M.Phil Physics Course Structure under CBCS

(For the candidate admitted from the academic year 2017-2018 onwards)

SEM	SUB CODE	COURSE	SUBJECT TITLE	HRS / WEEK	CREDIT	CIA Mark	SE MARK	TOTAL MARK
I	17MPPH1C1	CORE I	Research Methodology	4*	4	40	60	100
	17MPPH1C2	CORE II	Advanced Topics in Physics	4*	4	40	60	100
	17MPPH1C3	CORE III	Guide Paper (Based on Research Topic)	4*	4	40	60	100
	17MPPH1C4	CORE IV	Teaching & Learning Methodology	4*	4	40	60	100
		*One hour library for each course						
	TOTAL			16	16	100	300	400
II	17MPPH2PW		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.

Core Course – I

Research Methodology

Sub.Code: 17MPPH1C1

RESEARCH METHODOLOGY

Course Code : 17MPPH1C1 | **Max. Marks : 100**
Hours / Week : 4 | **Internal Marks : 40**
Credit : 4 | **External Marks : 60**

Objectives:

- To understand the identification, literature survey of research problems. Usage of internet in accessing research information and publishing the thesis write-ups. The presentation of research ideas in scientific seminars and to develop the art of writing the thesis.
- To study hyper geometric functions, statistical descriptions of data.
- To learn advanced computing and advanced analytical techniques.

UNIT – I: WORKING ON A RESEARCH PROBLEM (12 Hours)

Identification of the Problem – Determining the Mode of Attack – Literature Survey – Reference – Awareness of current status of the art –Abstraction of a Research Paper – possible way of getting oneself abreast of Current Literature –Internet – And Its applications-Assessing the status of the problem – Guidance from the supervisor – Actual investigation –Results and conclusions – Presenting a scientific seminar –Art of Writing the Thesis.

UNIT – II: 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 – III: DATA ANALYSIS (12 Hours)

Introduction –Statistical description of data – mean, variance, skewness, median, mode - Distributions: Binomial distribution – Gaussian distribution - Student's T-test, F-test, Chi-square test - Modeling data: Least squares, fitting data.

UNIT – IV: ADVANCED COMPUTATION (12 Hours)

Symbolic Manipulation using MAPLE: Introduction to Maple – symbolic computation – basic programming constructs: The assignment statement – conditional statement – recursive programming – basic data structures – expressions – procedures – computing with symbolic parameters – roots of polynomial and its plots – examples – programming with Maple graphics – evaluation rules – nested procedures – debugging Maple programs – solving differential equation (symbolic manipulation by a single command)

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 Statements - WHILE loop - INPUT/OUTPUT Commands - Applications of MATLAB - Transient analysis – RL - RC circuits.

UNIT – V: ADVANCED ANALYTICAL TECHNIQUES (12 Hours)

Single crystal and Powder diffraction- Diffractrometers- FT-IR, Raman and UV-Visible spectrometers –Photo luminescence –Light, Matter interaction –Photo reflectance –Electronic transitions –Analytical technique –principles of SEM, EDAX, EPMA –Instrumentation –Sample preparation.

BOOKS FOR STUDY AND REFERENCE

1. J.Anderson ,B.H.Durston &M.Poole,Thesis and assignment writing ,Wiley Eastern (1997).
2. Rajamal.P.A Devadas, A. Hand book of methodology of research,R.M.M vidyalaya press.
3. J.mathews and R.L Walker, Mathematical methods of physics W.A. Benjamin INC (1973).
4. L.A.Pipes and L.R.Harwil, Applied Mathematics for Engineers and Physicists McGraw Hill(1997).
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. Maple – Learning guide, Waterloo Maple Inc, Canada.(2001)
8. Maple – Programming guide, M.S. Mogan et.al., - Waterloo Maple Inc (2001)
9. Maple for scientists and engineers, R.H.Enns and G.Mc Guire Birkauser (1997)
10. Electronic circuit and analysis using MATLAB, John O. Attia, CRC Press,1999.
11. Basics of MATLAB and Beyond - Andrew Knight, CRC press, 2000.
12. MATLAB Primer (7th Ed) - Timothy A. Davis & Kermit Sigmon, CRC press, 2005.
13. Essential MATLAB for Engineers and Scientists - Brian D. Hahn & Daniel T. Valentine, Elsevier Publications, 2007

