SYLLABUS

M.Sc. PHYSICS

(Semester Scheme)

M.Sc. (Previous) Examination 2015-16
M.Sc. (Final) Examination 2016 -17

JAI NARAIN VYAS UNIVERSITY
JODHPUR
The Department of Physics was established in the year 1962 in Science Faculty, New Campus. Since then the Department has flourished under the guidance of renowned physicist and researchers. The department is equipped with modern laboratories and library. Sixteen devoted faculty members are making continuous efforts to further enhance the teaching and research activities in the department. Presently, the department is strengthened by three Professors, five Associate Professors and eight Assistant Professors, having expertise in different branches of Physics.

The department is conducting B. Sc. Regular Course, M. Sc. Physics Semester Course with CBCS and Ph. D. Course.

The major research areas in which the department has contributed remarkably are: Dielectric Spectroscopy, Polymer Physics, Solid Polymer Electrolytes, Nanodielectrics, Organic Semiconductors, Mossbauer Spectroscopy, Atomic and Molecular Spectroscopy, Multiferroic, Superconductors, Quantum Optics, Atomic Physics, Computational Physics, Theoretical Solid State Physics and X-Ray Spectroscopy. The department is equipped with XRD, High Energy Planetary Ball Mill, Computational Facilities, Mossbauer Spectroscopy, Dielectric Spectroscopy.

The department has been continuously receiving grants from the government funding agencies for development of infrastructure and research facilities. The recent funds received are DST-FIST grant, UGC-SAP DRS level-I and level-II grant, Major projects from UGC and DST granted to individual researchers and research fellowship to the students under UGC-BSR scheme.

The department has published more than 200 research papers in various International and National research journals of high impact factor during last one decade. The faculty members have been nominated as member of the editorial board of various International Journals. Post doctoral students from our department have been awarded Young Scientist project of SERB-DST and Research Associateship of CSIR.
MASTER OF SCIENCE (M. Sc.)

PHYSICS

M. Sc. Physics is a two years Post Graduate Degree Course, comprising of four Semesters, for regular students. There are two Semesters in each year (Academic Session). M. Sc. I Year comprised of Semester I and Semester II. Similarly, M. Sc. II year comprised of Semester III and Semester IV.

**FACULTY MEMBERS**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Teacher</th>
<th>Area of Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Prof. D.K. Sharma</td>
<td>Atomic Physics, Computational Physics</td>
</tr>
<tr>
<td>2.</td>
<td>Prof. R.J. Sengwa</td>
<td>Electronics, Dielectric Relaxation Spectroscopy, Materials Science, Polymeric Nanodielectric, Solid Polymer Electrolytes (Head)</td>
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<tr>
<td>3.</td>
<td>Prof. S.K. Sharma</td>
<td>Solid State Physics, Electronics</td>
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<td>4.</td>
<td>Dr. (Mrs.) Beena Bhatia</td>
<td>Molecular Spectroscopy, Glasses</td>
</tr>
<tr>
<td>5.</td>
<td>Dr. R.S. Singh</td>
<td>Solid State Physics, Condensed Matter Physics</td>
</tr>
<tr>
<td>6.</td>
<td>Dr. H.S. Singh</td>
<td>Mössbauer Spectroscopy, Superconductor, Ferrites</td>
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<td>7.</td>
<td>Dr. A.K. Gupta</td>
<td>Molecular Spectroscopy</td>
</tr>
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<td>8.</td>
<td>Dr. K.R. Patel</td>
<td>Mössbauer Spectroscopy, X-Ray</td>
</tr>
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<td>9.</td>
<td>Dr. K. Dhoot</td>
<td>X-Ray, Mossbauer Spectroscopy</td>
</tr>
<tr>
<td>10.</td>
<td>Dr. Sahi Ram</td>
<td>Mössbauer Spectroscopy, X-Ray Physics</td>
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<td>11.</td>
<td>Mr. Giriraj Chayal</td>
<td>Solid State Physics</td>
</tr>
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<td>12.</td>
<td>Mr. S. S. Meena</td>
<td>Molecular Spectroscopy</td>
</tr>
<tr>
<td>13.</td>
<td>Mr. S. L. Meena</td>
<td>Molecular Spectroscopy</td>
</tr>
<tr>
<td>14.</td>
<td>Dr. Manu Smrity</td>
<td>Semiconductor Electronics</td>
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<tr>
<td>15.</td>
<td>Dr. Uttam Paliwal</td>
<td>Condensed Matter Physics, Computational Materials Science</td>
</tr>
<tr>
<td>16.</td>
<td>Dr. Shiv Kumar Barwar</td>
<td>Condensed Matter Physics</td>
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</tbody>
</table>
GUIDELINES FOR CHOICE BASED CREDIT SYSTEM IN M. Sc. PHYSICS

DEFINITIONS OF KEY WORDS:

1. **Academic Year**: Two consecutive (one odd + one even) semesters constitute one academic year.

