PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636011

DEGREE OF MASTER OF SCIENCE
CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR
M.SC. PHYSICS
(SEMESTER PATTERN)
(For Candidates admitted in the Colleges affiliated to Periyar University from 2021-2022 onwards)
M.Sc PHYSICS REGULATIONS

1. OBJECTIVES OF THE COURSE

The recent developments in Physical Sciences have been included in the enriched M.Sc., (Physics) Syllabus to meet out the present day needs of Academic and Research Institutions and Industries.

2. DURATION OF THE PROGRAMME

The course of study shall be on Semester System. The two year post graduate programme in M.Sc., Physics consists of four semesters.

3. ELIGIBILITY

A candidate who has passed the B.Sc., Degree Examination with Physics as the main subject or B.Sc., Applied Physics or B.Sc., Physics (Vocational) of this University or an examination of some other universities accepted by the Syndicate as equivalent there to is eligible for admission to the Programme.

4. COURSE OF STUDY

The course of study for the Degree of Master of Science in Physics shall be under (CBCS-Choice Based Credit System) semester system with internal assessment according to the syllabus prescribed from time to time. This Course consists of Core Subjects and Elective Subjects.

5. DISTRIBUTION OF CREDIT POINTS

The minimum credit requirement for a two-year Master's Programme shall be 90 Credits. The break-up of credits for the Programme is as follows:

| Core Courses | : 68 credits |
| Elective Courses | : 16 credits |
| Extra Disciplinary Course | : 06 credits |
# COURSE OF STUDY AND SCHEME OF EXAMINATION

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>Paper Code</th>
<th>Subject Title</th>
<th>Hours/Week</th>
<th>Credits</th>
<th>Exam Hours</th>
<th>Internal (25%)</th>
<th>External (75%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>SEMESTER I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Core-I</td>
<td>21PPH01</td>
<td>Classical Mechanics, Thermodynamics and Statistical Mechanics</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Core-II</td>
<td>21PPH02</td>
<td>Mathematical Physics</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Core-III</td>
<td>21PPH03</td>
<td>Electronics</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Core Practical-I</td>
<td>21PPHP01</td>
<td>General Physics – Experiments*</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Elective-I</td>
<td>Elective–I (From Group A)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>EDC - I</td>
<td></td>
<td>Extra Disciplinary Course - 1</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>SEMESTER II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Core-IV</td>
<td>21PPH04</td>
<td>Theory of Semiconductor Devices</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Core-V</td>
<td>21PPH05</td>
<td>Quantum Mechanics - I</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Core-VI</td>
<td>21PPH06</td>
<td>Computational Physics &amp; C++ Programming</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Core Practical-II</td>
<td>21PPHP02</td>
<td>Electronics (Analog &amp; Digital) *Experiments</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Elective-II</td>
<td>Elective–II (From Group A)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Common Subject</td>
<td>21PHR01</td>
<td>Human Rights</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>Internship</td>
<td>21PPHIN</td>
<td>Compulsory Internship Programme (15 Days) Related to Curriculum-Report to be submitted</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Examinations will be at the end of Second Semester*
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>Paper Code</th>
<th>Subject Title</th>
<th>Hours/Week</th>
<th>Credits</th>
<th>Exam Hours</th>
<th>Internal (25%)</th>
<th>External (75%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core-VII</td>
<td>21PPH07</td>
<td>Electromagnetic Theory &amp; Plasma Physics</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Core-VIII</td>
<td>21PPH08</td>
<td>Quantum Mechanics-II</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Core-IX</td>
<td>21PPH09</td>
<td>Molecular Physics &amp; Spectroscopy</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Core Practical-III</td>
<td>21PPHP03</td>
<td>Microprocessor Experiments **</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Elective-III</td>
<td></td>
<td>Elective–III (From Group B)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>EDC-2</td>
<td></td>
<td>Extra Disciplinary Course-2</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
</tbody>
</table>

**SEMESTER III**

**SEMESTER IV**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>Paper Code</th>
<th>Subject Title</th>
<th>Hours/Week</th>
<th>Credits</th>
<th>Exam Hours</th>
<th>Internal (25%)</th>
<th>External (75%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core-X</td>
<td>21PPH10</td>
<td>Nuclear &amp; Elementary Particle Physics</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Core-XI</td>
<td>21PPH11</td>
<td>Condensed Matter Physics</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Core Practical-IV</td>
<td>21PPHP04</td>
<td>Micro Controller &amp; C++ Programming Experiments **</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Elective-IV</td>
<td></td>
<td>Elective–IV (From Group B)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Core-XII</td>
<td>21PPHPR1</td>
<td>Project &amp; Viva-Voce</td>
<td>9</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>TOTAL 120</strong></td>
<td><strong>90</strong></td>
<td><strong>2400</strong></td>
</tr>
</tbody>
</table>

**Examinations will be at the end of Fourth Semester**
6. EXAMINATION

For the purpose of uniformity, particularly for inter-departmental transfer of credits, there will be a uniform procedure of examinations to be adopted by all teachers offering courses. The practical examinations for M.Sc., Physics course shall be conducted at the end of every year.

Distribution of marks:

(a) The following are the distribution of external and internal marks for Theory papers.

i). External Exam. : 75 Marks
    Passing Minimum : 38 Marks

ii). Internal Exam : 25 Marks
    Passing Minimum : 12 Marks

(b) The following are the distribution of Internal marks for Theory papers.

1. Test (One best test out of 3 tests) : 05 Marks
2. End Semester Model Exam : 10 Marks
3. Assignments & Attendance : 05 Marks
4. Seminar : 05 Marks

TOTAL : 25 Marks

(c) The following are the distribution of Internal marks for Practical papers.

1. Minimum 15 experiments : 10 Marks
2. Model Exam : 10 Marks
3. Attendance : 05 Marks

TOTAL : 25 Marks

Submission of Record Notebooks for Practical Examinations:
Candidates taking the Practical Examinations should submit bonafide Record Note Books prescribed for the Practical Examinations with due certification by Staff in-charge & HOD is a must for External Practical Examination (for both Regular and Arrear Candidates). Otherwise, the candidates will not be permitted to take the Practical Examinations.
Allocation of Marks for University Practical Examinations:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record</td>
<td>10</td>
</tr>
<tr>
<td>Formula and Formula Description</td>
<td>10</td>
</tr>
<tr>
<td>Circuit Diagrams / Diagrams</td>
<td>07</td>
</tr>
<tr>
<td>Observation-Tabulation and Readings</td>
<td>20</td>
</tr>
<tr>
<td>Calculations</td>
<td>15</td>
</tr>
<tr>
<td>Presentation</td>
<td>02</td>
</tr>
<tr>
<td>Result</td>
<td>05</td>
</tr>
<tr>
<td>Viva-Voce</td>
<td>06</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>75</strong></td>
</tr>
</tbody>
</table>

Project & Viva-voce Exam:
Students are required to submit a Project report at the end of Semester - IV and also required to make presentation of the project work during Viva- voce Examination. The Project work shall be based on research-oriented topics both in the fields of theoretical and experimental physics under the guidance of a faculty member of the Department as a Project Supervisor. In the course of the project, the student will refer books, Journals or collect literature/data by the way of visiting research institutes/ industries. He/she may even do experimental /theoretical work in his/her college. After completion of the project work by the end of semester IV, each student should submit THREE copies of the project report with a minimum of 50 pages not exceeding 70 pages to the Department on or before the date notified for the same.

Format for Preparation of Project Report
The sequence in which the project should be arranged and bound should be as follows
1. Cover Page and title Page
2. Certificate
3. Declaration
4. Acknowledgement (not exceeding one page)
5. Contents (12 Font size, Times New Roman with 1.5 or double line spacing)
6. List of Figures/ Exhibits/Charts
7. List of tables
8. Symbols and notations
9. Chapters
10. Result & Discussion
11. Conclusion
12. References

13. Xerox Copies of Publications/Certificates of Seminar, Conference Participation

The bifurcation of marks for project will be as follows:

1. Evaluation of the Project Report : 150 Marks
2. Viva-voce Examination : 50 Marks

**Distribution of marks for Project Report & Viva-Voce (200 Marks)**

(a). For Organization and presentation of Project - 100 marks
(b). For the Novelty/Social relevance - 30 marks
(c). Presentation of work/Participation in State/National level Seminar/Publication - 20 marks
(d). Viva-Voce (Preparation, Presentation of work and Response to questions) - 50 marks

7. **QUESTION PAPER PATTERN**

The following question paper pattern shall be followed for the candidates admitted from the academic year 2021–2022 onwards.

Time: 3 Hours Maximum: 75 Marks

**Part – A (15 x 1 = 15 Marks)**
Answer ALL the Questions
Three Questions from each unit
15 multiple choice questions with four options

**Part - B (2 x 5 = 10 Marks)**
Answer Any TWO Questions out of FIVE
One Question from each unit.
All Questions carry equal Marks.

**Part - C (5 x 10 = 50 Marks)**
Answer ALL the Questions
One Question from each unit with Either or Type
All Questions carry equal Marks.

8. **PASSING MINIMUM**

In order to pass a paper 50% minimum is compulsory both in the internal and external.
A candidate who has secured a minimum 50 marks (internal - 12 and external - 38) in
all the courses prescribed in the programme and earned a minimum of 90 credits will be considered to have passed the Master's Programme.

9. COMMENCEMENT OF THIS REGULATION
This regulation and syllabus shall take effect from the academic year 2021 - 2022, for students who are admitted to the first year of the course during the academic year 2021 - 2022 and thereafter.

10. GRADING
Once the marks of the cumulative internal assessment and end semester examinations are available, they will be added. The mark thus obtained will then be graded as per details given below:

Marks and Grades:
The following table gives the marks grade points, letter grades and classification to indicate the performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade:

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Grade Points</th>
<th>Letter Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-100</td>
<td>9.0-10.0</td>
<td>O</td>
<td>OUTSTANDING</td>
</tr>
<tr>
<td>80-89</td>
<td>8.0-8.9</td>
<td>D+</td>
<td>EXCELLENT</td>
</tr>
<tr>
<td>75-79</td>
<td>7.5-7.9</td>
<td>D</td>
<td>DISTINCTION</td>
</tr>
<tr>
<td>70-74</td>
<td>7.0-7.4</td>
<td>A+</td>
<td>VERY GOOD</td>
</tr>
<tr>
<td>60-69</td>
<td>6.0-6.9</td>
<td>A</td>
<td>GOOD</td>
</tr>
<tr>
<td>50-59</td>
<td>5.0-5.9</td>
<td>B</td>
<td>AVERAGE</td>
</tr>
<tr>
<td>00-49</td>
<td>0.0</td>
<td>RA</td>
<td>RE-APPEAR</td>
</tr>
<tr>
<td>ABSENT</td>
<td>0.0</td>
<td>AAA</td>
<td>ABSENT</td>
</tr>
</tbody>
</table>

Ci = Credits earned for course i in any semester
Gi = Grade Point obtained for course i in any semester
n = refers to the semester in which such course was credited

For a Semester:

GRADE POINT AVERAGE [GPA] = \( \frac{\sum_i Ci Gi}{\sum_i Ci} \)

GPA = Sum of the multiplication of grade points by the credits of the courses

Sum of the credits of the courses in a semester
For the entire Programme:

CUMULATIVE GRADE POINT AVERAGE [CGPA] = \( \frac{\sum n \Sigma i Cni Gni}{\sum n \Sigma i Cni} \)

Sum of the multiplication of grade points by the credits of the entire programme

CGPA = \( \frac{\sum \text{of the credits of the courses of the entire programme}}{\sum \text{of the credits of the courses of the entire programme}} \)

11. CLASSIFICATION OF SUCCESSFUL CANDIDATES

A candidate who passes all the examinations and securing following CGPA and Grades shall be declared as follows:

<table>
<thead>
<tr>
<th>CGPA</th>
<th>GRADE</th>
<th>CLASSIFICATION OF FINAL RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5 - 10.0</td>
<td>O+</td>
<td>First Class with Exemplary*</td>
</tr>
<tr>
<td>9.0 and above but below 9.5</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>8.5 and above but below 9.0</td>
<td>D++</td>
<td>First Class with Distinction*</td>
</tr>
<tr>
<td>8.0 and above but below 8.5</td>
<td>D+</td>
<td></td>
</tr>
<tr>
<td>7.5 and above but below 8.0</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>7.0 and above but below 7.5</td>
<td>A++</td>
<td></td>
</tr>
<tr>
<td>6.5 and above but below 7.0</td>
<td>A+</td>
<td>First Class</td>
</tr>
<tr>
<td>6.0 and above but below 6.5</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>5.5 and above but below 6.0</td>
<td>B+</td>
<td>Second Class</td>
</tr>
<tr>
<td>5.0 and above but below 5.5</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>0.0 and above but below 5.0</td>
<td>U</td>
<td>Re-appear</td>
</tr>
</tbody>
</table>

*The Candidates who have passed in the first appearance and within the prescribed semester of the PG programme (Core, Elective and Extra Disciplinary Courses alone) are eligible.

12. RANKING

A candidate who qualifies for the M.Sc., Physics, passing all the Examinations in the first attempt, within the minimum period prescribed for the course from the date of admission to the course and secures first or second class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks. The improved marks shall not be taken into consideration for ranking.
13. CONFERMENT OF THE DEGREE

No candidate shall be eligible for conferment of the Degree unless he / she has undergone the prescribed course of study for a period of not less than four Semesters in an institution approved by/affiliated to the Periyar University and has passed the Examinations as have been prescribed therefore.

14. ELECTIVE COURSES

Elective courses will be chosen by the respective colleges from the list of Group Elective Papers. Paper Codes are given in the bracket.

Elective Papers: List of Group

Group – A (Elective First Year - Select any TWO of the following)
1. Microprocessor & Microcontroller (21PPHE01)
2. Nano Physics (21PPHE02)
3. Fundamentals of Instrumentation (21PPHE03)
4. Laser Physics & Non-Linear Optics (21PPHE04)

Group – B (Elective Second Year - Select any TWO of the following)
5. Physics of Non-conventional Energy Resources (21PPHE05)
6. Electronic Communications (21PPHE06)
7. Modern Optics and Imaging (21PPHE07)
8. Crystal Growth & Thin Film Physics (21PPHE08)

15. EXTRA DISCIPLINARY COURSES

The students from other postgraduate programs, in affiliated colleges, will get a choice to select any one of the Extra Disciplinary Courses. The students can take up the extra disciplinary course at the beginning of First & Third semester.

List of Extra Disciplinary Courses (EDC)
1. Energy Physics
2. Nano Science
3. Medical Physics
4. Electronic Appliances

16. TRANSITORY PROVISION

Candidates who have undergone the Course of Study prior to the Academic Year 2021 - 2022 will be permitted to take the Examinations under those Regulations for a period of four years i.e., up to and inclusive of the Examination of April 2025 thereafter they will be permitted to take the Examination only under the Regulations in force at that time.
M.Sc. PHYSICS
SEMESTER - I

CORE I – 21PPH01 - CLASSICAL MECHANICS,
THERMODYNAMICS & STATISTICAL MECHANICS

UNIT-I: LAGRANGIAN FORMULATION & HAMILTON’S EQUATION
Mechanics of a particle - Conservation Laws - Types of Constraints - Generalized Co-
ordinates - Principle of Virtual work – D’Alemberts principle - Conservative and non-
conservative systems - Lagrange’s equation of motion - Applications to LinearHarmonic
Oscillator - Simple Pendulum - Compound Pendulum - Atwood’s Machine- Cyclic
coordinates - Hamilton's principle - Lagrange’s equation from Hamilton's principle -
Variational Principle - Hamilton’s Canonical equation of motion - Applications to
Harmonic Oscillator, Simple Pendulum, Compound pendulum - Principleof Least action.

UNIT-II: CANONICAL TRANSFORMATION & THEORY OF SMALL
OSCILLATIONS
Canonical transformations - Generating functions and different forms - Poisson’s
brackets and its properties - Infinitesimal contact transformation - Lagrange Brackets –
Hamilton - Jacobi Theory - Harmonic oscillator problem - Jacobi identity - Action-angle
variables - Application to Kepler problem in action angle variables - Eigen value
equation - symmetry, invariance and Noether’s theorem.

Theory of Small Oscillations: Equilibrium - Normal coordinates - Normal modes -
Normal frequencies of vibration - Vibrations of a Linear Triatomic molecule.

UNIT-III: KINEMATICS OF RIGID BODY & THEORY OF RELATIVITY
Rigid Bodies: Independent coordinates of rigid body - Orthogonal transformation -
Angular velocity of a rigid body - Angular momentum of a Rigid body - Euler’s angle
and Euler’s theorem - Coriolis force - Angular momentum and kinetic energy of motion -
Moments and products of inertia - Euler’s equations of motion - Torque free motion of a
rigid body - motion of a Symmetrical top.

Special Theory of Relativity: Galilean Transformations - Lorentz Transformations –
Length contraction - Time dilation – Variation of mass with velocity - Mass-energy equivalence - Relation between momentum and energy - Four vectors - Four Velocity - Space, time and energy - momentum vectors - Relativistic classification of particles – Relativistic Lagrangian and Hamiltonian for a particle.

UNIT - IV: THERMODYNAMICS & FUNDAMENTALS OF STATISTICS


UNIT - V: CLASSICAL & QUANTUM STATISTICS


Specific Heat of Solids: Dulong-Petit law - Einstein and Debye Theory.

BOOKS FOR STUDY AND REFERENCE:
SEMESTER - I

CORE II - MATHEMATICAL PHYSICS (21PPH02)

UNIT-I: VECTOR ANALYSIS AND BETA, GAMMA FUNCTIONS

Vector Analysis: Concept of gradient, divergence and curl - Gauss divergence theorem, Greens theorem, Stokes theorem - Expression for gradient, divergence, curl and Laplacian in Cartesian, Orthogonal curvilinear coordinates and Spherical co-ordinates - Linearly dependent and independent sets of vectors - Schmidt’s orthogonalization process.

Beta & Gamma Functions: Definitions - Symmetry property of Beta function - different forms of Beta function - Evaluation of Gamma function - Fundamental properties of Gamma functions - Relation between Beta and Gamma functions – Examples.

UNIT-II: COMPLEX VARIABLE AND GROUP THEORY


UNIT-III: DIFFERENTIAL EQUATIONS AND PROBABILITY THEORY

Differential Equations: Linear Ordinary Differential equations - First order and second order equations and their various solutions.

Partial differential equations: Linear second order equations - Solution of Laplace equations - Wave equations and their solutions - Solution of Poisson’s equations, Helmholtz equations and Green’s functions


UNIT IV: MATRIX THEORY & TENSOR ANALYSIS

Matrices: Algebraic operations of matrices, Types of Matrices and their properties-Rank of a Matrix, Symmetry and Inverse of matrix-Hermitian, Skew-Hermitian matrix-Orthogonal,
Unitary matrices - Eigen values and Eigen vectors - Cayley-Hamilton’s theorem-
Diagonalization of different matrices - Problems.

Tensors: Definition - Scalars, Contravariant, Covariant and Mixed tensors - Rank of a
Tensor - Tensors of higher rank - addition and subtraction of Tensors - Summation
convention - Symmetry and Anti-symmetry Tensor - Contraction and direct product -
Quotient rule - Pseudo tensors, Levi-Civita Symbol - Dual tensors, irreducible tensors -
Metric tensors.

UNIT-V: SPECIAL FUNCTIONS & INTEGRAL TRANSFORMS

Special Functions: Differential Equations, Rodriguez’s formula, Recurrence relations and
Generating functions for Legendre, Hermite, Laguerre and Bessel polynomials -
Orthogonality relations of these polynomials - Applications of Special functions in Physics.

Integral Transforms: Fourier transforms - cosine and sine transforms.

Laplace transforms: Definition-Linearity, shifting and change of scale properties.

Inverse Laplace transforms: Definition - properties - problems.

BOOKS FOR STUDY AND REFERENCE:

   (2020).
8. Mathematical Physics, Binoy Bhattacharyaa, New Central Book Agency(P)Ltd.,
   Kolkatta (2009).
9. Matrices and Tensors in Physics, A.W.Joshi, New Age International (P) Limited.,
10. Fundamentals of Mathematical Physics, A.B.Gupta, Books and Allied (P) Limited,
     Kolkata (2011).
SEMESTER - I

CORE III - ELECTRONICS (21PPH03)

UNIT-I: SEMICONDUCTOR DEVICES
Semiconductors - Characteristics and applications of PN Junction diode - Zener Diode - Gunn diode - Tunnel diode - Photo diode - Schottky diode - Impatt diode - Varactor diode. 
Transistor CB, CE, CC configurations - Transistor biasing methods - Multistage transistor amplifiers - RC Coupled transistor amplifier. 
JFET - Structure and Characteristics – MOSFET - Depletion and Enhancement type MOSFFT. 
Construction, V-I characteristics and applications of UJT, SCR - DIAC, TRIAC. 

UNIT-II: IC FABRICATION & IC TIMER
Basic monolithic ICs - Epitaxial growth - Masking - Etching impurity diffusion - Fabricating monolithic resistors, diodes, transistors, inductors and capacitors - Circuit layout - Contacts and inter connections. 
**IC 555 Timer:** Description - Monostable, Bistable and Astable multivibrators - Phase Locked Loops - Basic principles - Voltage Controlled Oscillator - Design of Square wave, Saw tooth wave and Triangular wave generators. 

UNIT-III: OPERATIONAL AMPLIFIER
Operational Amplifier - Characteristics - Parameters - CMRR - Sample and Hold circuits. 
**Active Filters:** Design of Low, High, Band pass and Band reject first and second order filters. 

UNIT-IV: SEMICONDUCTOR MEMORIES & DIGITAL ELECTRONICS
Classification of memories and sequential memory - ROM, PROM and EPROM principle and operation Read & Write memory - Static RAM, dynamic RAM. Programmable Logic Array (PLA) - Operation, Internal Architecture. Charge Coupled Devices (CCD) - Principle, construction, working and Data transfer mechanism.
**Digital Electronics:** Number Systems - Binary, Octal, Hexadecimal, Gray code, Excess-3 code - Basic Logic gates - Universal gates.

**Boolean Algebra:** Boolean Laws - De Morgan’s theorem – Karnaugh map - Simplification using K-map

**UNIT-V: DIGITAL CIRCUITS**

**Arithmetic and Logic Circuits:** Half adder - Hall subtractor - Full adder - Full subtractor - Decoder - Encoder - Multiplexer and Demultiplexer.

**Sequential Circuits:** Flip flops - RS Flip flop - D flip flop - JK flip flop - Master Slave JK flip flop.

**Registers:** SISO, SIPO, PISO, PIPO Shift Registers.

**Counters:** Modulus of a Counter - Synchronous, Asynchronous, Ring and Up/Down Counters - BCD Counter.

**BOOKS FOR STUDY AND REFERENCE:**

SEMESTER - I
CORE IV: PRACTICAL - I

GENERAL PHYSICS EXPERIMENTS (21PHP01)

(Examination only at the end of Second Semester)

Group A: OPTICAL PHYSICS & LASERS (Any 12 Experiments - Compulsory)
1. Young's modulus by Elliptical fringes
2. Young's modulus by Hyperbolic fringes
3. Charge of an Electron by Spectrometer
4. Permittivity of a liquid using R.F. Oscillator
5. Iron / Copper Arc spectrum
6. Measurement of Numerical aperture (NA) of an optical fiber
7. Michelson Interferometer -- Determination of wavelength of monochromatic source
8. Biprism-Wavelength of monochromatic source - Refractive Index of a liquid
9. Polarization of light - Verification of Malus law and Brewster angle of glass
10. Determination of Rydberg's constant - Hydrogen spectrum
11. F.P. Etalon - Spectrometer - determination of thickness
12. Ultrasonic Interferometer - Velocity and Compressibility of a liquid
13. Permittivity of a liquid using R.F Oscillator
14. Laser beam - Interference Experiments
   (a) Using an optically plane glass plate (b) Using Lloyd’s single mirror method
15. Laser beam - Diffraction Experiments
   (a) Diffraction at straight edge (b) Diffraction at a straight wire
   (c) Diffraction at a circular aperture
16. Determination of (i) thickness of a wire (ii) diameter of a circular aperture and
   (iii) Wavelength of He-Ne laser / diode laser using diffraction grating
17. Determination of refractive index of the liquids using He-Ne/Laser

Group B: THERMODYNAMICS, MODERN PHYSICS & SOLID STATE PHYSICS
(Any 8 Experiments - Compulsory)
1. G.M. Counter - Characteristics, Inverse square law
2. G.M. Counter - Absorption co-efficient
3. Zeeman Effect - $e/m$ of an electron with a laser source
4. Determination of Stefan's constant
5. Determination of Solar constant
6. Thermal Conductivity - Forbe’s Method
7. Study of Hall Effect in a semiconductor and Measurement of Hall Coefficient of the
   Semiconductor
8. Determination of resistivity of a semiconductor by Four Probe Method
9. Determination of band gap in a semiconductor material
10. Thermistor - Temperature Coefficient and Band Gap Energy Determination
11. BH loop - Energy loss of a magnetic material - Anchor ring using B.G/CRO
12. Determination of magnetic susceptibility of liquid by Guoy's method
13. Determination of susceptibility of a paramagnetic solution by Quincke’s method
SEMESTER-II

CORE IV - THEORY OF SEMICONDUCTOR DEVICES (21PPH04)

UNIT I: SEMICONDUCTOR PHYSICS


UNIT II: SEMICONDUCTOR DEVICES

Basic Fabrication Steps: Oxidation, Lithography, Thermal Equilibrium Condition: Band Diagram, Equilibrium Fermi Level; Depletion Region: Abrupt junction, Linearly Graded junction; Depletion Capacitance, Current - Voltage Characteristics: generation - recombination and high-injection effects; Charge Storage and Transient behaviour, Junction Breakdown: Tunnelling effect, Avalanche multiplication, Heterojunction.

UNIT III: METAL-SEMICONDUCTOR DEVICES:

MOSFET and Related Devices: MOS Diode - metal & semiconductor work function, the SiO$_2$-Si MOS diode, CCD; MOSFET fundamental: linear and saturation regions, types of MOSFET, threshold voltage control; MOSFET scaling - CMOS - MOSFET on insulator - MOS Memory structures: DRAM, SRAM, Non-volatile memory-power MOSFET - Metal-Insulator-Semiconductor (MIS) system.

MESFET and Related Devices: Metal-Semiconductor Contacts - the Schottky barrier, semiconductor work function, Ohmic contact; MESFET: Devices structure, principles of operation, high-frequency performance; MODFET fundamentals - Static Induction Transistor (SIT).

UNIT IV: MICROWAVE DIODES, QUANTUM-EFFECT & HOT-ELECTRON DEVICES

Basic Microwave Technology: IEEE microwave frequency bands; Tunnel devices of different types - I-V Characteristics of Tunnel diode - Tunnel diode applications - IMPATT diode - Static & dynamic characteristics, field distributions and generated carrier densities -
electron devices - negative differential resistance, device operation - quantum-effect devices - resonant tunnelling diode, energy of electrons - hot electron devices - HBT, real-space-transfer transistor - MISS diodes.

**UNIT V: PHOTONIC DEVICES**

**Radiative Transitions & Optical Absorption:** Radiative transistor, Boltzmann distribution, optical absorption, optical absorption coefficients;

**LED:** visible LEDs, bandgap semiconductors, Snell’s law, organic LED, Infrared LED;

**Semiconductor Laser:** Laser operation, energy bandgap, carrier & optical confinement, optical cavity & feedback, basic laser structure, distributed feedback laser, quantum-well laser, energy of charge particle

**Photo Detectors:** Photoconductor, Photodiode, quantum efficiency, response speed, PIN photodiode, heterojunction photodiode, avalanche photodiode - Photo transistors.

**Solar Cell:** Solar radiation, p-n junction solar cell, conversion efficiency, silicon & compound - Semiconductor solar cells, optical concentration.

**BOOKS FOR STUDY AND REFERENCE:**


SEMESTER - II

CORE V - QUANTUM MECHANICS - I (21PPH05)

UNIT-I: FOUNDATIONS OF WAVE MECHANICS

UNIT-II: APPLICATIONS OF SCHRODINGER’S EQUATION-ONE & THREE DIMENSIONAL EIGEN VALUE PROBLEMS

One Dimensional Problem: Particle in a box - Square well potential - Barrier penetration- Quantum mechanical tunnelling - Bound States - Linear Harmonic oscillator - Schrodinger method-Operator method

Three Dimensional Problems: Orbital angular momentum and spherical harmonics - Central forces and reduction of two body problem-Particle in a Spherical well - Rigid Rotator - Hydrogen atom.

UNIT III: ANGULAR MOMENTUM

Orbital angular momentum, Spin angular momentum and Total angular momentum Operators - Commutation relations for angular momentum operators - Eigen value spectrum of J^2, J_z, J_x, and J_y - Ladder Operators - Matrix representation of Angular momentum - Pauli’s spin matrices - Addition of angular momenta - Clebsch-Gordan coefficients.

UNIT IV: TIME INDEPENDENT PERTURBATION THEORY

Time independent Perturbation theory in Non-degenerate and Degenerate cases - Application to perturbed Harmonic oscillator - Stark effect in hydrogen atom - Variation method - Application to ground state of He and hydrogen atom - WKB approximation and its application to tunnelling problem - Bohr-Sommerfeld quantization condition.

UNIT V: MATRIX FORMULATION OF QUANTUM THEORY

Hilbert space - Unitary transformation and their properties - Representation of State vector and equation of motion: Schrodinger, Heisenberg and Interaction pictures - correspondence

TIME DEPENDENT PERTURBATION THEORY

BOOKS FOR STUDY & REFERENCE:
3. Quantum Mechanics, S.L.Gupta, V.Kumar, H.V.Sharma and R.L.Sharma, Jai Prakashnath and Co, Meerut.
SEMESTER - II

CORE VI - COMPUTATIONAL PHYSICS &
C++ PROGRAMMING (21PPH06)

UNIT-I: SOLUTIONS OF LINEAR AND NONLINEAR EQUATIONS


UNIT-II: NUMERICAL INTEGRATION AND DIFFERENTIATION


UNIT-III: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS:


First order equations: Euler and improved Euler methods - Formulas - Second order equation - Euler methods - Solution of Ordinary differential equation by Euler, Runge-Kutta Fourth Order method for solving first order ordinary differential equations.

UNIT- IV: FUNDAMENTALS OF C++ PROGRAMMING

Basic structure of C++ programs - Creating the Source File - compiling and Linking. Tokens, Keywords – Identifiers - Basic Data Types - Symbolic Constants - Type Compatibility - Declarations of Variables - Dynamic Initialization of Variables - Reference Variables - Reading and writing a character - formatted inputs and outputs.

Operators in C++: Arithmetic, relational, logical, assignment, increment, decrement, and conditional, bitwise special operators - Operator Precedence - Type Cast Operator -
Expressions and Implicit Conversions - Operator Overloading - C++ math library functions-
C++ standard library header files.

UNIT V: DECISION MAKING, ARRAYS, STRUCTURES, FUNCTIONS & POINTERS

Decision Making Statements: If-else statement - nested if-else, else-if ladder - switch case statement - conditional statement - go to statement - break and continue statement - Nested control statements.

Loops: While loop - do-while loop - For loop - Nested For loop.

Arrays: Defining, initializing arrays - accessing array elements - One/Two dimensional arrays.

Structures: Specifying the structure - accessing structure members.

Functions: Function declaration and definition - Calling the Function.

Pointers: Address and pointers - Address of operator & pointer variables.

BOOKS FOR STUDY AND REFERENCE:

3. Numerical Methods, Dr.P.Kandasamy, Dr. K.Thilagavathy, Dr.K.Gunavathi, S.Chand & Company Private Limited, New Delhi (2016)
SEMESTER - II
ELECTRONICS (ANALOG & DIGITAL)
EXPERIMENTS (21PHP02)
(Examination at the end of Second Semester)

Group A: ELECTRONICS (Minimum 14 Experiments)
1. Construction of Dual IC regulated power supply
2. Study the characteristics of DIAC and TRIAC
3. MOSFET - Characteristics - depletion and enhancement mode
4. FET - Characteristics and FET as amplifier - Frequency response
5. Single stage and multi stage RC coupled transistor amplifier - Frequency response
6. SCR - Characteristics, Wave shaping and switching circuits
7. Study the characteristics of UJT and construction of UJT Relaxation oscillator
8. Characteristics of Tunnel diode and Gunn diode
9. I-V Characteristics of Solar cell and its efficiency
10. Photo diode and Photo transistor characteristics
11. Op-amp - summing, difference, average amplifier, differentiator and integrator
12. Op-amp - Solving simultaneous equations
13. Design of Square wave, Saw tooth wave and Triangular wave generators using OPAMP
14. Design of Square wave, Saw tooth wave and Triangular wave generators using IC 555 Timer
15. Op-amp - Design of Schmitt Trigger and construction of Monostable multivibrator
16. Op-amp - Design of active filters - second order - low pass, high pass, band pass
17. Op-amp – 4 bit D/A converter - Binary weighted method and R-2R ladder method
18. Parameters of Op-Amp, Voltage to current and current to voltage converters using OPAMP
19. Construction of A/D converter using comparator and study its performance
20. Design and study of Monostable and Bistable multivibrators using IC 555

Group B: DIGITAL ELECTRONICS (Minimum 6 Experiments)
1. Universal NAND/NOR Gates
2. Construction of half adder and full adder circuit using NAND gates
3. Construction of half subtractor and full subtractor circuits using NAND gates
4. Flip flops - RS, JK, Master Slave and T flip flops
5. Study of Counters: Ripple, MOD 3, MOD 5 Counters
6. BCD and UP/ DOWN Counters
7. Construction of Shift registers using IC 7476: Serial in-Serial out, Parallel in-Parallel out, Shift left and Shift right Registers.
8. Decoders and Encoders
9. Study of Multiplexer & Demultiplexer using IC for the generation of Boolean functions
10. IC 7490 as Modulus counters and display using IC-7447
SEMESTER - III
CORE VII - ELECTROMAGNETIC THEORY & PLASMA PHYSICS (21PPH07)

UNIT I: ELECTROSTATICS AND POLARISATION

Polarisation: Macroscopic electric field - Local electrical field at an atom - Electric displacement and Molecular Polarizability - Electronic, Ionic and Orientational Polarisation - Dielectric constant - Clausius-Mossotti equation - Polarization of Polar molecules - Langevin and Debye relation - Electrostatic energy.

UNIT II: MAGNETOSTATICS

UNIT III: ELECTRO MAGNETISM
Continuity equation - Displacement current - Maxwell’s equations and their physical significances - Energy in electromagnetic fields - Poynting’s theorem - Electromagnetic potentials - Maxwell’s equations in terms of electromagnetic potentials - Gauge transformations - Lorentz Gauge - Coulomb Gauge - Green function for the wave function - Conservation of energy and momentum for a system of charged particles and electromagnetic fields.

UNIT IV: ELECTROMAGNETIC WAVES AND WAVE PROPAGATION
Electromagnetic waves in free space - Propagation of electromagnetic waves in isotropic and anisotropic dielectrics - Reflection and refraction of electromagnetic waves - TM and TE modes - Propagation in Rectangular waveguides - Cavity Resonator - Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole - Superposition of waves - Polarization - Stokes Parameters.
UNIT V: PLASMA PHYSICS

Introduction, Types of Plasma; Properties of Plasma; V- I characteristics; Advantages of plasma processing. Thermal plasma: Principles of plasma generation; DC plasma torches; AC plasma torches; RF plasma torches, Plasma spraying; Structure of sprayed deposits; Plasma decomposition; Treatment of hazardous wastes - Synthesis of ultrafine/Nano powders. Plasma melting and remelting. Non-thermal plasma: Glow discharge plasma.

Plasma reactors for surface treatment: Corona & DBD atmospheric pressure surface treatment reactors - Magnetic hydrodynamic waves - Alfven waves and magnetosonic waves.

BOOKS FOR STUDY AND REFERENCE:

SEMESTER - III
CORE VIII - QUANTUM MECHANICS - II (21PH08)

UNIT I: IDENTICAL PARTICLES AND SPIN

UNIT II: SCATTERING THEORY
Differential and Total cross-section - Laboratory and Centre of mass coordinate system - Asymptotic behaviour of the Wave function - Scattering amplitude-Partial wave analysis - Optical Theorem-Phase Shifts-Born approximation and its validity-scattering by Coulomb and Screened coulomb potentials - Rutherford scattering formula - Square-well potential - Exponential - Gaussian potential - Low energy scattering: Scattering length and effective range scattering by a perfectly rigid sphere-resonant scattering-non resonant scattering – Ramsauer -Townsend effect - Scattering by square well potential - Breit-Wigner formula.

UNIT III: EMISSION AND ABSORPTION OF RADIATION

UNIT IV: QUANTUM THEORY OF ATOMIC & MOLECULAR STRUCTURE

UNIT V: RELATIVISTIC QUANTUM MECHANICS
Klein-Gordon Equation for a free particle and its solution - Charge and current densities in four vector - KG equation in electromagnetic field - Dirac relativistic equation for a free particle - Dirac matrices - Charge and current densities - Dirac Equation in Electromagnetic
field - Free particle solutions - Negative energy states - Spin of a Dirac particle - Spin orbit coupling.

**Quantization of Wave fields:** Classical Lagrangian equation - Classical Hamiltonian equation - Field quantization of the non-relativistic Schrodinger equation - Creation, destruction and number operators - Anticommutation relations - Quantization of Electromagnetic field energy momentum.

**BOOKS FOR STUDY AND REFERENCE:**


3. Quantum Mechanics, S.L.Gupta, V.Kumar, H.V.Sharma and R.L.Sharma, Jai Prakashnath and Co, Meerut.


SEMESTER - III
CORE IX - MOLECULAR PHYSICS & SPECTROSCOPY
(21PPH09)

UNIT-I: MOLECULAR STRUCTURE AND BONDING

UNIT-II: INFRARED SPECTROSCOPY

UNIT-III: RAMAN SPECTROSCOPY
Classical theory of Raman Scattering - Raman effect and molecular structure - Raman effect and crystal structure - Raman effect in relation to inorganic, organic and physical chemistry - Experimental techniques - Coherent anti-Stokes Raman Spectroscopy - Applications of Infrared and Raman Spectroscopy - Laser Raman Spectroscopy.

UNIT-IV: NMR AND NQR SPECTROSCOPY

UNIT-V: ESR AND MOSSBAUER SPECTROSCOPY
**BOOKS FOR STUDY AND REFERENCE:**

10. Spectroscopy, Dr. H. Kaur, Pragati Prakasan, Meerut, (2019).
CORE PRACTICAL - III - MICROPROCESSOR PROGRAMMING EXPERIMENTS (21PPHP03)

[Minimum 20 Experiments]

(Examination at the end of Fourth Semester)

Group A: 8085 MICROPROCESSOR PROGRAMMING EXPERIMENTS

(Minimum 15 Experiments-Compulsory)

1. 8 bit Addition and Subtraction
2. 8 bit Multiplication and Division
3. Number conversion: BCD to Binary and Binary to BCD
4. Number conversion: ASCII to HEX and HEX to ASCII
5. Ascending and descending order of numbers
6. Square and square root of a given number
7. Factorial of a given number
8. Largest and smallest number in a set of numbers
9. Search for a given data in an array
10. Interfacing of ADC with 8085 Microprocessor
11. Interfacing of DAC with 8085 Microprocessor (square, saw tooth and triangular waves)
12. Interfacing of 8253 (Timer IC) or 8255 with 8085 Microprocessor
13. Interfacing of 8279 keyboard/display controller with 8085 Microprocessor
14. Stepper Motor Interface
15. Traffic Light Control Interface
16. Design of digital Clock using 8085 Microprocessor
17. Design of digital Thermometer using 8085 Microprocessor
18. Sum of ‘n’ numbers using 8085 Microprocessor
19. BCD Addition using Microprocessors
20. Program to reverse the given string
Group B: 8086 MICROPROCESSOR PROGRAMMING EXPERIMENTS

(Minimum 5 Experiments-Compulsory)

1. 16 bit Addition and Subtraction
2. 16 bit Multiplication and Division
3. Largest and smallest number in a set of numbers
4. Searching for a number or character in a string
5. Program to reverse the given string
6. Program to count number of vowels in a given string
7. Program to add and subtract two numbers of BCD data
8. Program to determine the sum of elements in an array
SEMESTER - IV

CORE X - NUCLEAR & ELEMENTARY PARTICLE PHYSICS

(21PPH10)

UNIT-I: NUCLEAR STRUCTURE & NUCLEAR MODELS


UNIT-II: NUCLEAR FORCES


Mass Spectrometer-Bainbridge and Jordan mass spectrograph.

UNIT-III: NUCLEAR REACTIONS

Types of Nuclear reactions - Conservation laws - Q value - Scattering and Nuclear reaction cross section - Direct Nuclear Reactions: Knock out reaction, Pick-up reaction, Stripping reaction - Compound nucleus theory - Formation - Disintegration energy levels - Partial wave analysis of Nuclear reaction cross-section - Resonance Scattering and Reaction cross-section – Breit-Wigner dispersion formula - Scattering matrix - Reciprocity theorem - Resonance scattering - Absorption cross section at high energy.


UNIT-IV: RADIOACTIVE DECAYS, PARTICLE DETECTORS & ACCELERATORS

Properties of alpha, beta and gamma particles - Alpha decay – Geiger-Nuttal law-Gamow’s Theory - Neutrino hypothesis - Beta decay - Fermi theory of Beta decay - K electron capture

**Particle Detectors:** Ionization chamber - Proportional counter - G.M counters - Solid state detectors - Scintillation Counter - Bubble Chamber.

**Particle Accelerators:** Cyclotron - Synchrocyclotron - Synchrotron - Proton Synchrotron - Betatron.

**UNIT-V: ELEMENTRY PARTICLE PHYSICS**

Classification of Elementary particles – Hadrons - Leptons - Mesons - Hyperons - Types of interaction between elementary particles - Particle quantum numbers - Baryon number - Lepton number - Strangeness number – Hypercharge - Isospin quantum number – Murray Gell-Mann-Nishijima formula - Symmetry and conservation laws - Strangeness and associate production - CPT theorem-Quark model - Color and flavor - Isospin multiplets - SU(2) - SU(3) multiplets - Gell-Mann-Okubo mass formula - Universal Fermi interaction-Grand Unification Theories.

**BOOKS FOR STUDY AND REFERENCE:**

SEMESTER - IV

CORE XI - CONDENSED MATTER PHYSICS (21PPH11)

UNIT I: BONDING AND LATTICE VIBRATIONS


Vibration of monatomic lattices - Lattices with two atoms per primitive cell - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering of neutrons by phonons.

UNIT II: CRYSTALLOGRAPHY


UNIT III: FREE ELECTRON THEORY, ENERGY BANDS AND SEMICONDUCTOR CRYSTALS


UNIT IV: MAGNETISM AND SUPERCONDUCTIVITY

Domain Model - Domain theory – Antiferromagnetism - Ferrimagnetism - Structure of Ferrite-Ferroelectric crystals.

**Superconductivity** - Meissner effect - Thermodynamics of Superconducting transition - London equation - Coherence length - BCS theory - Flux Quantization - Type-I and Type-II Superconductors - Josephson tunnelling effect - DC and AC Josephson effect - SQUID - Recent developments in high Temperature Superconductivity - Application of Superconductors.

**UNIT V: NANOSOLIDS & TYPES OF MATERIALS**


**BOOKS FOR STUDY AND REFERENCE:**

CORE PRACTICAL - IV - MICROCONTROLLER & C++ PROGRAMMING EXPERIMENTS (21PHP04)

(MINIMUM 20 EXPERIMENTS)
(Examination at the end of Fourth Semester)

Group A: 8051 MICROCONTROLLER PROGRAMMING
(Minimum-10 Experiments compulsory)
1. 16 bit Addition, Subtraction
2. 16 bit Multiplication and Division
3. Largest and smallest number in a set of numbers
4. Binary to BCD conversion and Hex to ASCII conversion
5. Generation of square, triangular, saw tooth waves
6. DC Motor Control Interface
7. HEX key board Interface
8. Switching of an array of LED'S
9. Addition of array of numbers
10. Code conversion programs - Micro Controllers
11. Timer and Counter programming - Microcontrollers
12. Interfacing Traffic signal control using Microcontrollers
13. Interfacing DAC module using Microcontrollers
14. Interfacing Stepper motor control using Microcontrollers
15. Interfacing Seven segment display using Microcontrollers

Group B: C++ PROGRAMMING
(Minimum - 10 Experiments compulsory)
1. Given number is odd or even
2. Greatest number from given numbers
3. Matrix addition and subtraction
4. Matrix multiplication
5. Eigen values of a given matrix
6. Transpose and inverse of a matrix
7. Root of non-linear equation by Newton-Raphson method
8. Solution of simultaneous linear equations
9. Straight line fit by the method of least squares
10. Exponential fit by the method of least squares
11. Newton's (Forward/Backward difference) and Lagrange's Interpolation
12. Numerical integration by Simpson's rules (1/3 & 3/8) and Trapezoidal rule
13. Solution of Differential equation by Fourth order Runge-Kutta Method
14. Calculation of standard deviation of a given range
15. Drawing of rectangle and circles using graphics
M.Sc., PHYSICS

LIST OF ELECTIVE COURSES

ELECTIVE I - MICROPROCESSORS AND MICROCONTROLLERS (21PPHE01)

UNIT - I: MICROPROCESSOR 8085 ARCHITECTURE


UNIT - II: 8085 ASSEMBLY LANGUAGE PROGRAMMING

Instruction format-Instruction Set: Data transfer instructions - Arithmetic instructions - Logical instructions - Branching instructions and machine control instructions. Addressing modes - Assembly Language programming - programming techniques - Looping, counting and indexing - Counters and time delays - Stack - subroutine - Simple programs - 16-bit additions, subtractions, multiplications and divisions.

