# M.Phil Physics Course Structure under CBCS

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

<table>
<thead>
<tr>
<th>SEM</th>
<th>SUB CODE</th>
<th>COURSE</th>
<th>SUBJECT TITLE</th>
<th>HRS / WEEK</th>
<th>CREDIT</th>
<th>CIA MARK</th>
<th>SE MARK</th>
<th>TOTAL MARK</th>
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<tbody>
<tr>
<td>I</td>
<td>17MPPH1C1</td>
<td>CORE I</td>
<td>Research Methodology</td>
<td>4*</td>
<td>4</td>
<td>40</td>
<td>60</td>
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<tr>
<td>I</td>
<td>17MPPH1C2</td>
<td>CORE II</td>
<td>Advanced Topics in Physics</td>
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<td>I</td>
<td>17MPPH1C3</td>
<td>CORE III</td>
<td>Guide Paper</td>
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<td>(Based on Research Topic)</td>
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<td>I</td>
<td>17MPPH1C4</td>
<td>CORE IV</td>
<td>Teaching &amp; Learning Methodology</td>
<td>4*</td>
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*One hour library for each course

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<tr>
<th>TOTAL</th>
<th>16</th>
<th>16</th>
<th>100</th>
<th>300</th>
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| 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)

UNIT – II: HYPERGEOMETRIC FUNCTIONS                     (12 Hours)

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:


UNIT – V: ADVANCED ANALYTICAL TECHNIQUES                   (12 Hours)
BOOKS FOR STUDY AND REFERENCE

12. MATLAB Primer (7th Ed) - Timothy A. Davis & Kermit Sigmon, CRC press, 2005.
Core Course – II

Advanced Studies in Physics

Sub.Code: 17MPPPH1C2
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)


Unit – II: Quantum Statistics
(12 Hours)


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)


Unit – V: Quantum Computing
(12 Hours)

References:

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


Reference:

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)


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)


Unit – V: Applications of Nanomaterials (12 Hours)


Book for Reference:

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)

Unit – II: Particle Accelerators  (12 Hours)

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)

Unit – V: Experimental Techniques in Nuclear Physics  (12 Hours)

Reference:
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)


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

Hirota’s direct bilinearisation method – Nonlinear pulse propagation in SiO₂ 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:

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)


Unit-II: Theories of ultrasonic velocity in mixtures and solutions (12 Hours)


Unit – III: Properties of liquids and solutions (12 Hours)


Unit – IV: Structure Determination (12 Hours)


Unit – V: Ultrasonics (12 Hours)

Book for studies


Reference:

# ULTRASOUND AND ITS APPLICATIONS

**Guide: Mr. F.S. Muzammil**

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## 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)

## Unit – II: Ultrasound study of Liquid Mixtures and Solutions (12 Hours)

## Unit – III: Acoustical and Thermo dynamical parameters (12 Hours)

## 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)
Reference:


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)

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)


REFERENCES:

6. Charless P.Poole, Jr., Frank J.Owens, Introduction to nanotechnology, Wiley India(P) Ltd., 2015.
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)

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)

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:

Books for Reference:
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)

Unit – IV: Nanomaterials in energy applications


Unit – V: High energy physics


References:

1. Introduction to solid state physics – Kittel, seventh edition, John Wiely and sons Singapore.
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)

Unit – III: Online Teaching in Higher Education (12 Hours)

Unit – IV: Virtual Learning (12 Hours)

Unit – V: Computer Networking Skills (12 Hours)

Reference Books: