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

Course Outcomes:
1. understand and identify the research problems and find their solutions
2. acquire knowledge to the preparation of research paper writing
3. acquire knowledge of hypergeometric functions and Data analysis
4. apply the mathematical tools learnt to physical problems
5. understand the principle, instrumentation and applications of the analytical instruments

UNIT – I: Research Problems and Methodology 12 hours

UNIT – II: Procedure of research paper writing 12 hours
Structure of a research paper – first page preparation – effective writing of an abstract – past and current research work – experimental materials and methods – results of the research work – discussion of research results – role of authors and co-authors - format of correct references – #good quality drawings (usage of MS EXCEL, Origin Pro ) #of table and figures – understanding the method of paper submission to various journals – writing of good covering letter - procedure to write a review paper – English language and grammar checking – #plagiarism checking and related softwares#.

UNIT – III: HYPERGEOMETRIC FUNCTIONS 12 hours

UNIT – IV: ERRORS AND DATA ANALYSIS 12 hours
Approximate numbers and Significant figures – Rounding of Numbers – Absolute, Relative and Percentage errors – Relation between relative error and the significant figures – The general formula for errors

UNIT – V: ADVANCED COMPUTATION 12 hours
BOOKS FOR STUDY AND REFERENCE


Online References:

2. [https://wordvice.com/writing-the-results-section-for-a-research-paper/](https://wordvice.com/writing-the-results-section-for-a-research-paper/)
7. [https://www.reverso.net/spell-checker/english-spelling-grammar/](https://www.reverso.net/spell-checker/english-spelling-grammar/)
8. [https://windowsreport.com/plagiarism-software/](https://windowsreport.com/plagiarism-software/)

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### Programme Outcomes (POs)

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Number of Matches= 39, Relationship : HIGH
Course Outcomes:

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

Unit – I: Classical Statistics


Unit – II: Quantum Statistics


Unit – III: Symmetry and conservation laws


Unit – IV: Elements of Field Quantization


Unit – V: Quantum Computing

Books for Study:


UNIT I: Sections 1.3, 1.10, 2.12, 2.14, 3.1-4, 13.1 to 13.3, 13.6, 13.7 (T.B 1)
UNIT II: Sections 6.1 to 6.7, 7.3 to 7.7 (T.B 2)
UNIT III: Sections 7.1 to 7.6 (T.B 3)
UNIT IV: Sections 16.1 to 16.5, 16.8 – 16.10 (T.B 3)
UNIT V: Sections 1.1, 1.2, 2.2.1, 3.1, 3.2, 3.4, 3.7, 4.1, 4.2, 4.4, 5.2 (T.B 4)

References:


Online references:


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

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Number of Matches = 40, Relationship: HIGH
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<td>4</td>
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<td>75</td>
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</table>

Course Outcome:

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

Unit – I:  Communication Technology  12 hours
Convergence of information technology – communication policies and development – uses of communication technology – barriers of communication technology – contribution of communication technology to education and limitations.

Unit – II: Media in Physics  12 hours

Unit – III: Online Teaching in Higher Education  12 hours

Unit – IV: Virtual Learning  12 hours

Unit – V: Computer Networking Skills  12 hours
Reference Books:

6. Gorana Celebic, Dario Ilija Rendulic, Basic Concepts of Information and Communication Technology, handbook, ITdesk.info.

Online Course Reference:

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

<table>
<thead>
<tr>
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Number of Matches = 37, Relationship: HIGH
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</tr>
</tbody>
</table>

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

**Unit – I: Fundamentals Nanomaterial**

12 hours


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

12 hours

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

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

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

12 hours


**Unit IV: Characterisation**

12 hours


**Unit – V: Applications**

12 hours

References


7. book.department@intechopen.com

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

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

<table>
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<tr>
<th>Semester</th>
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Number of Matches=35, Relationship : HIGH

Prepared by:  
1. Mr. A. Mohamed Saleem

Checked by:  
Dr. M. Jamal Mohamed Jaffar
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<td>NONLINEAR DYNAMICS: BIFURCATIONS, CHAOS AND SYNCHRONIZATION</td>
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</table>

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

**Unit – I: Dynamical Systems and their Qualitative Features**
Dynamical Systems-Nonlinearity and its Implications in Dynamical Systems-Linearity Superposition Principle-Time Plots-Phase Plane Analysis-Classification of the Equilibrium Points of a Two Dimensional Dynamical System-Limit Cycle-Motion-Periodic Attractor-Poincare-Bendixson Theorem-Torus and Chaotic behaviours.

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


**Unit – III: Bifurcations and Onset of Chaos in Time Continuous Systems**
Duffing Oscillator- Fixed Points Analysis-Period Doubling Route to Chaos-Intermittency Transitions-Quasiperiodicity and Strange Non-Chaos Attractors (SNA)s, Lyapunov Exponents and Power Spectrum.

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

**Unit – IV: Chaos in Nonlinear Electronic Circuits**

Unit – V: Control and Synchronization of Chaos
Algorithms for control of Chaos-Control of Chaos in Chua’s Oscillator and MLC Circuit.
Synchronization of Chaos- Pecora-Carroll Method:Drive-Response Concept-Condition for Control of Chaos: Conditional Lyapunov Exponent (CLE) -Synchronization of Chaos in Chua’s and MLC Oscillators.
Numerical Simulation of Control and Synchronization of Chaos in these Circuits.

References
Units I, II and III

Units IV and V

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

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

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Number of Matches= 35, Relationship : HIGH

Prepared by: 1. Dr. A. Ishaq Ahamed
Checked by: Dr. M. Jamal Mohamed Jaffar
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<td>Core – IV</td>
<td>EXPERIMENTAL TECHNIQUES IN NUCLEAR PHYSICS</td>
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<td>4</td>
<td>100</td>
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</table>

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

**Unit – I: A B C’s of Nuclear Science**

12 hours


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

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Number of Matches = 38, Relationship : HIGH

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

Checked by:  
Dr. M. Jamal Mohamed Jaffar
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</table>

**Course Outcomes:**

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

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


**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:

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

<table>
<thead>
<tr>
<th>Semester</th>
<th>Code</th>
<th>Title of the Paper</th>
<th>Hours</th>
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Number of Matches= 38, Relationship : HIGH

Prepared by: Dr. R. Raj Muhamed

Checked by: Dr. M. Jamal Mohamed Jaffar
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<thead>
<tr>
<th>Semester</th>
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<td>ULTRASOUND AND ITS APPLICATIONS</td>
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</tbody>
</table>

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

**Unit – I: Measurement techniques of ultrasound velocity**  
12 hours

**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:


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Number of Matches= 35, Relationship : HIGH

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

Checked by:  
Dr. M. Jamal Mohamed Jaffar
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<tr>
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<tr>
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<td>GROWTH OF CRYSTALLINE MATERIALS</td>
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<td>4</td>
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<td>25</td>
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</tbody>
</table>

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

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

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

**Unit II: Solution growth 12 hours**


**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:

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

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Number of Matches= 40, Relationship : HIGH

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

Checked by:
Dr. M. Jamal Mohamed Jaffar
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<tbody>
<tr>
<td>I</td>
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<td>Core – IV</td>
<td>ENERGY PHYSICS AND ITS APPLICATIONS</td>
<td>4</td>
<td>4</td>
<td>100</td>
<td>25</td>
<td>75</td>
</tr>
</tbody>
</table>

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

**UNIT I: Energy Sources**  
12 hours
Various forms of energy - renewable and conventional energy systems - comparison - coal, oil and natural gas - availability - merits and demerits.
Renewable energy sources - solar energy - nature of solar radiation - components - solar heaters - crop dryers - space cooling - solar ponds, solar cookers - water desalination - merits and demerits of solar energy.

**Unit II : Non-Conventional Energy Sources**  
12 hours
Biomass energy - classification - biomass conversion process - gobar gas plants - wood gasification - advantages and disadvantages of biomass as energy source
Geothermal energy - wind energy - ocean thermal energy conversion (OTEC) - energy from waves and tides (Basic ideas, nature, applications, merits and demerits of these) - energy storage and hydrogen as a fuel (basics)

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

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

**Unit – V : High energy physics**  
12 hours
References:
1. Introduction to solid state physics – Kittel, seventh edition, John Wiely and sons Singapore.

Online references:
1. https://nptel.ac.in/courses/112105050/
4. https://nptel.ac.in/courses/113105025/
5. https://nptel.ac.in/courses/115103101/

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

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

| Course Outcomes (COs) | Programme Outcomes (POs) | Programme Specific Outcomes (PSOs) |...
|-----------------------|--------------------------|-----------------------------------|...
| CO1                   | PO1  PO2  PO3  PO4  PO5  | PSO1  PSO2  PSO3  PSO4  PSO5      |...
| CO2                   | PO1  PO2  PO3  PO4  PO5  | PSO1  PSO2  PSO3  PSO4  PSO5      |...
| CO3                   | PO1  PO2  PO3  PO4  PO5  | PSO1  PSO2  PSO3  PSO4  PSO5      |...
| CO4                   | PO1  PO2  PO3  PO4  PO5  | PSO1  PSO2  PSO3  PSO4  PSO5      |...
| CO5                   | PO1  PO2  PO3  PO4  PO5  | PSO1  PSO2  PSO3  PSO4  PSO5      |...

Number of Matches= 35, Relationship : HIGH

Prepared by:  
1. Dr.C.Hariharan

Checked by:  
Dr. M. Jamal Mohamed Jaffar