2. **Choice Based Credit System (CBCS)**: The CBCS provides choice for students to select from the prescribed elective and skill courses. A student needs to select two elective papers offered by the Department in which he/she is doing core course. This shall be part of core programme during third and fourth semester. Each student has to complete four skill courses; two within the Department and two from other Department within JNV University or the Universities approved by JNV University.

3. **Course**: Usually referred to, as ‘papers’ is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/tutorials/laboratory work/field work/project work/self-study etc. or a combination of some of these.

4. **Credit Based Semester System (CBSS)**: Under the CBSS, the requirement forwarding a degree is prescribed in terms of number of credits to be completed by the students.

5. **Credit Point**: It is the product of grade point and number of credits for a course.

6. **Credit**: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one period of teaching (lecture or tutorial) or two periods of practical work/field work per week.

7. **Cumulative Grade Point Average (CGPA)**: It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

8. **Grade Point**: It is a numerical weight allotted to each letter grade on a 10-point scale.
9. **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.

10. **Programme:** An educational programme leading to award of the Postgraduate Degree in the Core subject in which he/she is admitted.

11. **Semester Grade Point Average (SGPA):** It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

12. **Semester:** Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to November/December and even semester from December/January to May. **Odd semester University examination shall be during second/third week of December and even semester University examination shall be during second/third week of May. The Department shall conduct the Practical examinations with a board of internal and external examiners prior to commencement of End semester theory examination.**

13. **Transcript or Grade Card or Certificate:** Based on the grades earned, a statement of grades obtained shall be issued to all the registered students after every semester. This statement will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

**Fairness in Assessment:**
Assessment is an integral part of system of education as it is instrumental in identifying and certifying the academic standards accomplished by a student and projecting them far and wide as an objective and impartial indicator of a student’s performance. Accordingly the Departments of the Faculty of Science resolves the following:

- All internal assessments shall be open assessment system only and that are based on Quizzes, term test and seminar.
- Attendance shall carry the prescribed marks in all papers and Practical examination internal assessment.
- In each semester as far as possible, two out of four theoretical component University examination shall be undertaken by external examiners from outside the university conducting examination, who may be appointed by the competent authority.
Grievances and Redressal Mechanism

a) The students will have the right to make an appeal against any component of evaluation. Such appeal has to be made to the Head/Principal of the College or the Chairperson of the University Department concerned as the case may be clearly stating in writing the reason(s) for the complaint / appeal.

b) The appeal will be assessed by the Chairman and he/she shall place before the Grievance Redressal Committee (GRC), Chaired by the Dean, Faculty of Science, comprising all HODs of the Faculty and if need be Course Teacher(s) be called for suitable explanation; GRC shall meet at least once in a semester and prior to CCA finalization.

c) The Committee will consider the case and may give a personal hearing to the appellant before deciding the case. The decision of the Committee will be final.

Table 1: Grades and Grade Points

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Letter Grade</th>
<th>Meaning</th>
<th>Grade Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>‘O’</td>
<td>Outstanding</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>‘A+’</td>
<td>Excellent</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>‘A’</td>
<td>Very Good</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>‘B+’</td>
<td>Good</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>‘B’</td>
<td>Above Average</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>‘C’</td>
<td>Average</td>
<td>5</td>
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<tr>
<td>7</td>
<td>‘P’</td>
<td>Pass</td>
<td>4</td>
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<td>8</td>
<td>‘F’</td>
<td>Fail</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>‘Ab’</td>
<td>Absent</td>
<td>0</td>
</tr>
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</table>

i. A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.

ii. For noncredit courses (Skill Courses) ‘Satisfactory’ or ‘Unsatisfactory’ shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

Grade Point assignment

- = and > 95 % marks Grade Point 10.0
- 90 to less than 95 % marks Grade Point 9.5
- 85 to less than 90 % marks Grade Point 9.0
- 80 to less than 85 % marks Grade Point 8.5
- 75 to less than 80 % marks Grade Point 8.0
- 70 to less than 75 % marks Grade Point 7.5
- 65 to less than 70 % marks Grade Point 7.0
- 60 to less than 65 % marks Grade Point 6.5
- 55 to less than 60 % marks Grade Point 6.0
- 50 to less than 55 % marks Grade Point 5.5
- 45 to less than 50 % marks Grade Point 5.0
- 40 to less than 45 % marks Grade Point 4.5
- 35 to less than 40 % marks Grade Point 4.0
Computation of SGPA and CGPA:

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

\[ \text{SGPA} (S_i) = \frac{\Sigma (C_i \times G_i)}{\Sigma C_i} \]

Where \( C_i \) is the number of credits of the \( i \)th course and \( G_i \) is the grade point scored by the student in the \( i \)th course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

\[ \text{CGPA} = \frac{\Sigma (C_i \times S_i)}{\Sigma C_i} \]

where \( S_i \) is the SGPA of the \( i \)th semester and \( C_i \) is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for SGPA