Core Course – II

Advanced Studies in Physics

Sub.Code: 17MPPH1C2

ADVANCED STUDIES IN PHYSICS

Course Code : 17MPPH1C2 | **Max. Marks : 100**
Hours / Week : 4 | **Internal Marks : 40**
Credit : 4 | **External Marks : 60**

Objectives:

- To have a knowledge in advanced concepts of classical and quantum statistics
- To study Relativistic the theories of Wave Equations and Elements of Field Quantization
- To learn the concepts of Quantum computing

Unit – I: Classical Statistics (12 Hours)

Statistical equilibrium – micro canonical ensemble – Partition functions and their properties – Calculation of thermodynamic quantities – validity of classical approximation - Equipartition theory and its applications – Phase transformation of a simple substance - Entropy and probability – statistical equilibrium of free electrons in semiconductors – phase transitions – theory of critical phenomena.

Unit – II: Quantum Statistics (12 Hours)

Ideal Bosons – Condensation of ideal Bose gas – Thermodynamic properties of B-E gas – twofluid model for He-II – Landau's spectrum of Phonons and Rotons – The field of sound waves - Fermions – thermodynamics of black body Radiation – electrons in metals – White dwarfs–nuclear matter – Ultracold atomic Fermi gases – Statistical mode of the atom.

Unit – III: Relativistic Wave Equations (12 Hours)

Covariant notation – covariance of Dirac equation - Relativistic invariance of Dirac equation – Lorentz transformation operator – Demonstration of the relativistic invariance – The parity operation – Charge conjugation – time reversal operation - Feynman's theory of positrons.

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 – system of Bosons – Creation and Annihilation operators – system of Fermions – Relativistic fields – the Klein-Gordon field – The Dirac 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 Qubit gates – Multiple Qubit gates – Bell states- Quantum half adder and subtractor- Applications of quantum computing: Quantum teleportation – Quantum Parallelism – Superdense coding – Quantum communication – Shor's algorithm – Quantum Fourier Transform.

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. Statistical Mechanics – B.K. Agarwal & Melvin Eisner, Newage publishing (2007).
4. Quantum Mechanics theory and problems, S.L.Kakani, H.M.Chandalia, Sultan Chand & Sons (2007).
5. Quantum Mechanics, N.Devanathan, Narosa Publishing House (2005).
6. Quantum Mechanics, G. Aruldhas, PHI Learning Private Limited.(2009).
7. Quantum Computing, Vishal Sahni, Tata McGraw Hill, 2007.

Core Course – III

Research topics in Physics

ULTRASONICS AND ITS APPLICATIONS

(Guide: Dr. M. JAMAL MOHAMED JAFFAR)

Course Code	**: 17MPPH1C3**	**Max. Marks**	**: 100**
Hours / Week	**: 4**	**Internal Marks**	**: 40**
Credit	**: 4**	**External Marks**	**: 60**

Objectives:

- To learn the measurement techniques of ultrasound velocity
- To understand the ultrasound study of liquid mixtures and Solutions
- To study the concepts of acoustical and thermo dynamical parameters
- To know the applications of Ultrasound in medicine and Non – Destructive Testing on liquid samples.

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: Ultrasound in Diagnosis (12 Hours)

Ultrasound blood flow meter – ultrasonic Doppler blood flowmeter – Doppler flowmeter using continuous waves – recording foetal heart movements and blood circulation using Doopler ultrasound method

Unit – V: Ultrascan (12 Hours)

A mode – B mode – M mode – recording devices – ultrasonic imaging instrumentation – digital real time ultrasonic scanner – applications of ultrascan in medicine and limitations

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.

NANOSCIENCE AND ITS APPLICATIONS

(Guide: Mr. A. Mohamed Saleem)

Course Code : 17MPPH1C3 | **Max. Marks : 100**
Hours / Week : 4 | **Internal Marks : 40**
Credit : 4 | **External Marks : 60**

Objectives:

- To study about the nanomaterials.
- To Learn advancement in preparation and characterisation of new materials.
- To know the uses of nanoscience in various fields

Unit - I: Fundamentals of Nanomaterials (12 Hours)

Nanomaterials - basis of nanomaterials - four generations of Nanotechnology – classification -Properties of nanomaterials: variation of physical properties with size - Mechanical properties – optical properties – Electrical properties - magnetic properties – Electrochemical properties – Chemical sensing properties.

