structure by XRD and optical band gap - Applications of thin films in various fields.

Unit V: Nano materials and fabrication methods **12 hours**

Importance of nanomaterials - Novel techniques for synthesis of nanoparticles - Silicon Carbide, Alumina and various metal oxides - Methods of measuring properties: Scanning electron and Tunneling microscopes, Field Ion microscope, Infrared Surface Spectroscopy, Brillouin Spectroscopy and Luminescence.

Books for Study:

1. P**.** Santhana Raghavan and P**.**Ramasamy**,** 'Crystal Growth Processes and Methods'**,** KRU Publications Kumbakonam (2000).

2. J.C. Brice, “Crystal growth from solution”, North Holland publishing Co., Amsterdam, (1965).

3. R.F. Bunshah, “Handbook of deposition technologies for thin films and coatings” Noyeas Publications (2005).

4. C.P. Poole and F.J. Owens, “Introduction to Nanotechnology”, Wiley- Interscience, (2003).

Books for Reference:

1. J.W. Mullin, “Crystallization”, Butterworths, London, (1972).
2. P.Hortman, “Crystal growth an introduction”, North Holland publishing Co., Amsterdam, (1965).
3. H.K.Henish, “Crystal growth from gel”, The Pennsylvania state university, (1969).
4. P.Ramasamy, “Recent trends in Crystal growth“, ICSU- COSTED Publications, Madras, (1988).
5. B.R.Pamplin, “Crystal Growth”, Pergamon press, London, (1980).
6. D.Elwell and S.H.Scheel, “High Temperature Solution Growth“, Academic press, (1975).
7. Nanomaterials, A.K. Bandyopadhyay, New Age International Publishers, (2008).
8. Progress in Materials Science: One dimensional nanostructured materials: Satyanarayana V.N.T. Kuchibhatla, A.S. Karakoti, Debasis Bera, S. Seal, Elsevier Publications, (2007).

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

Semester	Code			Title of the Paper		Hours		Credits		
I	20MPPH1CC4			GROWTH OF CRYSTALLINE MATERIALS		4		4		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔		✔	✔		✔	✔	✔	✔	✔
CO2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO3	✔		✔	✔	✔	✔		✔	✔	
CO4	✔		✔		✔	✔	✔	✔	✔	✔
CO5	✔		✔		✔	✔		✔	✔	✔
Number of Matches= 40, Relationship : HIGH										

Prepared by :
1. Dr. A.S. Haja Hameed

Checked by:
Dr. M. Jamal Mohamed Jaffar

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPPH1CC4	Core – IV	ENERGY PHYSICS AND ITS APPLICATIONS	4	4	100	25	75

Course Outcomes:

1. Would acquired qualitative ideas about Solar energy, solar energy harvesting devices like solar cells, solar cookers.
2. Gets an idea about basic principle of various energies such as wind energy, ocean energy, geothermal energy and biomass energy and their prodcution.
3. Can evaluate and use models for nucleating and growth of thin films and asses the relation between deposition technique, film structure, and film properties for energy applications.
4. Would be able under stand and demonstrate various nucleation mechanisms, crystal growth and characterization techniques.
5. Become familiar with high energy elementary particles and gain a clear picture on statistical model of nucleus which induces them towards research.

UNIT-I: Energy Sources **12 hours**

Various forms of energy - renewable and conventional energy systems - comparison - coal, oil and natural gas - availability - merits and demerits.

Renewable energy sources - solar energy - nature of solar radiation - components - solar heaters - crop dryers - space cooling - solar ponds, solar cookers - water desalination - - merits and demerits of solar energy.

Unit II : Non-Conventional Energy Sources **12 hours**

Biomass energy - classification - biomass conversion process - gobar gas plants - wood gasification - advantages and disadvantages of biomass as energy source

Geothermal energy - wind energy - ocean thermal energy conversion (OTEC) - energy from waves and tides (Basic ideas, nature, applications, merits and demerits of these) - energy storage and hydrogen as a fuel (basics)

Unit – III: Materials in energy applications **12 hours**

Introduction – deposition technique – physical deposition method – chemical vapour deposition – sputtering – spray pyrolysis – analysis of films composition – Resistivity and conductivity measurement – four probe method – absorption and transmittance – characteristics studies – thickness measurement – Structural identification by X-ray diffraction - Photo voltaics: PN junctions. Solar cells, PV systems, photovoltaic generation basics.

Unit – IV: Nanomaterials in energy applications **12 hours**

Introduction – nanomaterials – classification of nanomaterials – synthesis of nanomaterials – chemical vapour deposition – sol gel method – laser deposition – ball milling - carbon nanotube – types of carbon nanotubes –SWNT – MWNT- applications of carbon nanotubes – characterization: TEM – AFM - STM – applications of nanomaterials in the field solar energy

Unit – V : High energy physics **12 hours**

Introduction – elementary particles – classification of elementary particles – fundamental interaction – elementary particle quantum numbers – SU(3) symmetry – CPT theorem – Gellmann Okubo mass formula – Quark structure of Hadrons and mesons – baryon magnetic moments – deep inelastic scattering of leptons –Nucleon structure function – Bjorken scaling – relation between the charged and neutral structure function – statistical model of the nucleon

References:

1. Introduction to solid state pjysics – Kittel , seventh edition, John Wiely and sons Singapore.
2. Nanotechnology, Mick Wilson et.al., Overseas press (INDIA) Ltd, New Delhi (2005)
3. A.Goswani – Thin film fundamentals, New age international (P) Ltd, New Delhi (2006)
4. Nuclear Physics - V.Devanathan, Narosa Publication , India (p) Ltd (2005)
5. Solar Energy by G.D. Rai, Ed. V, 1995.
6. Solar energy by S.P. Sukhatme, Tata McGraw-Hill Publishing Company, Ed. II, 1997.
7. Non Conventional Energy Sources, G.D. Rai, 4th Edition, 1997.

Online references:

1. https://nptel.ac.in/courses/112105050/
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113104075/lec41.pdf
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/117108047/lec36.pdf
4. https://nptel.ac.in/courses/113105025/
5. https://nptel.ac.in/courses/115103101/

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

Semester	Code	Title of the Paper	Hours	Credits
I	20MPPH1CC4	ULTRASOUND AND ITS APPLICATIONS	4	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔	✔	✔		✔	✔	✔		✔
CO2		✔	✔	✔			✔	✔	✔	
CO3	✔	✔	✔			✔	✔	✔		
CO4			✔	✔	✔			✔	✔	✔
CO5	✔		✔	✔	✔		✔	✔	✔	✔
Number of Matches= 35, Relationship : HIGH										

Prepared by :
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Checked by:
Dr. M. Jamal Mohamed Jaffar