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course</th>
<th>Credit</th>
<th>Grade letter</th>
<th>Grade point</th>
<th>Credit Point (Credit x Grade)</th>
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<tbody>
<tr>
<td>1</td>
<td>Course 1</td>
<td>4</td>
<td>B</td>
<td>6</td>
<td>4 x 6 =24</td>
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<tr>
<td>2</td>
<td>Course 2</td>
<td>4</td>
<td>B+</td>
<td>7</td>
<td>4 x 7 =28</td>
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<tr>
<td>3</td>
<td>Course 3</td>
<td>4</td>
<td>B</td>
<td>6</td>
<td>4X 6 =24</td>
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<tr>
<td>4</td>
<td>Course 4</td>
<td>4</td>
<td>O</td>
<td>10</td>
<td>4 X 10 =40</td>
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<tr>
<td>5</td>
<td>Course 5- Practical I</td>
<td>4</td>
<td>C</td>
<td>5</td>
<td>4 X 5 =20</td>
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<tr>
<td>6</td>
<td>Course 6 – Practical II</td>
<td>4</td>
<td>B</td>
<td>6</td>
<td>4 X 6 = 24</td>
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<tr>
<td></td>
<td>Total</td>
<td>24</td>
<td></td>
<td></td>
<td>24+28+24+40+20+24 =160</td>
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</table>

Thus, \( \text{SGPA} = \frac{160}{24} =6.67 \)

Illustration for CGPA

<table>
<thead>
<tr>
<th></th>
<th>Semester- I</th>
<th>Semester-II</th>
<th>Semester-III</th>
<th>Semester-IV</th>
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<tr>
<td>Credit</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
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<tr>
<td>SGPA</td>
<td>6.67</td>
<td>7.25</td>
<td>7</td>
<td>6.25</td>
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</tbody>
</table>
CGPA = \[
(24 \times 6.67 + 24 \times 7.25 + 24 \times 7 + 24 \times 6.25)/96
\]

652.08/96 = 6.79

**SEMESTER-WISE THEORY PAPERS/ PRACTICALS/ SKILL COMPONENTS**

<table>
<thead>
<tr>
<th>Type of course</th>
<th>Course code</th>
<th>Title of the Course</th>
<th>Lecture-Tutorial Practical/ Week</th>
<th>No. of credits</th>
<th>Continuous Comprehensive Assessment (CCA)</th>
<th>End-Semester Examination (ESE) [University Examinations]</th>
<th>Total</th>
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<td>PH-101</td>
<td>Statistical Physics</td>
<td>4-0-0</td>
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<td>PH-102</td>
<td>Electronic Circuits and Instrumentation</td>
<td>4-0-0</td>
<td>4</td>
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<td>Core course 3</td>
<td>PH-103</td>
<td>Quantum Mechanics</td>
<td>4-0-0</td>
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<td>30</td>
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<td>PH-104</td>
<td>Computational Physics</td>
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<tr>
<td>Core course practical 1</td>
<td>PH-105</td>
<td>Electronics Laboratory</td>
<td>0-0-8</td>
<td>4</td>
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<td>PH-106</td>
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<td>Skill Course I</td>
<td>PH-107</td>
<td>Materials Science I</td>
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<td>24</td>
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<td>Numerical Methods</td>
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<td>General Physics and Laser Laboratory</td>
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<td>LAB</td>
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<td>Application of Software Packages</td>
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<td>Materials Science II</td>
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<td>Core course 11</td>
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<td>Discipline Specific Elective 3</td>
<td>PH-403</td>
<td>Molecular and Resonance Spectroscopy</td>
<td>4-0-0</td>
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<td>Discipline Specific Elective 4</td>
<td>PH-404</td>
<td>Solid State Physics</td>
<td>4-0-0</td>
<td>4</td>
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<td>70</td>
<td>100</td>
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<td>Core course practical 6</td>
<td>PH-405</td>
<td>Communication and Microwave Electronics</td>
<td>0-0-8</td>
<td>4</td>
<td>30</td>
<td>70</td>
<td>100</td>
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</tbody>
</table>
* Each Department shall offer two skill courses per semester from the list of skill courses approved for the Department.

The Department is free to distribute the Periods between Theory/Tutorial/Practical as per the Course content and the need of the course. However the selection shall be from any one of the following pattern

1. 4 : 0 : 0 (four lectures only (no tutorial and no practical) per week).
2. 2 : 1 : 1 (two lectures, one tutorial, and one practical per week).
3. 0 : 2 : 2 (no lecture, two tutorials, and two practicals per week).
4. 1 : 2 : 1 (one lecture, two tutorials, and one practical per week).
5. 2 : 2 : 0 (two lectures, two tutorials, and no practical per week).
6. 0 : 4 : 0 (no lecture, four tutorials only, and no practical per week).
7. 1 : 1 : 2 (one lecture, one tutorial, and two practicals per week).
8. 2 : 0 : 2 (two lectures, no tutorial, and two practicals per week).
9. 0 : 0 : 4 (no lecture, no tutorial, and four practicals only per week).
10. 1 : 0 : 3 (one lecture, no tutorial, and three practicals per week).
11. 3 : 1 : 0 (three lectures, one tutorial, and no practical per week).
12. 0 : 1 : 3 (no lecture, one tutorial, and three practicals per week).
13. 1 : 3 : 0 (one lecture, three tutorials, and no practical per week).
14. 3 : 0 : 1 (three lectures, no tutorial, and one practical per week).
15. 0 : 3 : 1 (no lecture, three tutorials, and one practical per week).

The Duration of the Period shall be forty five minutes. In each of these combinations, the first value stands for the same number of lecture instructions per week, whereas the last two values stand for double the number of tutorial / practical instructions per week.

In each practical group the maximum number of students that can be accommodated will be 15 as decided by the Department Council. The workload is to be computed accordingly.

Course Evaluation (Evaluation of the Students)
All courses (Core/ Elective) involve an evaluation system of students that has the following two components:-

(i) Continuous Comprehensive Assessment (CCA) accounting for 30% of the final grade that a student gets in a course; and

(ii) End-Semester Examination (ESE) accounting for the remaining 70% of the final grade that the student gets in a course.
Continuous Comprehensive Assessment (CCA): This would have the following components:

a. **Quizzes**: Two Quiz examinations of 45 minutes duration each having a maximum of 40 marks shall be arranged for theory paper during the semester course period.

b. **Term Test**: One term test shall be arranged for each theory paper prior to University End Semester Examination (ESE); examination duration shall be of three hours; maximum marks is 70.

c. **Seminar**: Each student shall prepare and deliver a seminar per theory paper; maximum marks shall be 15. The seminar shall commence after first quiz examination and shall be completed prior to term test for all the papers.

d. **Classroom Attendance**: Each student will have to attend a minimum of 75% Lectures / Tutorials / Practicals. A student having less than 75% attendance will not be allowed to appear in the End Semester Examination (ESE). Attendance shall have 15 marks and will be awarded by following the system proposed below:

Those having greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to percent attendance) will be awarded CCA marks as follows:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>CCA Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>75% to 80%</td>
<td>3 marks</td>
</tr>
<tr>
<td>80% to 85%</td>
<td>6 marks</td>
</tr>
<tr>
<td>85% to 90%</td>
<td>9 marks</td>
</tr>
<tr>
<td>90% to 95%</td>
<td>12 marks</td>
</tr>
<tr>
<td>&gt; 95%</td>
<td>15 marks</td>
</tr>
</tbody>
</table>

All students’ cumulative attendance shall be displayed in the Department Notice Board every month with a copy to the Dean, Faculty of Science.

e. CCA are based on open evaluation system without any bias to any student

f. Any grievance received in the Department from student shall be placed before the **Grievance Redressal Committee** with adjudicated comments

Each component marks will be added without rounding and the total thus obtained is ratio by a factor of six. This value shall be rounded.

Illustration: Quiz 1 – Marks obtained = 30
Quiz 2 – Marks obtained = 35.5
Term Test Marks obtained = 50.5
Seminar Marks obtained = 14
Attendance Marks obtained = 9
Total = 139.00
Conversion = 139/6 = 21.6666
Award = 22.00

**Skill Course Evaluation**: Based on student performance and hands on practice, the respective Department shall declare the result as “Satisfactory” or “Non-Satisfactory”; each student need to get a minimum of three “Satisfactory” declaration for the course completion

In laboratory courses (having only practical (P) component), the CCA will be based on students attendance (50%); hands on Practical in physical science stream (50%) and collection of biological material (25%) and hands on Practical (25%) in biological and earth science stream.

For QUIZ (2 quizzes per semester), 40 marks per Quiz and total of 80 marks, 45 minutes
duration for each quiz:

<table>
<thead>
<tr>
<th>Types of question</th>
<th>Number of Questions</th>
<th>Marks Per question</th>
<th>Total marks per type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Multiple choice</td>
<td>10</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2. Fill in the blanks</td>
<td>10</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3. Short answer (15 words)</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td></td>
<td><strong>40</strong></td>
</tr>
</tbody>
</table>

For the Term test and End Semester Examination (ESE):

**Part A**

Ten short type questions including definitions, functions, short explanations, etc. (answer upto 30 words) for two marks each. Total $10 \times 2 = 20$ marks; two questions from each Unit; no choice in this part.

**Part B**

Five questions (answers upto 250 words) for four marks each. Total $5 \times 4 = 20$ marks; one question from each Unit with internal choice.

**Part C**

Five questions of long/explanatory Answer (500 words) type, one drawn from each Unit; student need to answer any three; ten marks each; Total $3 \times 10 = 30$ marks

Each core/ elective course total marks $20+20+30 = 70$ marks

Qualifying for Next semester

1. A student acquiring minimum of 40% in total of the CCA of each course separately is eligible to join next semester.

2. A student who does not pass the examination (CCA+ESE) in any course(s) (or due to some reason as he/she not able to appear in the ESE, other conditions being fulfilled, and so is considered as ‘Fail’), shall be permitted to appear in such failed course(s)’ in the subsequent ESE to be held in the following October / November or April / May, or when the course is offered next, as the case may be.

3. A student who fails in one or more papers in a semester shall get three more chances to complete the same; if he/she fails to complete the same within the prescribed time i.e. three additional chances for each paper; the student is ineligible for the Postgraduate degree in the Subject in which he/she is admitted. Additional chances examination fee shall be on additive basis.

Improvement Option:

Every student shall have the opportunity to improve Credit thorough University Examination only. Improvement opportunity for each paper is only with two additional chances; improvement examination fee shall be on additive basis; the Credit obtained in improvement examination shall be final. There shall be no improvement opportunity in Practical examinations.

Result Declaration:

The ESE (End Semester Examination i.e. University Examination) results shall be declared within twenty days of the last examination. The Theory/ Practical Classes of even semesters shall begin from the next day of ESE; whereas odd semester classes shall commence after summer vacation.
M. Sc. Physics Syllabus
(CBCS and CBSS based)

M. Sc. Physics I Year (2015-2016)

SEMESTER I

PH-101 STATISTICAL PHYSICS

UNIT-1
Partition Function: Canonical partition function, Molecular partition function, Translational partition function, Rotational partition function, Vibrational partition function, Electronic and Nuclear partition function, application of rotational partition function, homonuclear molecules and nuclear spin, application of vibrational partition function to solids, vapour pressure, chemical equilibrium, Real gas.

UNIT-2
Ideal Bose-Einstein Gas: Bose-Einstein distribution, Bose Einstein condensation, Thermodynamic properties of an ideal Bose Einstein gas, Liquid Helium, Two fluid model of liquid helium II, Landau spectrum of phonons and rotons, $^3$He-$^4$He mixtures, Superfluid phases of $^3$He.

UNIT-3
Ideal Fermi-Dirac Gas: Fermi-Dirac distribution, Degeneracy, Electrons in metals, Thermionic emission, Magnetic susceptibility of free electrons, White dwarf, Nuclear matter.

UNIT-4
Semiconductor statistics: Statistical equilibrium of free electrons in semiconductors, Non-degenerate case, Impurity semiconductors, Degenerate semiconductors, Occupation of donor levels, Electrostatic properties of p-n junction.

UNIT-5
Non-equilibrium states: Boltzmann transport equation, Particle diffusion, Electrical conductivity, Thermal conductivity, Isothermal Hall effect, Non-equilibrium semiconductors, electron hole recombination, quantum Hall effect.

Books Suggested
Huang, Statistical Mechanics
UNIT-1
DC power supply: Full wave bridge rectifier circuit with various filters and their working, regulated dc power supply, transistor series and shunt regulator circuit, IC voltage regulators (78XX, 79XX and LM317), switching action of PN junction diode and transistor, diode reverse recovery time and its measurement methods.

UNIT-2
Oscillators: Block diagram of electronic oscillator and required oscillatory conditions, RC phase shift oscillator, Wein bridge oscillator, Hartley and Colpitt’s oscillators, astable multivibrator, UJT relaxation oscillator, voltage and current sweep generators.

UNIT-3
Op Amp applications: Op Amp basics, virtual ground concept, inverting and non-inverting Op Amp voltage gain, circuits of Op Amp sign changer, constant multiplier, adder, subtractor, integrator, differentiator, log and antilog amplifier, comparator and waveform generator.

UNIT-4
Instrumentation I: Block diagram of standard signal generator and its characteristic, FETVM, digital multimeter, frequency counter, harmonic distortion analyser, block diagram of CRO and its uses in amplitude, frequency, phase and bandwidth measurements.

UNIT-5
Instrumentation II: Transducers, block diagram of analog and digital data acquisition system, multiplexers, IC555 and its use in square and triangular waveform generator, Fourier analysis of square wave, origin of bio-electrical signals, ECG and Sonography.

Books suggested
Allen Mottershead, Electronic Devices and Circuits, PHI
A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI
Jacob Millman and Herbert Taub, Pulse, Digital and Switching Waveforms, TMH
Robert Boylestad and Louis Nasheslsky, Electronic Devices and Circuits, PHI
R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, PHI
Abraham Pallas, Electronic devices and circuit Analysis, CBS
N. N. Bhargaya, DC Kulshreshtha and S. C. Gupta, Basic Electronics and Linear Circuits, TMH
PH- 103 QUANTUM MECHANICS

UNIT-1
Matrix representation of operators, Unitary transformations, Diagonalization of Observable operators, Illustration using two state systems.
Coordinate and momentum representation, Gaussian wave packets, Compatible and incompatible observables, simultaneous eigenkets of maximum set of compatible observables, Heisenberg uncertainty principle.

