DEPARTMENT OF PHYSICS

COURSE STRUCTURE & SYLLABI
(For the students admitted from year 2023-2024 onwards)

Programme : M.Phil. Physics

JAMAL MOHAMED COLLEGE (AUTONOMOUS)
Accredited with A++ Grade by NAAC (4th Cycle) with CGPA 3.69 out of 4.0
(Affiliated to Bharathidasan University)
TIRUCHIRAPPALLI – 620 020

M.Phil. PHYSICS

Sem	Course Code	Course Category	Course Title	Hrs / Week	Credit	CIA Mark	ESE Mark	Total Mark
I	23MPPH1CC1	Core - I	Research Methodology	4*	4	25	75	100
	23MPPH1CC2	Core - II	Advanced Physics	4*	4	25	75	100
	23MPPH1CC3	Core - III	Teaching and Learning Skills	4*	4	25	75	100
	23MPPH1CC4	Core – IV (Elective)	Paper on Topic of Research (The syllabus will be prepared by the guide and examination will be conducted by the COE)	4*	4	25	75	100
		*One hour library for each course						
			Total	**16***	**16**	**100**	**300**	**400**
II	20MPPH2PD		Dissertation #	-	8	-	200	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	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC1	Core – I	4	4	25	75	100

Course Title | **RESEARCH METHODOLOGY**

SYLLABUS

Unit	Contents	Hours
I	**Research Problems and Methodology:** 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	**12**
II	**Procedure of research paper writing:** 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#.	**12**
III	**Hypergeometric Functions** Series solution of gauss hypergeometric equation – elementary properties of hypergeometric function – *symmetry property* – differentiation of hypergeometric function – integral representation – linear transformation of hypergeometric functions.	**12**
IV	**Errors and Data Analysis:** 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	**12**
V	**Advanced Computation:** **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.	**12**

……. Self Study

Text Book(s):

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).

Reference Book(s):

1. Internet: An Introduction, Cistern School of Computing Jaipur Tata McGraw Hill New Delhi (1999).
2. Electronic Circuit and Analysis using MATLAB, John O. Attia, CRC Press,1999.
3. Basics of MATLAB and Beyond - Andrew Knight, CRC press, 2000.
4. MATLAB Primer (7th Ed) - Timothy A. Davis & Kermit Sigmon, CRC press, 2005.
5. Essential MATLAB for Engineers and Scientists - Brian D. Hahn & Daniel T. Valentine, Elsevier Publications, 2007

Web Resource(s):

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/

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	explain the principle, instrumentation and applications of the analytical instruments	**K1 &K2**
CO2	identify the research problems and find their solutions	**K3**
CO3	preparethe research paper writing	**K4**
CO4	applythemathematicaltoolslearnt to physicalproblems	**K5**
CO5	solve hypergeometricfunctions and Data analysis	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	**3**	2	**2**	**2**	**2**	**2**	**2**	**3**	**1**	**1**	**2.0**
CO2	**1**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**1**	**2.2**
CO3	**1**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**1**	**2.0**
CO4	**2**	**2**	**2**	**1**	**3**	**1**	**2**	**2**	**3**	**1**	**1.9**
CO5	**1**	**2**	**3**	**2**	**1**	**2**	**3**	**2**	**2**	**1**	**1.9**
										Mean Overall Score	**2.0**
										Correlation	**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. A.S. Haja Hameed & Dr. C. Hariharan

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC2	CORE – II	4	4	25	75	100

Course Title	ADVANCED PHYSICS

SYLLABUS

Unit	Contents	Hours
I	**Classical Statistics :** 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	12
II	**Quantum Statistics :** 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.	12
III	**Symmetry and conservation laws :** 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*	12
IV	**Elements of Field Quantization:** 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	12
V	**Quantum Computing:** 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	12

……. Self Study

Text Book(s):

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).

Reference Book(s):

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).

Web Resource(s):

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

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	explain the energy and physical environment based on fundamental principles of statistical and quantum physics.	**K1 &K2**
CO2	identify and understand the kinds of experimental results which are	**K3**
CO3	incompatible with classical physics and thus interpret the statistical and quantum function and apply it to construct an approximate quantum mechanical models	**K4**
CO4	learn 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	**K5**
CO5	use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanation	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	3	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2.3**
CO2	**3**	2	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2.2**
CO3	**2**	2	**2**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**2.3**
CO4	**2**	3	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2.3**
CO5	**1**	2	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2.1**
										Mean Overall Score	**2.24**
										Correlation	**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator :

1. Dr. A.S. HajaHameed
2. Dr.C.Hariharan

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC3	CORE – III	4	4	25	75	100

Course Title	TEACHING AND LEARNING SKILLS

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Communication Technology** Convergence of information technology – communication policies and development – *uses of communication technology* – barriers of communication technology – contribution of communication technology to education and limitations.	**12**
II	**Media in Physics** 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*.	**12**
III	**Online Teaching in Higher Education** Online learning – online delivery system – multimedia in teaching-learning – computer media in education – satellite and education: communication satellite – EDUSAT – teleconferencing: organization – *advantages and limitations*.	**12**
IV	**Virtual Learning** 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	**12**
V	**Computer Networking Skills** 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.	**12**

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Text Book(s):

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.

Reference Book(s):

1. Victoria L. Tinio, ICT in *Education*, ICT for DevelopmentUnited Nations Development ProgrammeBureau for Development Policy, NewYork
2. GoranaCelebic, Dario IlijaRendulic, Basic Concepts of Information and Communication Technology, handbook, *ITdesk.info*
3. David Moursund, Introduction to Information andCommunication Technology inEducation,Teacher Education, University of OregonEugene, Oregon 97405

Web Resource(s):

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

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	explain the principle of communication technology in teaching and learning methods	**K1 &K2**
CO2	use of electronic media for teaching physics principles	**K3**
CO3	utilization of the online teaching in higher education	**K4**
CO4	develope skills in Virtual Learning and usage computer network in education	**K5**
CO5	develope the art teaching with technical aids in social media.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	2	2	2	3	2	2	3	2.3
CO2	2	2	2	2	2	2	3	2	3	2	2.2
CO3	3	2	3	2	2	3	2	3	3	3	2.2
CO4	3	2	3	3	2	3	2	3	2	2	2.5
CO5	2	2	3	2	3	2	3	2	2	3	2.5
Mean Overall Score											2.34
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Coordinator :

1. Dr. A. Mohamed Saleem
2. Dr. R. Raj Mohamed

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC4	CORE - IV	4	4	25	75	100

Course Title	NONLINEAR DYNAMICS: BIFURCATIONS, CHAOS AND SYNCHRONIZATION

SYLLABUS

Unit	Contents	Hours
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.	12
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.	12
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.	12
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.	12
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-CarollMethod: 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.	12

…… Self Study

Text Book(s):

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.

Reference Book(s):

1. Guo-QungZhong, “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.
2. Leon O Chua, Memristor, “The Missing Circuit Element- IEEE Transactions on Circuit Theory”, Vol CT-18, No: 5, September 1971.
3. Dmitri B. Strukov, Gregory S. Snider, Duncan R. Stewart& R. Stanley Williams, “The missing memristorfound”,Nature, Vol: 453,1 May, 2008.

Web Resource(s):

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

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	explain dynamical systems, namely discrete and continuous systems and their qualitative features such as bifurcations and chaos admitted by them.	**K1&K2**
CO2	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	**K3&K4**
CO3	equip themselves to interpret the results and present/publish their research findings	**K5**
CO4	develop reasoning skills and ability to solve scientific problems which may arise	**K6**
CO5	develop a consciousness to help in the solutions of the problems faced by the people around them or the society at large.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	2	2	3	3	2	2	2	2.3
CO2	3	2	2	2	2	2	3	2	2	2	2.2
CO3	2	2	3	2	2	2	2	2	3	3	2.3
CO4	2	2	3	2	3	2	2	2	3	3	2.4
CO5	3	2	3	2	2	2	3	3	2	2	2.4
										Mean Overall Score	2.32
										Correlation	Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Coordinator :

1. Dr. A. IshaqAhamed

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC4	CORE IV	4	4	25	75	100

Course Title	NUCLEAR PHYSICS

SYLLABUS		
Unit	**Contents**	**Hours**
I	**A B C's of Nuclear Science** Nuclear Structure – Radio Activity – Alpha decay – Beta Decay – Gamma Decay – Half Life – Reactions – Fusion – Cosmic Rays – Antimatter.	**12**
II	**Particle Accelerators** Cockcroft – Walton generator – Van De Graaf generator – betatron – cyclotron – pelletron – colliders – large Hadron Collider(LHC) – Relativistic Heavy Ion Collider (RHIC) – Circular Particle Accelerator - (Tevatron).	**12**
III	**Nuclear Detectors** 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.	**12**
IV	**Theory of Nuclear Reactions** General descriptions of Nuclear reactions – Matrix theory of Nuclear reactions – Compound Nucleus reactions – Optical model and diffraction Phenomena – Direct Nuclear reactions – Multiple diffraction scattering.	**12**
V	**Experimental Techniques in Nuclear Physics** 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.	**12**

Text Book(s):

D. C. Tayal, Nuclear Physics, Himalaya publishing house, 2nd edition, 2011.

Reference Book(s):

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

Web Resource(s):

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	explain the basic principle of theoretical and experimental Nuclear Physics.	**K1&K2**
CO2	enhance their knowledge by learning the recent findings in multiple research sources.	**K3**
CO3	get motivation to learn the new analytical / numerical / experimental techniques to solve the identified problems.	**K4**
CO4	develop the communication knowledge and interpretation skill to present his findings with moral and scientific ethical values.	**K5**
CO5	become effective felicitations of knowledge to motivate young minds towards research with social concern.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2.2**
CO2	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**2.3**
CO3	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**2.4**
CO4	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2.2**
CO5	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**2.3**
Mean Overall Score											**2.28**
Correlation											**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Coordinator :

1. Dr. N. Peer Mohamed Sathik

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC4	CORE IV	4	4	25	75	100

Course Title	LIQUID STATE PHYSICS

SYLLABUS

Unit	Contents	Hours
I	**Ultrasonic study of liquid mixture and solutions** 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	**12**
II	**Theories of ultrasonic velocity in mixtures and solutions** 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	**12**
III	**Properties of liquids and solutions** 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	**12**
IV	**Structure Determination** 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	**12**
V	**Unit – V: Ultrasonics** 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.	**12**

Text Book(s):

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 Book(s):

1. Science and technology of ultrasonicsBaldev 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, AnuradhaAgencies(2005).
5. Thermodynamic Properties of non-electrolusicsolutions,Acree,New York Academic Press, 1984.

Web Resource(s):

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

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	explain 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.	**K1&K2**
CO2	applylatest theories which related to liquid mixture studies in laboratory.	**K3**
CO3	use the acoustical and thermo dynamical parameters and identify the research problems to find their solutions	**K3**
CO4	equipthe spectroscopic instrumentation, and underlying quantum concepts of spectroscopy. Applied the mathematical tools in molecular vibrations such as DFT, molecular docking etc.	**K4 &K5**
CO5	motivate 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.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	3	2	3	3	2	2.3
CO2	2	2	3	3	2	2	3	2	2	3	2.3
CO3	2	2	2	2	2	3	2	2	2	2	2.1
CO4	2	2	2	2	2	2	2	2	3	2	2.1
CO5	2	3	3	2	3	2	2	2	3	3	2.5
Mean Overall Score											2.26
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator :

1. Dr. R. Raj Muhamed

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC4	CORE IV	4	4	25	75	100

Course Title	GROWTH OF CRYSTALLINE MATERIALS

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Introduction to crystal growth and nonlinear optics** Nucleation – Theories- Spherical and cylindrical nucleation - Nonlinear optics- basic concepts – First, second and third order harmonic generation- Nonlinear optical (NLO) materials- applications.	**12**
II	**Solution growth** 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.	**12**
III	**Melt growth** Different growth techniques**:** Bridgeman method – Czochralski method- Vapour growth**:** Physical vapour deposition-– Chemical vapour deposition.	**12**
IV	**Thin films and deposition techniques** Definitions and concepts - Growth of thin films - Various deposition techniques: s gel, spin coating, electro-deposition - spray pyrolysis, sputtering- Measurement film thickness, structure by XRD and optical band gap - Applications of thin films various fields.	**12**
V	**Nano materials and fabrication methods** 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.	**12**

Text Book(s):

1. P**.** SanthanaRaghavanandP**.**Ramasamy**,** 'Crystal Growth ProcessesandMethods'**,** 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 Publicatio (2005).
4. C.P. Poole and F.J. Owens, "Introduction to Nanotechnology", Wiley- Interscience, (2003).

Reference Book(s):

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, DebasisBera, S. Seal, Elsevier Publications, (2007).

Web Resource(s):

1. https://acadpubl.eu/hub/2018-119-12/articles/2/489.pdf

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	explainthe principle of various nucleation methods and nonlinear optical crystals.	**K1&K2**
CO2	apply the different crystal growth methods	**K3**
CO3	analysethe methods of crystal growth from melt.	**K4**
CO4	interpretthe thin film techniques and apply to various fields.	**K5**
CO5	develop the skills to synthesis nanomaterials and analyze the materials by various optical characterization techniques.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**2**	**2.4**
CO2	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2.3**
CO3	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2.3**
CO4	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**2.5**
CO5	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2.3**
Mean Overall Score											**2.36**
Correlation											**Mdium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Coordinator :

1. Dr. A.S. Hajan Hameed

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC4	CORE IV	4	4	25	75	100

Course Title	LIQUID STATE PHYSICS

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Ultrasonic study of liquid mixture and solutions** 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	**12**
II	**Theories of ultrasonic velocity in mixtures and solutions** 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	**12**
III	**Properties of liquids and solutions** 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	**12**
IV	**Structure Determination** Raman spectrometer – polarisation of Raman scattered light – molecules of type XY – molecules of type XY3 – molecules of type XY4 – Raman investigation of pha transitions – normal vibrations of CO_2 and H_2O molecules – Hydrogen bonding	**12**
V	**Ultrasound in Medicines** 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.	**12**

Text Book(s):

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 Book(s):

1. Science and technology of ultrasonicsBaldev 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, AnuradhaAgencies(2005).
5. Thermodynamic Properties of non-electrolusicsolutions,Acree,New York Academic Press, 1984.

Web Resource(s):

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

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	explain 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.	**K1 & K2**
CO2	apply the latest theories related to liquid mixture studies in laboratory for characterization	**K3**
CO3	explain concept of acoustical and thermo dynamical parameters, identify the research problems and find their solutions	**K4**
CO4	implement the spectroscopic instrumentation, and underlying quantum concepts of spectroscopy. Applied the mathematical tools in molecular vibrations such as DFT,molecular docking etc.	**K5**
CO5	motivate 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.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	2	2	3	3	2	2	2	**2.3**
CO2	2	3	2	2	3	2	2	3	3	3	**2.4**
CO3	3	2	2	2	2	3	3	2	2	2	**2.3**
CO4	2	3	2	3	2	2	2	3	3	3	**2.5**
CO5	3	2	3	3	2	2	3	3	2	3	**2.4**
										Mean Overall Score	**2.38**
										Correlation	**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Coordinator :

1. Dr. S. Abbas Manthiri

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPPH1CC4	CORE IV	4	4	25	75	100

Course Title	ENERGY PHYSICS AND ITS APPLICATIONS

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Energy Sources** 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.	**12**
II	**Non-Conventional Energy Sources** 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)	**12**
III	**Materials in energy applications** 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.	**12**
IV	**Nanomaterials in energy applications** Introduction – nanomaterials – classification of nanomaterials – synthesis nanomaterials – chemical vapour deposition – sol gel method – laser deposition – b milling - carbon nanotube – types of carbon nanotubes –SWNT – MWN applications of carbon nanotubes – characterization: TEM – AFM - STM applications of nanomaterials in the field solar energy	**12**
V	**High energy physics** 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	**12**

Text Book(s):

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)

Reference Book(s):

1. A.Goswani – Thin film fundamentals, New age international (P) Ltd, New Delhi (2006)
2. Nuclear Physics - V.Devanathan, Narosa Publication , India (p) Ltd (2005)
3. Solar Energy by G.D. Rai, Ed. V, 1995.
4. Solar energy by S.P. Sukhatme, Tata McGraw-Hill Publishing Company, Ed. II, 1997.
5. Non Conventional Energy Sources, G.D. Rai, 4th Edition, 1997.

Web Resource(s):

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/

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	explain qualitative ideas about Solar energy, solar energy harvesting devices like solar cells, solar cookers.	**K1 &K2**
CO2	apply the basic principle of various energies to generate such as wind energy, ocean energy, geothermal energy and biomass energy and their production.	**K3**
CO3	interpret high energy elementary particles and statistical model of nucleus which induces them towards research.	**K4**
CO4	demonstrate various nucleation mechanisms, crystal growth and characterization techniques.	**K5**
CO5	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.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	2	2	2	2	2	2	2	2.1
CO2	2	2	3	3	3	2	3	2	3	2	2.5
CO3	2	2	3	2	2	3	2	2	2	2	2.2
CO4	2	3	2	3	2	2	2	2	3	2	2.3
CO5	2	2	3	2	2	2	2	3	2	3	2.3
Mean Overall Score											2.32
Correlation											Mdium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator :

1. Dr.C.Hariharan