Unit – II: Growth Techniques of Nanomaterials (12 Hours)

Top-down Vs bottom-up technique – Lithographic process and its limitations – Non lithographic techniques: Sputtering – thermal evaporation – chemical vapour deposition – pulsed laser deposition – molecular beam epitaxy – Sol-Gel technique – Electrodeposition

Unit – III: Characterisation of Nanomaterials (12 Hours)

Determination of grain size using X-ray line broadening studies (Scherrer's formula) - X-ray photo electron spectroscopy (XPS) - Confocal Microscopy (CM) – Atomic Force Microscope – STM - TEM.

Method Sample preparation: Chemical fixation – dehydration – chemical etching – Ion etching – conductive coating

Unit – IV: Quantum dots and Quantum Wells (12 Hours)

Growth of quantum dots – basics of semiconductor quantum dots – carrier relaxation in quantum dots – optical spectroscopy of single and multiple quantum dots – basics of metal quantum dots and their applications.

Infinite deep square wells – parabolic wells –triangular wells –sub band formation in low dimensional system –occupation of sub bands –quantum wells in hetero-structures – basics of tunneling transport.

Unit – V : Applications of Nanomaterials (12 Hours)

Nano electronics: Single electron transistor - Nanomaterials in medicine – Energy sector – High energy density batteries – Phosphors for HDTV – Catalysis – High sensitivity sensors – Water purification – Food – Fabric industry – Environment .

Book for Reference:

1. K.K. Chattopadhyay and A.N. Banerjee, *Introduction to Nanoscience and Nanotechnology*, PHI Learning Private Limited, New Delhi, 2012
2. M.A.Shah and Tokeer Ahmad, *Principles of Nanoscience and Nanotechnology*, Narosa Publishing House. 2013
3. Charless P.Poole, Jr., Frank J.Owens, *Intoduction to nanotechnology*, Wiley India(P) Ltd..,2015.
4. T.Pradeep, *Nano the Essentials Under standing Nanoscience and Nanotechnology*, Tata McGraw-Hill Publishig Company Limited,New Delhi, 2009
5. BS Murty etal, *Text Book of Nanoscience and Nanotechnology*, Universities Press-IIM, 2013

Experimental Techniques in Nuclear Physics
(Guide: Dr. N. Peer Mohamed Sathik)

Course Code : 17MPPH1C3	**Max. Marks : 100**
Hours / Week : 4	**Internal Marks : 40**
Credit : 4	**External Marks : 60**

Objectives:

- To enhance the experimental ideas in nuclear science and to study the theory of Nuclear Reactions

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

NON LINEAR DYNAMICS: INTEGRABILITY, SOLITONS AND CHAOS
(Guide: Dr. R. Radhakrishnan)

Course Code : 17MPPH1C3 | **Max. Marks : 100**
Hours / Week : 4 | **Internal Marks : 40**
Credit : 4 | **External Marks : 60**

Objectives:

- To understand the concepts of nonlinear dynamics and to practice the problems of integrability, solitons and chaos.

Unit – I: Linear and Nonlinear Oscillators **(12 Hours)**

Damped and driven linear and nonlinear oscillators – Autonomous and nonautonomous systems – Classification of equilibrium points:- Two-dimensional case – Chaos in dissipative nonlinear oscillator:-Example:-Duffing and van der Pol oscillators – Chaotic dynamics of the electronic analog simulation of the Duffing oscillator – Lyapunov exponents.

Unit – II: Painlevé analysis and the Integrability **(12 Hours)**

The notion of integrability – How to detect integrability – Painlevé analysis – Classification of singular points – Historical development of the Painlevé analysis – The Painlevé analysis for partial differential equations – Detecting the integrable properties of the nonlinear Schrödinger(NLS) equation by using the Painlevé analysis.