UNIT - III: MICROPROCESSOR 8086

Intel 8086 Microprocessor - Introduction - Comparison between 8085 and 8086 Microprocessors - Architecture of 8086 – Pin configuration - Format of 8086 instructions - Classification of 8086 instructions - Memory addressing: 8-bit data from even and odd address bank, 16-bit data from even and odd address bank - Addressing modes - Simple programs - 16-bit additions, subtractions, multiplications and divisions.

UNIT - IV: MICROCONTROLLER 8051 ARCHITECTURE AND PROGRAMMING

Introduction to microcontroller and embedded system - Difference between microprocessor and microcontroller - 8051 microcontrollers: Pin configuration, Architecture and Key features of 8051 - Instruction set: Data transfer instructions - Arithmetic instructions - Logical instructions - Branching instructions - Boolean operations instructions - Program-control instructions - Addressing modes.

UNIT - V: INTERFACING OF MICROPROCESSOR 8085

Basic concepts of programmable device - 8255 Programmable Peripheral Interface (PPI) - interface of ADC and DAC - 8257 Direct Memory Access (DMA) controller - Basic concepts...
of serial I/O and data communication-interface of 8251 Universal Synchronous Asynchronous Receiver Transmitter (USART)

**BOOKS FOR STUDY AND REFERENCE:**

M.Sc., PHYSICS

ELECTIVE II - NANO PHYSICS (21PPHE02)

UNIT I: NANO SCALE SYSTEMS
Introduction to Nanoscale - Size-Dependent properties - Size effect - Surface tension, wettability - specific surface area and surface area to volume ratio - Reason for change in optical properties, electrical properties and mechanical properties - nanoscale catalysis - Principles of Top-Down and Bottom-Up approaches - Electrical, Optical, Thermal, Mechanical and Magnetic properties of nanoparticles.

UNIT II: SYNTHESIS OF NANO STRUCTURE MATERIALS
Gas phase condensation - Vacuum deposition - Physical vapor deposition (PVD) - Chemical vapor deposition (CVD) - Sol-Gel - Ball milling - spray pyrolysis - plasma based synthesis process (PSP) - hydrothermal synthesis - Etching technologies: wet and dry etching - photolithography - Drawbacks of optical lithography for nanofabrication - electron beam lithography - ion beam lithography - dip-pen nanolithography.

UNIT III: QUANTUM DOTS
Quantum Dots-properties - Excitons and excitonic Bohr radius - difference between nanoparticles and quantum dots - Preparation through colloidal methods - Epitaxial methods-MOCVD and MBE growth of quantum dots - current-voltage characteristics - magneto tunnelling measurements - Absorption and emission spectra of quantum dots - Photo luminescence spectrum.

UNIT IV: CHARACTERIZATION:
Nano SEM - Scanning Conducting microscopy (SCM) - High-resolution Transmission Electron Microscopy (HRTEM) - single nanoparticle characterization - Scanning capacitance microscopy - Principle and working of Atomic Force Microscopy (AFM) and Scanning tunnelling microscopy (STM) - Principle of Transmission Electron Microscopy (TEM) - applications to nanostructures-nano mechanical characterization-nano indentation - Particle size estimation by XRD/SPM/STM/AFM techniques.

UNIT V: APPLICATIONS OF NANOTECHNOLOGY:
Nano diodes, Nano switches, molecular switches, Nano-logic elements - Single electron transistors - small metallic tunnel junctions - Nanoparticles based solar cells and quantum dots based white LEDs - CNT based transistors-Surface acoustic wave (SAW) devices, microwave MEMS, field emission display devices - Super hard nano composite coatings and...

**BOOKS FOR STUDY AND REFERENCE:**

M.Sc., PHYSICS
ELECTIVE III - FUNDAMENTALS OF INSTRUMENTATION (21PPHE03)

UNIT I: GENERALIZED CHARACTERISTICS OF INSTRUMENTS

UNIT II: VACUUM SYSTEMS
Principle and operation of various pumps: rotary, diffusion, sorption, turbo molecular, ionization and cryo-pumping. Gauges: McLeod, diaphragm, thermocouple, Pirani, Penning, Ionisation and hot and cold cathodes - design of high vacuum systems - high pressure cells - measurements at high pressures.

UNIT III: THERMAL SYSTEMS

UNIT IV: DETECTORS AND SPECTROSCOPY
Detectors: Pyroelectric, thermoelectric, photo conducting, photoelectric, photomultiplier, scintillation types of detectors, photon counters. Spectroscopy: principles of atomic absorption spectroscopy - instrumentation-single and double beam spectrometers-theory and components of nuclear quadrupole resonance technique-applications.

UNIT V: ELECTRONICS AND EXPERIMENTAL METHODS
BOOKS FOR STUDY & REFERENCE:

M.Sc PHYSICS
ELECTIVE IV-LASER PHYSICS AND
NON-LINEAR OPTICS (21PPHE04)

UNIT I: LASERS-FUNDAMENTALS AND TYPES
Basic Construction and Principle of Lasing-Einstein Relations and Gain Coefficient -
Creation of a Population Inversion - Three-Level System - Four-Level System - Threshold
Gain Coefficient for Lasing-Laser Types - He-Ne Laser - CO₂ Laser - Nd:YAG Laser-
Semiconductor Laser.

UNIT II: LASER OPERATION
Optical Resonator - Laser Modes - Axial modes - Transverse Modes - Modification in Basic
Laser Structure - Basic Principle of Mode Locking - Active Mode Locking - Passive Mode
Locking - Q switching - Pulse Shaping.

UNIT III: LASER BEAM CHARACTERISTICS
Wavelength – Coherence - Mode and Beam Diameter – Polarizations - Introduction to
Gaussian Beam width – Divergence - Radius of Curvature - Rayleigh Range - Gouy Phase
Shift - 3-D Gaussian Beams - ABCD Law for Gaussian Beam - Complex Radius of
Curvature- Tensorial ABCD Law.

UNIT IV: FOCUSING OF LASER BEAM
Diffraction - Limited spot size - M² Concept of Beam Quality - Spherical Aberration -
Thermal Lensing Effects - Depth of Focus - Tight focusing of laser beam - Angular Spectrum
Representation of Optical near Field - Aplanatic Lens - Focusing of Higher - order laser
modes - Radially Polarized Doughnut Mode - Azimuthally Polarized Doughnut mode.

UNIT V: NON-LINEAR OPTICS
Introduction - Nonlinear Optical Media - The Nonlinear Wave Equation - Scattering Theory
Born Approximation - Second-order Nonlinear Optics-Second - Harmonic Generation (SHG)
and Rectification - Electro-Optic Effect – Three Wave Mixing - Frequency and Phase
Matching - Third Harmonic Generation-Optical Kerr Effect - Self-Focusing - Four-Wave
Mixing (FWM) - Optical Phase Conjugation (OPC) - Use of Phase Conjugators in Wave Restoration.

**BOOKS FOR STUDY & REFERENCE:**

ELECTIVE V - PHYSICS OF NON-CONVENTIONAL ENERGY RESOURCES (21PPHE05)

UNIT-I: NON-CONVENTIONAL ENERGY SOURCES & SOLAR RADIATION
Various non-conventional energy resources - Classification, merits and demerits - Sun as source of energy - Solar constant - solar radiation at the Earth’s surface - direct and diffused radiation - spectral power distribution of solar radiation - depletion of solar radiation - measurement of solar radiation - Solar radiation data.

UNIT-II: APPLICATIONS OF SOLAR ENERGY

UNIT III: SOLAR CELLS
Solar cells for direct conversion of solar energy to electric power - single crystal silicon solar cell - principle and working of a solar cell - Solar cell electrical characteristics - equivalent circuit-Solar cell parameters - Poly crystalline silicon solar cells - Thin film solar cells (CdTe, CIGS, GaAs) - Perovskite Solar cells - Organic solar cells - Dye sensitized solar cells - Quantum dot solar cells.

UNIT-IV: WIND ENERGY & GEOTHERMAL ENERGY
Nature of the wind - power in the wind - basic components of wind energy conversion system (WECS) - horizontal axis wind turbine - generating systems - scheme for electric generation - applications of wind energy.
Origin of Geothermal energy - hydrothermal resources - vapor dominated systems - wet steam system - environmental considerations - applications of geothermal energy.

UNIT-V: BIO-MASS ENERGY AND OCEAN ENERGY
Biomass conversion technologies - wet and dry process - photosynthesis - biogas generation - basic process and energetics - advantages of anaerobic digestion - classification of biogas plants.
Origin and nature of Ocean tidal energy - tidal energy power - ocean tidal energy conversion schemes - wave energy - heaving float type and pitching type wave energy converters - ocean thermal energy - open cycle OETC system.
BOOKS FOR STUDY AND REFERENCE:

ELECTIVE VI - ELECTRONIC COMMUNICATIONS (21PPHE06)

UNIT-I: PROPAGATION OF WAVES AND TRANSMISSION LINES

UNIT-II: WAVE GUIDES, ANTENNAS AND RESONATORS
Wave Guides - Attenuation in parallel plane guides - Attenuation for TE waves, TM waves and TEM waves - Rectangular and Circular wave guides - Field configurations for dominant TM and TE modes - Wave guide couplings matching and attenuation - Cavity resonator. Basic considerations of antennas - Wire radiators in space - antenna parameters - Effect of ground on antennas - Different types of antennas - Impedance matching to antenna - Directional high frequency antennas - Microwave antennas - Wideband, Special purpose antennas - Antenna arrays.

UNIT-III: MICROWAVE DEVICES AND RADARS

UNIT-IV: SATELLITE COMMUNICATIONS
Introduction - Kepler’s Laws - Geostationary orbit - Power systems - Attitude Control - Satellite Station keeping - Antenna Look Angles - Limits of visibility - Frequency plans and polarization - Transponders - Uplink power budget calculations - Down link power budget calculations - Overall link budget - Digital carrier Transmission - Multiple-access Methods.

UNIT-V: MOBILE COMMUNICATION
BOOKS FOR STUDY AND REFERENCE:

ELECTIVE VII - MODERN OPTICS AND IMAGING (21PPHE07)

UNIT-I: WAVE NATURE AND LIGHT PROPAGATION
Electromagnetic wave propagation, Harmonic waves, phase velocity, group velocity, energy flow - Poynting vector - Wave motion - equation - superposition of waves, interference, diffraction, basics of coherence theory, temporal and spatial coherence - Multi-wave interference - Michelson and Fabry-Perot interferometer - Scattering and polarization - types.