UNIT-2
One dimensional simple harmonic oscillator, eigenkets and eigenvalues by operator method, creation and annihilation operators, eigenkets in coordinate representation
Schrodinger picture, Heisenberg picture and Interaction picture.
Identical particles: The identity of particles, the indistinguishability principle, symmetry of wave function, spin and statistics, the Pauli’s exclusion principle.
Variation Method: Principle and application to linear harmonic oscillator and Helium atom.

UNIT-3
Time independent perturbation theory: Non degenerate case, simple applications including anharmonic oscillator and linear harmonic oscillator. Degenerate case applications to linear stark effect and Zeeman effect in Hydrogen atom
Time independent perturbation theory: Constant perturbation, Transition to continuum, Fermi’s golden rule, harmonic perturbation.

UNIT-4
Symmetries and Angular Momentum: Symmetry transformation and conservation laws, invariance under space translation, space rotation and time translation. Conservation of momentum, energy and angular momentum.
Angular momentum operators and their Eigenvalues and their eigenstates (angular momentum states), matrix representations of the angular momentum operators and their eigenstates, coordinate representations of the orbital angular momentum operators and their eigenstate (Spherical Harmonics).
Solution of Schrodinger equation for hydrogen atom, energy levels and stationary wave functions.

UNIT-5
Addition of angular momenta, Clebsch-Gordon (C.G) Coefficients, C.G coefficients for addition of \( j_1=1/2 \) and \( j_2=1/2 \). Tensor operators and Wigner Eckart theorem, Tensor operators for Electric dipole, electric quadrupole, and magnetic dipole operators. Expectation values of these operators for angular momentum states and selection rules for electric dipole, electric quadrupole and magnetic dipole transitions.

Books Suggested
Ashok Das and A.C.Melissions, Quantum Mechanics-A modern approach, Gordon & Breach Science Publication.
Ghatak and Loknathan, Quantum Mechanics-Theory and Applications, Macmillan (2010),
V.K. Thankappam, Quantum Mechanics, New Age International (1985).
PH 104  COMPUTATIONAL PHYSICS

UNIT-1
Problem solving through computers, algorithms, flow charts, programming languages, low level and high level language, interpreter and compilers, program development procedures. Errors in numerical calculations: Fixed and floating point representation, consequences of floating point arithmetic, rounding off of numbers, absolute and relative errors. Errors in computation: syntax error, logical error, error due to finite storage and approximation of infinite processes.

UNIT-2
Programming language C: Data types, qualifiers, constants, identifiers, variables, variable declaration, arithmetic operators: binary and unary operators, expressions. Preprocessor directives, including header files, library functions. Data input and output: getchar and putchar, scanf, control string, conversion characters, formatting input, field width, printf, conversion character and escape sequence, formatting output, field width and precision parameters, use of flags, string input/ output, gets and puts.

UNIT-3
Relational operators, relational expressions, logical operators transfer of control: if – else and switch-case statements. Repetitive statements: for loop, while and do-while statements, nesting of loops, continue and break statements. Arrays in C: one dimensional and multidimensional arrays, defining, declaring and initializing arrays.

UNIT-4
Functions in C program: Storage classes, static and external variable declaration, main function, return statement, defining a function, function declaration, function call, function prototype, passing arguments to a function, local and global parameters, call by value and call by reference, passing arrays to a function, recursion, static and external function definition.

UNIT-5
Pointers in C: pointer data type, declaration of pointers, indirection, operation on pointer variables, pointers and arrays, dynamic memory allocation, malloc function, pointer to array and array of pointers, pointer to a function. Files in C: opening and closing a data file, creating a data file, processing a data file.

Books Suggested
Rajaraman, Computer Programming in C, Prentice Hall of India.
1. Design and study of dc power supply with various filters and IC regulator
2. Design and study of Op Amp differentiator, integrator and log amplifier circuit
3. Design and study of different voltage gain inverting Op Amps and determination of frequency response using CRO
4. Waveform study of an astable multivibrator
5. Frequency response and input and output impedance study of current series negative feedback amplifier
6. Fourier analysis of a square wave, triangular wave and half rectified wave
7. Design and study of UJT saw tooth waveform generator
8. Carriers life time measurements by reverse recovery method
9. Carriers life time measurements by open circuit method
10. Design and study of diode and transistor switching behavior and their operating point
11. Design and study of RC phase shift oscillator/ Wein bridge oscillator
12. Design and study of Hartley oscillator
13. Design and study of Colpitt oscillator
14. Design and study of digital timing circuit using IC555
PH-106  COMPUTATIONAL PHYSICS LABORATORY

Note: Students are required to perform following experiments using programming language C.