Unit – III: Linear and Nonlinear waves **(12 Hours)**

Linear dispersive wave propagation:- Fourier Transform analysis – Nonlinear waves – Cnoidal and Solitary wave solutions of the Korteweg – de Vries(K-dV) Equation – FPU numerical experiments – Recurrence Phenomenon – The Numerical experiments of Zabusky and Kruscal – the birth of Soliton – Solitons in Optics.

Unit – IV: Hirota's Method and Scalar Optical Solitons **(12 Hours)**

Hirota's direct bilinearisation method – Nonlinear pulse propagation in SiO_2 and NLS equation – Optical soliton solution of the NLS equation with the positive and Negative Nonlinearity – soliton interaction in the negative Kerr media – Application of solitons in the fiber communication.

Unit – V: Vector Optical Soliton **(12 Hours)**

Inadequacy of NLS equation – Vector optical Soliton – Manakov model – Bright vector optical solitons and their collision dynamics – Asymptotic analysis – application of Bright vector optical soliton in the optical computation.

References:

1. Nonlinear dynamics, Integrability, chaos and patterns, M. Lakshmanan and S. Rajasekar, Springer – Verlag(2003)
2. Solitons, Nonlinear Evolution equations and inverse scattering , M. J. Abolwitz and P. A. Clarkson, Cambridge University Press, Cambridge.
3. Applications of Nonlinear fiber optics, Govind P. Agrawal, Academic Press, Newyork (1989).
4. Solitons: Nonlinear Pulses and Beams, Nail N.Akhmediev and Adrian Ankiewicz, CHAPMAN & HALL, London (1997).
5. Nonlinear Optics, Robert W. Boyd, Academic Press, Newyork.
6. R.Radhakrishnan, M. Lakshmanan and J. Hietarinta 1997 Phys. Rev. E 56 2213; R.Radhakrishnan, P. T. Dinda and G. Millot 2004 Phys. Rev. E 69 046607
7. Jakubowski.M.H.,Steiglitz.K and Squier.R 1998 Phys.Rev. E 586752

LIQUID STATE PHYSICS

(Guide: Dr. R. Raj Mohamed)

Course Code	**: 17MPPH1C3**	**Max. Marks**	**: 100**
Hours / Week	**: 4**	**Internal Marks**	**: 40**
Credit	**: 4**	**External Marks**	**: 60**

Objectives:

- To learn the measurement techniques of ultrasound velocity
- To understand the ultrasound study of liquid mixtures and Solutions
- To study the concepts of acoustical and thermo dynamical parameters
- To know the applications of Ultrasound in medicine and Non – Destructive Testing on liquid samples.

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.

ULTRASOUND AND ITS APPLICATIONS

(Guide: Mr. F.S. Muzammil)

Course Code : 17MPPH1C3	**Max. Marks : 100**
Hours / Week : 4	**Internal Marks : 40**
Credit : 4	**External Marks : 60**

Objectives:

- To learn the measurement techniques of ultrasound velocity
- To understand the ultrasound study of liquid mixtures and Solutions
- To study the concepts of acoustical and thermo dynamical parameters
- To know the applications of Ultrasound in medicine and Non – Destructive Testing on liquid samples.

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).

4. Biomedical Instrumentation, M.Arumugam, Anuradha Agencies(2005).

5. Thermodynamic Properties of non-electrolusic solutions,Acree,New York Academic Press, 1984.

LASERS AND NANOMATERIALS IN MEDICAL APPLICATIONS

(Guide: Dr. J. Ebenezar)

Course Code	**: 17MPPH1C3**	**Max. Marks**	**: 100**
Hours / Week	**: 4**	**Internal Marks**	**: 40**
Credit	**: 4**	**External Marks**	**: 60**

Objectives:

- To learn the theory of Lasers.
- To study, the working mechanism and medical applications of Lasers.
- To understand the concepts of nano materials, quantum dots and their analyzing techniques.

Unit – I: LASER THEORY AND MEDICAL LASERS (12 Hours)

Fundamentals of Laser action - Einstein's relations - Conditions for large stimulated emission - Different types of pumping - Three level and four level pumping schemes; - Lasers Rate Equations: Three level and four level laser system; Medical Lasers: Nd-YAG, Ar-Ion, and Excimer lasers.