UNIT-II: OPTICAL ENGINEERING AND NON-LINEAR OPTICS
Image formation (first-order optics), aberrations, prisms and mirrors, stops and apertures, basic optical devices, the design of optical systems: general, aplanatic points, solid immersion lens, numerical aperture increasing lens. Fourier optics - Thin lens as phase transformation - Thickness function - Various types of lenses.

UNIT-III: FIBER OPTICS COMMUNICATION & OPTICAL FIBER SENSORS
Optical Fiber Sensors: General features, types of OFS, intrinsic and extrinsic sensors, intensity sensors, temperature and pressure measurements - reflective OFS and applications.

UNIT - IV: HOLOGRAPHY & PHOTO DETECTORS
Photo Detectors: Physical principles of Photodiodes-Pin Photo Detector-Avalanche Photodiodes - Photodetector Noise - Comparison of Photo Detectors.

UNIT - V: OPTICAL MICROSCOPY & IMAGING TECHNIQUES
BOOKS FOR STUDY AND REFERENCE:

ELECTIVE VIII-CRYSTAL GROWTH & THIN FILM PHYSICS (21PPHE08)

UNIT I: BASIC CONCEPTS, NUCLEATION AND KINETICS OF GROWTH

UNIT II: CRYSTALLIZATION PRINCIPLES AND GROWTH TECHNIQUES
Classes of crystal system - Crystal symmetry - Solvents and solutions - Solubility diagram - Super solubility - Expression for super saturation - Metastable zone and induction period - Miers T-C diagram - Solution growth - Low and high temperatures solution growth - Slow cooling and solvent evaporation methods - Constant temperature bath as a crystallizer.

UNIT III: GEL, MELT AND VAPOR GROWTH TECHNIQUES

UNIT IV: THIN FILM DEPOSITION TECHNIQUES
Vacuum evaporation - Hertz-Knudsen equation - Evaporation from a source and film thickness uniformity - E-beam, pulsed laser and ion beam evaporations - Glow discharge and plasmas - Mechanisms and yield of sputtering processes - DC, rf, magnetically enhanced, reactive sputtering - Spray pyrolysis - Electro deposition - Sol-gel technique.

UNIT V: CHARACTERIZATION TECHNIQUES
X-ray diffraction - Powder and single crystal - Fourier transform infrared analysis - Elemental dispersive X-ray analysis - Transmission and scanning electron microscopy - UV-vis-NIR spectrometer - Chemical etching - Vickers micro hardness - Basic principles and operations of AFM and STM - X-ray photoelectron spectroscopy for chemical analysis - Ultraviolet photoemission spectroscopy analysis for work function of the material - Photoluminescence – Thermoluminescence.
BOOKS FOR STUDY AND REFERENCE:

LIST OF EXTRA DISCIPLINARY COURSES (EDC)

EDC PAPER I - ENERGY PHYSICS (21PHEDC)

UNIT I: INTRODUCTION TO ENERGY SOURCES

UNIT II: SOLAR CELLS
Solar cells for direct conversion of solar energy to electric powers - Solar cell parameter - Solar cell electrical characteristics - Efficiency - Single crystal silicon solar cells - Polycrystalline silicon solar cells - Concepts of quantum dot solar cells - Dye sensitized solar cell - Organic solar cells - hybrid solar cell - Cadmium sulphide solar cells - other types of advanced solar materials and solar cell devices.

UNIT - III: SOLAR ENERGY - APPLICATIONS

UNIT - IV: WIND ENERGY

UNIT - V: BIOMASS ENERGY
BOOKS FOR STUDY & REFERENCE:
7. The Physics of Solar Cells by Jenny Nelson (Published by Imperial college press)
EDC PAPER II - NANO SCIENCE (21PHEDC)

UNIT - I: INTRODUCTION TO THE NANOWORLD
Introduction - Historical perspective on Nanomaterial - Classification of Nano materials - Quantum mechanics of low dimensional systems - Bound states and density of states: 3D, 2D, 1D and 0D - Quantum confinement - Quantum wells, wires and dots - size dependent properties - Mossbauer effect - surface Plasmon resonance - single electron tunnelling.

UNIT - II: METALS, SEMICONDUCTORS AND CERAMICS NANOCRYSTALS
Reduction of size - Synthesis of metal nanoparticles and structures - Routes to arrangements - Background on Quantum Dot semiconductors-background on reverse Micellar solution - Synthesis of Semiconductors - Cadmium Telluride Nano crystals - Cadmium sulfide Nano crystals - Alloy Semiconductors - Chemical, Physical and Mechanical properties of Ceramics.

UNIT - III: NANO PARTICLES AND MAGNETISM
Magnetism in particles of reduced size and dimensions - Single domain particles and superparamagnetism - magnetism in clusters of non-magnetic solids - magnetic behaviour of small particles - diluted magnetic semiconductors (DMS)-Intermetallic compounds - Importance of nanoscale magnetism.

UNIT - IV: CHEMICAL AND CATALYTIC ASPECTS OF NANOCRYSTALS
Nano materials in Catalysis - Nanostructured Adsorbents - Nanoparticles as new Chemical reagents - Specific Heat of Nano crystalline materials - melting points of Nanoparticle materials.

UNIT - V: APPLICATION OF NANOMATERIALS
BOOKS FOR STUDY & REFERENCE:
EDC PAPER III - MEDICAL PHYSICS (21PHEDC)

UNIT I: BIOELECTRIC SIGNALS & TRANSDUCERS

UNIT II: BLOOD PRESSURE MEASUREMENTS

UNIT -III: MAGNETIC RESONANCE IMAGING

CT and MRI Radiotherapy: CT based treatment simulation and planning - MRI in Radiotherapy.

UNIT IV: X-RAYS
Interaction of gamma rays and X-rays with matter-types of interaction with matter - over all interaction of photons with matter.

UNIT V: THERMOGRAPHY

BOOKS FOR STUDY & REFERENCE:
EDC PAPER IV - ELECTRONIC APPLIANCES (21PHEDC)

UNIT I: ELECTRONIC COMPONENTS

UNIT II: ELECTRICAL APPLIANCES
Electrical Bulbs - Florescent Lamps - Inverter - Basic of UPS - Stabilizers - Voltage regulators - Iron Box - Heaters - Electrical Oven - Wet Grinder - Mixer - Refrigerators - Air Conditioners - Freezers - Washing Machines.

UNIT III: ELECTRONIC APPLIANCES

UNIT IV: COMPUTERS
Block diagram of a Computer - Input Device - Memory Device - Control Unit - Arithmetic logic unit - Output device - Microprocessor - RAM - ROM.

UNIT V: COMMUNICATION ELECTRONICS
Basics of Telephones - Mobile Phones - Wireless Phones – Antenna – Internet - Satellites.

BOOKS FOR STUDY & REFERENCE:
MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
FIRST SEMESTER
CLASSICAL MECHANICS, THERMODYNAMICS & STATISTICAL MECHANICS

Time: 3 Hours

Maximum: 75 Marks

Part – A (15 x 1 = 15 Marks)
Answer ALL the questions

Choose the Correct Answer:

1. For a conservative system, the potential energy does not depend upon
   a. force   b. generalized velocity   c. generalized coordinates   d. all of above

2. The number of degrees of freedom for N particles with k constraint relations is
   a. 3N-3k   b. 3N+k   c. 3N-k   d. k-3N

3. If the Lagrangian of a system does not depend on time explicitly, then
   a. Hamiltonian is conserved   b. Hamiltonian cannot be constant
   c. Potential energy is constant   d. Kinetic energy is constant

4. The action and angle variables have the dimension of
   a. energy and angle   b. force and angle
   c. angular momentum and angle   d. are dimensionless quantities

5. Which of the following theory provides a powerful tool to study the motion of periodic systems?
   a. Hamilton’s theory   b. Hamilton-Jacobi theory
   c. Lagrange theory   d. principle of least action

6. For a transformation to be canonical
   a. Poisson bracket changes sign   b. Poisson bracket becomes equal to unity
   c. Poisson bracket becomes zero   d. Lagrange and Poisson brackets remain invariant

7. The transformation for body set of axes to space set of axes is an
   a. an orthogonal   b. not an orthogonal   c. unitary   d. sometimes orthogonal

8. If a rod of 1 metre length is moving along its length with a velocity 0.6c, then
   length of the rod as it appears to an observer on the earth is
   a. 0.7m   b. 0.8m   c. 0.8 cm   d. 0.2m

9. The most general displacement of a rigid body is
   a. translational   b. rotational
   c. translational and rotational   d. translational and vibrational

10. In a Carnot cycle, the algebraic sum of the entropy changes for the cycle is
    a. always positive   b. always less than unity
    c. always zero   d. either zero or less than that

11. If $\rho$ is density of phase points in phase space, then $\partial \rho / \partial t = 0$ is called
    a. Einstein’s theorem   b. Liouville’s theorem
    c. Maxwell’s theorem   d. none of these

12. Phase space means superposition of
    a. all momentum spaces   b. all position spaces
    c. position and momentum space   d. volume elements

13. Pauli’s exclusion principle not applies to
14. At short wavelength, Planck’s radiation formula reduces to
15. Only one phase point can occupy one phase cell according to
   a. Classical Statistics  b. Bose-Einstein Statistics  c. Fermi-Dirac Statistics  d. All of these

**Part - B (2 x 5 = 10 Marks)**

Answer Any TWO Questions out of FIVE
All Questions carry equal marks.

17. What are the Poisson’s and Lagrange’s brackets? Show that Lagrange’s bracket is invariant under Canonical transformation.
18. A particle of rest mass $m_0$ moves with speed $C/\sqrt{2}$.
   Find i). its mass  ii). its momentum  iii). Total energy  iv). its kinetic energy
19. Starting from B-E distribution law, derive Planck’s law of black body radiation.
20. State the basic assumptions on which the classical, Fermi-Dirac and Bose-Einstein statistics are developed.

**PART-C (5 x 10 = 50 Marks)**

Answer ALL the questions
All Questions carry equal marks.


   (OR)

   b). State and prove the principle of Least action.

22. a). What are Canonical transformations? Discuss how the transformation equations can be obtained from generating functions of type $F_1$ and $F_2$.

   (OR)

   b). State and prove Hamilton-Jacobi equation for Hamilton’s principal function and explain how it can be used to solve Kepler’s problem for a particle in an inverse square central force field.

23. a). Derive the Lorentz space-time transformation formula. Discuss the length contraction and time dilation.

   (OR)

   b). Derive Euler’s equations of motion of a rigid body. Hence show that for a torque free rotational motion of a symmetric body, the magnitude of the angular velocity is constant.

24. a). Derive the Maxwell-Boltzmann distribution law and obtain expressions for the most probable energy and most probable speed of a gas molecule.

   (OR)

   b). Derive Maxwell’s four fundamental thermodynamical relation.

25. a). Deduce Fermi-Dirac distribution law. Hence obtain an expression for the energy of a Fermi gas at absolute zero and point out its physical significance.