1. Calculate Legendre polynomial of different orders
2. Calculate Hermite Polynomial of different orders
3. Calculate and plot Plank’s distribution function
4. Calculate and plot Maxwell’s distribution function
5. Calculate an infinite series up to desired accuracy
6. Calculate standard deviation of given data
7. Calculate frequency distribution of given data and plot histogram
8. Calculate some periodic functions using Fourier Series
9. Calculate cross sections of some physical processes using given formula
10. Calculate the wave function of Harmonic oscillator and plot it for one period
11. Calculate and plot energies and radial wave functions for a square well potential for a few lower l-values
12. Find product of two square matrices
PH-107  MATERIALS SCIENCE I

Glasses: Definitions, properties; Structural features: Atomic arrangement, chemical composition; Optical features: Transparency, linear and non-linear refractive index and dispersion, Classification of glasses by preparation method, Glass by melt-quenching technique, Glass by chemical vapor deposition, Glass by sol-gel process. Important glass systems: oxide glasses, Halide and chalcogenide glasses.

Solid Polymer Electrolytes (SPEs): Applications of SPEs, importance of SPEs over ion conducting glass and liquid electrolytes, polymer-alkali metal salt interactions, salt dissociation and formation of ion dipolar complexes, conductivity requirement of SPE films for lithium ion batteries, preparation methods of solid polymer electrolytes, structural characterization, electrical characterization, ac and dc ionic conductivity, concept of ion transportation, importance of inorganic nanofiller in SPE films, electrolytes with nano filters.

Multiferroic materials: Types of ferroic materials, Magneto electric effect, Thermodynamic theory of magnetostatic effect, single phase and composite multiferroic materials, different synthesis and characterization techniques, recent trends and future prospectus of magneto electric multiferroic materials.

Practicals
1. Measurement of refractive index and density of glass sample and computation of physical parameters
2. Assignment of various transitions in the absorption spectrum of glass specimen
3. Computation of energy interaction parameters
4. Computation of Judd Ofelt intensity parameters
5. Preparation of solid polymer electrolyte (SPE) film with lithium ion
6. Structural study of SPE film by various techniques
7. Dielectric and electrical study of SPE film
8. Thermal study of SPE film
9. Synthesis of Multi Ferroic Materials
10. Structural Study of Multi Ferroic Materials
11. Dielectric Study of Multi Ferroic Materials

Books Suggested
Masayuki Yamane and Yoshiyuki Asahara, Glasses for photonics, Cambridge University Press 2000
Sujit Jain, Spectral Studies of Rare Earth Doped Borax Glasses Paperback, Scholars’ Press
F. M. Gray, Polymer Electrolytes: Fundamentals and Technological Applications, VCH
T. Minami et al, Solid State Ionics for Batteries, Springer
C. Brechijnac, P. Houdy and M. Lahmani, Nano Materials and Nano Chemistry, European Materials Research Society, Springer
Satishchandra and Ballkrishana Ogale, Functional Matal Oxides, New Science and Novel applications, Wiley - VCH
SEMESTER II

PH-201 NUMERICAL METHODS

UNIT- 1

UNIT- 2

UNIT- 3
Interpolation: Polynomial interpolation, Newton formula for interpolation, Forward differences, Differences of polynomial, Backward differences, Lagrange’s interpolation, Divided differences interpolation and inverse interpolation, Finite difference operators, Spline interpolation, Least square curve fitting, Linear regression.

UNIT- 4
Numerical differentiation, First order derivative by a two point formula, Numerical Integration, Trapezoidal rule of integration, Simpson’s 1/3 rule, Simpson’s 3/8 rule of integration, Double integration, Newton-Cotes formulae of integration, Gaussian integration formula, Gaussian two point formula.

UNIT- 5

Books Suggested
UNIT-1
Pauli’s principle and its mathematical formulation, angular momentum, parity and their selection rules.

UNIT-2
Atoms in external magnetic and electric fields: The normal and anomalous Zeeman Effect, Weak fields-Russel Saunders terms and general case, The intensities of lines in weak fields and quadrupole lines, Paschen Back effect and illustrative example.

UNIT-3
X-ray spectra: Salient features of x-ray emission spectra, K, L and M series spectra and their origin, energy level diagram, selection rules, relative intensities of lines, regular and Irregular doublets and doublet laws, Sommerfield screening constants, Gamma sum and permanence rule.
Non-diagram lines: Origin of non-diagram lines, Wentzel, Richtmyer and Coster Kronig theories, Auger effect, origin of low frequency satellites.

UNIT-4
X-ray diffraction: Diffraction from a crystal -the structure factor in terms of indices of reflection. Convolution, Diffraction by a periodic distribution, The electron density equation.
X-Ray spectrographs: Construction, working and focussing action of (i) Oscillating Plane crystal spectrograph (ii) Bent crystal spectrograph of Cauchois, Johann and Johansson type, Resolving and Dispersive Powers for all the spectrographs.