Unit – II: LASER-TISSUE INTERACTION (12 Hours)

Laser tissue interaction: Photophysical and photobiological processes; - Analysis of different Interactions: Photothermal - Photochemical - Electromechanical - Photoablative processes. Tissue optics: Measurement of optical properties of tissues using integrating sphere methods.

Unit – III: LASERS IN DIAGNOSIS AND THERAPY (12 Hour)

Principle and theory of Fluorescence - Different techniques for cancer detection: Laser-induced fluorescence (LIF), Diffuse reflectance spectroscopy (DRS) and Laser-Raman spectroscopy. Cancer treatment: Photodynamic therapy (PDT) - Principle and mechanism of PDT.

Unit – IV: NANOMATERIALS AND ITS ANALYSING TECHNIQUES (12 Hours)

Basics of nanomaterials – size dependent properties of nanomaterials – surface effects of nanomaterials – synthesis techniques of nanomaterials: Co-precipitation, Sol-gel, Hydrothermal and High energy Ball Milling – Characterization of nanomaterials: Instrumentation and principle of particle size determination by XRD, X-ray photo electron spectroscopy (XPS), Atomic Force Microscopy (AFM) and TEM.

Unit – V : QUANTUM DOTS **(12 Hours)**

Fundamentals of quantum dots –Quantum structures - Quantum confinement – Quantum wires – Quantum wells – Preparation of quantum dots by lithography, colloidal and plasma methods – Applications: LED - Cellular imaging - Tumor targeting.

REFERENCES:

1. William T. Silvast, "Laser Fundamentals", 2nd Edition, Cambridge University Press, New Delhi, 2004.
2. K. Thyagarajan and A.K. Ghatak, "Lasers Theory and Applications", Macmillan India Ltd., 2007.
3. S. Svanberg, "Atomic and Molecular Spectroscopy-Basic aspects and practical applications", 4th Edition Springer-Verlag Berlin Heidelberg, 2007.
4. Markolf H. Niemz, "Laser-Tissue Interactions-Fundamentals and Applications", Springer-Verlag Berlin Heidelberg, 1996.
5. M.A.Shah and Tokeer Ahmad, *Principles of Nanoscience and Nanotechnology*, Narosa Publishing House. 2013
6. Charless P.Poole, Jr., Frank J.Owens, *Intoduction to nanotechnology*, Wiley India(P) Ltd..,2015.
7. S. Shanmugam, "Nanotechnology", MJP Publishers, Chennai, 2010.
8. B. Viswanathan, "Nanomaterials" Narosa Publishing house, Chennai, 2010.
9. T. Pradeep, "NANO: The Essentials-Understanding Nanoscience and Nanotechnolgy" , McGraw-Hill education, NewDelhi, 2007.

GROWTH OF CRYSTALLINE MATERIALS
(Guide: Dr. A.S. Haja Hameed)

Course Code : 17MPPH1C3	**Max. Marks : 100**
Hours / Week : 4	**Internal Marks : 40**
Credit : 4	**External Marks : 60**

Objectives:

- To learn the crystal growth and characterization techniques
- To study about the formation of thin films.
- To study the importance and fabrications of nano materials

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).

ENERGY PHYSICS AND ITS APPLICATIONS

(Guide: Dr.C.HARIHARAN)

Course Code : 17MPPH1C3	**Max. Marks : 100**
Hours / Week : 4	**Internal Marks : 25**
Credit : 4	**External Marks : 75**

Objectives:

- To learn the fundamentals and applications of energy physics
- To understand the applications of thin films, crystal growth and nanomaterials in the field of energy
- To study the high energy physics

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.

Core Course – IV

Teaching and Learning Methodology

Sub.Code: 17MPPH1C4

TEACHING AND LEARNING METHODOLOGY

Course Code : 17MPPH1C4 | **Max. Marks : 100**
Hours / Week : 4 | **Internal Marks : 40**
Credit : 4 | **External Marks : 60**

Objectives:

- To know the use of the communication technology in teaching and learning methods
- To have a knowledge in usage of electronic media for teaching physics principles
- To learn the utilization of the online teaching in higher education
- To have a knowledge in Virtual Learning and Computer Networking Skills.

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 chating – 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.