   (OR)

   b). Explain the term Degeneracy and B-E Condensation. Bring out clearly the essential differences between Bose-Einstein and Fermi-Dirac Statistics.
MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
FIRST SEMESTER
ELECTRONICS

Time: 3 Hours  
Maximum: 75 Marks

PART–A (15 x 1 = 15 Marks)

Choose the Correct Answer:

1. An ------------ is a set of electronic circuits on one small flat piece of semiconductor.
2. Which of the following is most difficult to fabricate in an IC?
3. An UJT has ________________
   a). Two P-N junction  b). One P-N junction
   c). Three P-N junction  d). Four P-N junction
4. The most popular form of IC package is ------
5. cannot be fabricated on an IC.
   a). Transistor  b). Diodes  c). Resistor  d). large inductors and transformers
6. Metallization is used for
7. Which is not the internal circuit of an Operational amplifier
8. How a triangular wave generator is derived from square wave generator?
   a). Connect oscillator at the output  b). Connect voltage follower at the input
   c). Connect differentiator at the output  d). Connect integrator at the output
9. Name the filter that has two stop bands
10. If Q=0, the output is set to be ________
11. Mod 5 Synchronous counter is designed using J-K flip flops, the number of count
    skipped by it will be
12. A BCD counter has
13. Which of the following memories are non volatile memories?
14. RAM is also known as
15. PROM are available in
    a). Bipolar version only  b). MOS version only
    c). both Bipolar and MOS version  d). None of the above
PART-B (2 x 5 = 10 Marks)
Answer Any TWO Questions out of FIVE
All Questions carry equal marks.

16. The collector current of a transistor is 100 mA and its $\beta$ is 75. Calculate the value of base current and emitter current.

17. Describe the fabrication of monolithic diodes.

18. Explain the construction and working of a Triangular wave generator using Op-amp.

19. Assume that the reverse gate voltage of JFET changes from 5.0 V to 4.9 V and the drain current changes from 1.2 mA to 1.5 mA. What is the value of transconductance?


PART - C (5 x 10 = 50 Marks)
Answer ALL the questions
All Questions carry equal Marks.

21. a). Explain the UJT Relaxation oscillator with necessary diagram.

   (OR)

   b). What are the characteristics of JFET? Explain it with diagram.

22. a). Briefly explain the fabrications of monolithic IC’s.

   (OR)

   b). Explain the operation of an astable multivibrator with necessary circuit diagram using IC-555 timer.

23. a). Explain the working of 4-bit R-2R ladder network D/A converter with an op-amp circuit.

   (OR)

   b). Solve the second order differential equation using Op-amp.

24. a). Explain in detail on the operation of basic phase locked loop.

   (OR)

   b). Explain the principle and operation of Read and Write memory.

25. a). Draw the block diagram of up/down counter and explain its functions.

   (OR)

   b). Design half adder and full adder circuits using gates and verify their truth tables.
Choose the Correct Answer:

1. When the distance between two charged particles is halved, the force between them becomes  
   a. one-fourth b. one-half c. double d. four times

2. The flux density is related to polarization and electric field intensity by the relation  
   a. \( D = E - P \)  b. \( D = \varepsilon_0 E + P \)  c. \( D = E + P \)  d. \( D = \varepsilon_0 E + P \)

3. The outward flux of \( E \) through any closed surface \( S \) is equal to  
   a. net charge inside  b. \( \frac{1}{\varepsilon_0} \) times the net charge inside  
   c. \( \varepsilon_0 \) times the net charge inside  d. none of these

4. The dielectric constant of a material at optical frequencies is mainly due to  
   a. ionic polarizability  b. electronic polarizability  
   c. dipolar polarizability  d. ionic and dipolar polarizability

5. The magnetic field at a point due to a elemental conductor carrying current at a distance \( r \)  
   from the element is given by  

6. Maxwell using the concept of displacement current modified which of the following laws  
   a. Faradays law  b. Gauss law  c. Ampere’s law  d. Biot-Savart’s law

7. The Poynting theorem is a mathematical statement of the conservation of  
   a. momentum  b. charge  c. electromagnetic energy  d. current

8. The displacement current arises due to  
   a. positive charges only  b. negative charges only  
   c. time varying electric field  d. both positive and negative charges

9. Magnetic induction vector is equal to  
   a. \( \text{div} \ A \)  b. \( \text{curl} \ A \)  c. \( \text{grad} \ A \)  d. \( \text{div} \ B \)

10. The field of magnetic vector \( B \) is always  
    a. irrotational  b. non-solenoidal  c. solenoidal  d. rotational

11. Magnetic induction \( B \) at a point \((r, \theta, \phi)\) due to an oscillating dipole  
    a. varies as \( \frac{1}{\sin \theta} \)  b. varies as \( \sin \theta \)  c. varies as \( \sin^2 \theta \)  d. varies as \( \frac{1}{\sin^2 \theta} \)

12. In terms of electromagnetic potentials (A and \( \phi \)) the field vectors E and B are given by  
    a. \( B = \text{Curl} \ A \) and \( E = -\text{grad} \ \phi + \frac{\partial A}{\partial t} \)  
    b. \( B = -\text{Curl} \ A \) and \( E = \text{grad} \ \phi + \frac{\partial A}{\partial t} \)  
    c. \( B = \text{Curl} \ A \) and \( E = \text{grad} \ \phi - \frac{\partial A}{\partial t} \)  
    d. \( B = \text{Curl} \ A \) and \( E = -\text{grad} \ \phi - \frac{\partial A}{\partial t} \)

13. The power radiated by an electric oscillating dipole is proportional to the frequency  
    given by  
    a. \( \omega \)  b. \( \omega^2 \)  c. \( \omega^3 \)  d. \( \omega^4 \)

14. The ratio of magnitude of electric field intensity to the magnitude of magnetic field  
    intensity is called  
    a. attenuation constant  b. phase constant  
    c. extrinsic impedance  d. intrinsic impedance
15. Plasma is created by Magnetic fields which is known as…
   a.stable state  b.shifted state  c.metastable state  d.all of above

**PART-B (2 x 5 = 10 Marks)**
Answer Any **TWO** Questions out of **FIVE**
All Questions carry equal marks.

16. A region is specified by the potential function given by \( V = 2x^2 + 5y^2 - 3z^2 \). Calculate the electric field strength at point (2,3,4) in this region.

17. State and explain Biot-Savart law.

18. Derive Maxwell’s equations in differential form from the integral form.

19. A specimen of iron is uniformly magnetized by a magnetizing field of 500 A/m. If the magnetic induction in the specimen is 0.2 Wb/m^2, find the relative permeability and the susceptibility.

20. Write the properties of Plasma. Discuss about the principles of Plasma generation.

**PART - C (5 x 10 = 50 Marks)**
Answer **ALL** the questions
All Questions carry equal Marks.

21. a). Explain the Electronic polarisation, Orientational polarization and Ionic Polarisation. Write down the Clausius-Mossotti relation connecting the quantity with the dielectric constant of the material.

   **(OR)**

   b). Establish Gauss’s theorem for an electrostatic field. Deduce Laplace and Poisson’s equations.

22. a). State and Prove Ampere’s Circuital law.

   **(OR)**

   b). Derive an expression for magnetic scalar potential and magnetic vector potential.

23. a). Write down Maxwell’s equations in differential and integral forms and explain their physical meaning.

   **(OR)**

   b). Obtain the Poynting’s theorem for conservation of energy in an electromagnetic field. Discuss significance of Poynting’s vector.

24. a). Using of the Maxwell’s field equations, derive the equation for plane electromagnetic waves in free space.

   **(OR)**

   b). Derive expressions for electric and magnetic field due to an Oscillating dipole. Calculate the total power radiated by it.

25. a). Explain how the hazardous wastes are removed?

   **(OR)**

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
FOURTH SEMESTER
CORE-X: NUCLEAR & ELEMENTARY PARTICLE PHYSICS
Time: 3 Hours
Maximum: 75 Marks

PART–A (15 × 1 = 15 Marks)
Answer ALL the questions

Choose the Correct Answer:
1. According to Nuclear collective model, the shape and quadrupole moment of odd-odd nuclei are respectively
   a. spherical and finite     b. non-spherical and finite
   c. non-spherical and zero  d. spherical and zero
2. An element has binding energy 8 eV per nucleon. If it has total binding energy of 128 eV, then the no. of nucleons are
   a. 32    b. 16    c. 64    d. 8
3. The empirical formula for the nuclear radius is
   a. $R = r_o A^{2/3}$     b. $R = r_o A^{1/3}$     c. $R = r_o A^{2/3}$     d. $R = r_o A^{-1/3}$
4. The exchange of ________ is responsible for the nuclear binding force.
   a. pions     b. kaons     c. neutrinos     d. all of these
5. The binding energy of the deuteron is
   a. 2.224 MeV    b. 2.224 eV    c. 22.24 MeV    d. nota
6. Nuclear force is
   a. short range and charge dependent    b. long range and charge dependent
   c. short range and charge independent  d. long range and charge independent
7. What is the particle ‘Y’ in the given nuclear reaction?
   \[ ^4\text{Be}^9 + ^2\text{He}^4 \rightarrow ^6\text{C}^{12} + Y \]
   a. electron    b. positron    c. proton    d. neutron
8. The chain reaction can be set up only if the mass of the fissionable material is
   a. equal to the critical mass    b. greater than the critical mass
   c. less than the critical mass   d. nota.
9. Cadmium rods are used in a nuclear reactor for
   a. speeding up slow neutrons    b. absorbing protons
   c. slowing down fast neutrons   d. absorbing neutrons
10. The theory which explain continuous $\beta$ ray spectrum is
    a. Wheeler’s theory    b. Bohr theory
    c. Koufmann theory    d. Fermi theory
11. Cyclotron is used to accelerate
    a. electrons only    b. positive ions only
    c. neutrons only    d. both positive and negative ions
12. The machine in which frequency of electric field is constant and magnetic field is varied is called
    a. betatron    b. cyclotron    c. proton synchrotron    d. synchrotron
13. The elementary particles having mass more than the nucleons are called
   a. neutrons   b. photons   c. hyperons   d. mesons
14. The formation of electron-positron pair from gamma ray is an example of
   a. weak interaction   b. strong interaction
      c. electro-magnetic interaction   d. gravitational interaction
15. Which of the elementary particle as believed to contain three identical ‘s’
      quarks?   a. omega hyperons   b. pions   c. Kaons   d. baryons

   PART-B (2 x 5 = 10 Marks)
   Answer Any TWO Questions out of FIVE
   All Questions carry equal marks.

16. Calculate the Binding energy of an alpha particle and express the result both
    in MeV and joules.
17. Calculate the energy released in nuclear fusion of a single helium nucleus
    formed by the fusion of two deuterium nuclei.
18. Explain the energy balance and Q value in a Nuclear reactions.
19. Write a note on K-electron capture.
20. Give an account of fundamental interactions between elementary particles.

   PART - C (5 x 10 = 50 Marks)
   Answer ALL the questions
   All Questions carry equal Marks.

21. a). Describe the liquid drop model of the nucleus. How can the semi-empirical
      mass formula be derived from it.
      (OR)
      b). (i). Explain the features of nuclear Shell model.
         (ii). Explain why electrons cannot be present inside nucleus.
22. a). Write the characteristic properties of nuclear forces.
      Discuss the Meson theory of Nuclear forces.
      (OR)
      b). Discuss the construction and working of Bainbridge and Jordan Mass
         Spectrograph.
23. a). Discuss the principle and construction of a nuclear reactor.
      (OR)
      b). Derive Breit and Wigner dispersion formula.
24. a). Explain the Gamow’s theory and tunneling effect of alpha decay.
      (OR)
      b). Describe a GM Counter. Explain its working. What are its advantages &
         disadvantages?
25. a). State and explain the various conservation laws governing the elementary
      particles.
      (OR)
      b). Explain the classification of elementary particles according to (i). interactions
         (ii). mass. Write a notes on anti-particles.
MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
FIRST SEMESTER / SECOND SEMESTER
ELECTIVE COURSE: MICROPROCESSORS AND MICROCONTROLLER

Time: 3 Hours                                      Maximum: 75 Marks

PART–A (15 x 1 = 15 Marks)

Choose the Correct Answer:

1. MOV A,C is executed by
   a) 1 machine cycle  b) 2 machine cycles  c) 3 machine cycles  d) 4 machine cycles
2. The Compiler is
   a) faster than interpreter  b) slower than interpreter
   c) an interpreter  d) a single-step process
3. The 8085 has _______ segments.
   a) 6 memory  b) 8 memory  c) 4 memory  d) 10 memory
4. XCHG is a/an
   a) data transfer instruction  b) arithmetic instruction
   c) logical instruction  d) I/O and stack instruction
5. IN 00H is an instruction of
   a) direct addressing  b) indirect addressing
   c) register addressing  d) immediate addressing
6. When a CALL instruction is executed, the stack pointer register is
   a) decremented by 2  b) incremented by 2  c) decremented by 1  d) incremented by 1
7. The 8086 has a
   a) 16-bit data bus and 20-bit address bus  b) 8-bit data bus and 20-bit address bus
   c) 16-bit data bus and 16-bit address bus  d) 8-bit data bus and 16-bit address bus
8. The segment memory capacity of 8086 is
   a) 1 MB  b) 64 KB  c) 2MB  d) 4 MB
9. The 16-bit register of 8086 consists of
   a) 16 flags  b) 8 flags  c) 9 flags  d) 7 flags
10. The 8051 Microcontroller has
    a) 32 pins for I/O  b) 24 pins for I/O  c) 16 pins for I/O  d) 8 pins for I/O
11. The 8051 Microcontroller has
    a) 128 bytes of on-chip ROM  b) 256 bytes of on-chip ROM
    c) 228 bytes of on-chip ROM  d) 556 K bytes of on-chip ROM
12. Which of the following instructions is not a logical instruction?
    a) ANL A, #FF  b) CPL A  c) INC A  d) SWAP A
13. A D/A converter’s full scale output voltage is 10V and it’s accuracy is +0.4%. The maximum error of DAC will be
    a) 20mV  b) 30mV  c) 40mV  d) none of these
14. A digital instrument is used to measure analog voltage and display it in 7-segment display devices. The instrument has
    a) an ADC at input and DAC at the output  b) an ADC at input
    c) an DAC at input  d) an ADC at output
15. The number of pins in 8255 is
    a) 14  b) 32  c) 16  d) 40
PART-B (2 x 5 = 10 Marks)
Answer Any TWO Questions out of FIVE
All Questions carry equal marks.

16. Explain the interrupt process and the difference between a maskable and non-maskable interrupt
17. Give the operation of the following Intel 8085 instructions.
18. What are the differences of 8085 and 8086 Microprocessors?
19. Explain the data transfer instruction in 8051 Microcontroller
20. Explain DMA Controller (8257).

PART-C (5 x 10 = 50 Marks)
Answer ALL the questions
All Questions carry equal Marks.

21. a) Explain the architecture of 8085 Microprocessor.
   (OR)
   b) Discuss about the hardware and software interrupts.
22. a) Explain the arithmetic and logical instructions of 8085 Microprocessor.
   (OR)
   b) Discuss the addressing modes of 8085 Microprocessor.
23. a) Explain the register data and immediate addressing modes of 8086.
   (OR)
   b) Enumerate the segment and flag registers with diagram.
24. a) Explain the architecture of 8051 Microcontroller.
   (OR)
   b) Describe the logical instruction set of 8051 with examples.
25. a) Explain the interfacing of 8255 with neat block diagram.
   (OR)
   b) Explain the A/D converter using 0809.
Choose the Correct answer:

1. The high energy yield ratio is called______energy sources.
   a).primary  b).secondary  c).supplementary  d). all of the above
2. Solar energy, wind energy and water energy are ____ energy sources.
   a).primary  b). secondary  c). supplementary  d).all of the above
3. The increase in population and standard of living causes______crisis.
   a).financial  b).energy  c).water  d).energy and water
4. Three types of solar______are pressurized, non-pressurized and forced circulation.
   a).water heating  b). water cooling  c). space heating  d). space cooling
5. Space heating are of two types, namely______and______.
   a).active and passive  b). normal and moderate
   c). collector and detector  d). none of the above
6. Two types of absorption air conditioners are______water and ammonia water.
   a). lithium bromide b). lithium fluoride c). lithium iodide d). all of the above
7. The efficiency of the solar cells is______
   a). 15%  b). 20%  c). 35%  d). 50%
8. ____cell is the source of energy for satellite.
   a).Solar  b).Fuel  c).Electric  d).None of these
9. The current density of a photovoltaic ranges from______.
10. The combination of wind turbine and generator is referred as______.
11. The cost of power generation from wind force is ____ Diesel power.
    a).lower than  b). higher than  c). moderate  d).equal to
12. Wind pattern at any particular site remain______year by year.
    a).variable  b). decrease  c).increase  d).constant
13. The term Bio-mass most often refers to______
    a). Inorganic matter  b). Organic matter
    c). Chemicals  d). Ammonium compounds
14. Bio-mass is useful to reduce______________.
15. Which one of the following is an example of starch crops biomass feed stocks

PART-B (2 x 5 = 10 Marks)
Answer Any TWO Questions out of FIVE
All Questions carry equal marks.

16. What are primary and secondary energy sources?
17. Describe briefly thermal electric conversion from solar energy.
18. What are the differences between single crystal silicon solar cells and polycrystalline silicon solar cells?
19. Explain the components of wind electric systems with suitable diagrams.
20. Explain an aerobic digestion and its principle.

**PART-C (5 x 10 = 50 Marks)**

Answer ALL the questions
All Questions carry equal Marks.

21. a). What are the conclusions of alternate energy strategies?
   (OR)
   b). What are the conventional or non-conventional energy sources? Describe briefly.

22. a). Design the principle and construction of a box type solar cooker?
   (OR)
   b). Briefly explain the principle and construction of a solar distillation?

23. a). Explain the principle and working of a single crystal silicon solar cells.
   (OR)
   b). Explain principle and working of a polycrystalline silicon solar cells.

24. a). Briefly explain the types of horizontal axis wind machine.
   (OR)
   b). Discuss the applications of Geothermal energy

25. a). Explain the process of photosynthesis. What are the conditions, which are necessary for it?
   (OR)
   b). How biogas plants are classified? Explain them briefly.
GROUP A: OPTICAL PHYSICS & LASERS
1. Determine the Young’s modulus of glass plate and Poisson’s ratio of the given glass plate by forming Elliptical fringes.
2. Determine the velocity of Ultrasonic waves in the given liquid using Ultrasonic Interferometer. Also determine the Compressibility of the given liquid.
3. Determine the Refractive index of two liquids using Laser.
4. Determine (i) the thickness of Fabry-Perot Etalon
   (ii) the change in wavelength for shift of one fringe and
   (iii) the change in wavelength of a satellite line associated with a main line
5. Determine the permittivity of a liquid using R.F. Oscillator
6. Determine (i). Thickness of a wire (ii). Diameter of a circular aperture and
7. Determine the value of Rydberg’s constant using Hydrogen Spectrum.
8. Determine the wavelength of a Laser by Michelson Interferometer.

GROUP B: THERMODYNAMICS, MODERN PHYSICS & SOLID STATE PHYSICS
9. Using the given experimental setup, determine the value of Stefan's constant.
10.Determine the Temperature coefficient and band gap energy of the given thermistor.
11.Determine the resistivity of a Semiconductor by Four Probe Method.
12.Determine the Susceptibility of a paramagnetic solution by Quincke’s method.
13.Verify the Inverse square law using GM Counter.
14.Determine the following using Hall effect in Semiconductor:
   (i). Charge of the carriers (ii).Hall voltage
   (iii).Hall Coefficient (iv).Carrier density
15. Determine the magnetic susceptibility of solution at different concentrations using Gouy’s Method.
GROUP A: ANALOG ELECTRONICS
1. Construct an JFET amplifier circuit, based on its output draw the characteristic curve.
2. Study the operation and characteristics of SCR and determine the forward break over voltage.
3. Construct a single stage RC coupled amplifier and study its frequency response.
4. Design adder and subtractor circuits using OPAMP and study their outputs for five different input voltages.
5. Design Schmitt Trigger circuit using IC 741 and study its function.
6. Study the Photo Transistor characteristics behavior using suitable circuit.
7. Construct a Relaxation Oscillator using the given UJT and determine the frequency of oscillations.
8. Construct a monostable multivibrator using IC 555 and measure the pulse width for different R and C values. Also, Construct and study the behaviour of bistable multivibrator using IC 555 timer.

GROUP B: DIGITAL ELECTRONICS
9. Using NAND gates, construct a half-adder and full-adder circuit and verify its outputs.
10. Construct the BCD counter circuit and verify its operation.
12. Study the function of Multiplexer and Demultiplexer using suitable circuit.
13. Using suitable circuit, show the output of a Decoders and Encoders.
PRACTICAL MODEL QUESTION PAPER PATTERN
M.Sc PHYSICS DEGREE EXAMINATION
Semester – III
CORE PRACTICAL - III – MICROPROCESSOR PROGRAMMING EXPERIMENTS

Time: 4 Hours  Maximum Marks: 75

GROUP A: 8085 MICROPROCESSOR PROGRAMMING EXPERIMENTS

1. Write and execute the 8-bit Addition and Subtraction programs in 8085 microprocessor
2. Write and execute the Number conversion programs BCD to Binary and Binary to BCD
3. Write and execute the program for Factorial of a given number
4. Write and execute the program for largest and smallest number in a set of numbers
5. Write and execute the programs for interfacing of DAC with 8085 microprocessors to generate square, saw tooth and triangular waves
6. Write and execute the program for Traffic Light Control Interface with 8085 microprocessor
7. Write and execute the program for design of digital Clock using 8085 microprocessor
8. Write and execute the program for sum of ‘n’ numbers using 8085 microprocessor
9. Write and execute the program for program to reverse the given string using 8085 microprocessor

GROUP B: 8086 MICROPROCESSOR PROGRAMMING EXPERIMENTS

10. Write and execute the program for largest and smallest number in a set of numbers
11. Write and execute the program for searching a number or character in a string
12. Write and execute the program to determine the sum of elements in an array
PRACTICAL MODEL QUESTION PAPER PATTERN
M.Sc PHYSICS DEGREE EXAMINATION
Semester - IV
CORE PRACTICAL – IV - MICROCONTROLLER &
C++ PROGRAMMING EXPERIMENTS
Time: 4 Hours
Maximum Marks: 75

Group A: 8051 MICROCONTROLLER PROGRAMMING
1. Write and execute the 16-bit Addition and Subtraction programs in 8051 microcontroller
2. Write and execute the program for largest and smallest number in a set of numbers
3. Write and execute the program for generation of square, triangular, saw tooth waves
4. Write and execute the program for Code conversion programs - Micro Controllers
5. Write and execute the program for interfacing Stepper motor control using Microcontrollers
6. Write and execute the program for interfacing Seven segment display using Microcontrollers

Group B: C++ PROGRAMMING
7. Write a C++ programme for Matrix multiplication
8. Write a C++ programme to find Eigen values of a given matrix
9. Write a C++ programme to find the transpose and inverse of a matrix
10. Write a C++ programme to find the straight line fit by the method of least squares
11. Write a C++ programme to find the Numerical integration by Simpson’s rules and Trapezoidal rule
12. Write a C++ programme to find the solution of differential equation by Fourth order Runge-Kutta Method