UNIT-5
Basic elements of a laser: Threshold condition; Four-level laser system, CW operation of laser; Critical pumping rate; Population inversion and photon number in the cavity around threshold; Output coupling of laser power.
Optical resonators; Cavity modes; Mode selection; Pulsed operation of laser: Q-switching and Mode locking; Experimental technique of Q-switching and mode locking
Different laser systems: Ruby, CO₂, Dye and Semiconductor diode laser.

Books Suggested
Raj Kumar, Atomic and Molecular Spectra, Kedarnath Ramnath, Meerut.
Gupta Kumar Sharma, Elements of spectroscopy, Pragati Prakashan (2012)
O. Svelto, Principles of Laser.
UNIT-1
Scattering (non-relativistic) : Differential and total scattering cross section, transformation from CM frame to Lab frame, solution of scattering problem by the method of partial wave analysis, expansion of a plane wave into a spherical wave and scattering amplitude, the optical theorem, Applications-scattering from a delta potential, square well potential and the hard sphere. Scattering of identical particles, energy dependence an resonance scattering. Breit-Wigner formula, quasi stationary states. The Lippman-Schwinger equation and the Green's functions approach for scattering problem, Born approximation and its validity for scattering problem, Coulomb scattering problem under first Born approximation in elastic scattering.

UNIT-2
Relativistic Formulation ad Dirac Equation: Attempt for relativistic formulation of quantum theory, The Klein-Gordon equation, Probability density and probability current density, solution for free particle K.G. equation in momentum representation, Interpretation of negative probability density and negative energy solutions. Dirac equation for a free particle, properties of Dirac matrices and algebra of gamma matrices, non-relativistic correspondence of the Pauli equation (inclusive of electromagnetic interaction). Solution of the free particle Dirac equation, orthogonality and completeness relations for Dirac spinors, interpretation of negative energy solution and hole theory.

UNIT-3
Symmetries of Dirac Equation : Lorentz covariance of Dirac equation, proof of covariance and derivation of Lorentz boost and rotation matrices for Dirac spinors, Projection operators energy and spin, Parity (P), charge conjugation (C), time reversal (T) and CPT operators for Dirac spinors.

UNIT-4
Bilinear covariants, and their transformations, behaviour under Lorentz transformation, P,C,Tand CPT, expectation values of coordinate and velocity involving only positive energy solutions and the associated problems, inclusion of negative energy solution, Zitterbewegung, Klein paradox.

UNIT-5

Books Suggested
Ashok Das and A.C. Milissiones, Quantum mechanics - A Modern Approach, Garden and Breach Science Publishers.
J. J. Sakurai, Advanced Quantum Mechanics, John Wiley.
UNIT-1:
Constraints, Generalised coordinates, D’Alembert’s principle and Lagrange’s equations, Velocity dependant potentials and dissipative function, Simple applications of Lagrangian formulation. Calculus of variations, Hamilton’s variational principle, Derivation of Lagrange’s equations from Hamilton’s principle, Conservation theorems and symmetry properties

UNIT-2:
Generalized momentum, Legendre’s transformation and the Hamilton’s canonical equations of motion, simple applications of Hamiltonian formulation, Cyclic coordinates, Canonical transformation, Different forms of generating function, Examples of canonical transformation, Poisson and Lagrange's brackets, Equation of motion in Poisson bracket formulation, Angular momentum Poisson Bracket relations.

UNIT-3:

UNIT-4:
Fourier Transforms: Development of the Fourier integral from the Fourier Series, Fourier and inverse Fourier transform: Simple Applications: Finite wave train, Wave train with Gaussian amplitude, Fourier transform of derivatives, solution of wave equation as an application. Convolution theorem, Application of Fourier transform to diffraction theory: diffraction pattern of one and two slits

UNIT-5:
Curvilinear coordinates: Orthogonal coordinate systems, Gradient, Curl, Divergence and Laplacian in orthogonal coordinate systems, Spherical, Polar and Cylindrical coordinates, Poisson’s and Laplace Equations, Solution of Laplace differential equations, two dimensional steady flow of heat (Cartesian coordinates), Solution of two dimensional Laplace’s equation in the cylindrical coordinates, Green’s theorem.

Books Suggested
B. S. Rajput, Mathematical Physics, Pragti Prakashan, Meerut, (1997).
Merle C. Potter and Jack Goldberg, Mathematical Methods, Prentice Hall of India.
1. To determine Planck’s constant by photocell (using prism)
2. To determine laser beam parameters
3. To study magneto optic effect and to determine Verdet constant
4. To determine Young’s modulus of glass by Cornu’s method
5. To measure Brewster angle and determine refractive index of given material
6. To determine Planck’s constant by photocell (using filters)
7. To determine slit width from the study of Fraunhoffer diffraction pattern
8. To study electro optic effect and to determine Kerr constant of a given material
9. To determine paramagnetic susceptibility of given material (solution)
10. To study Zeeman effect and to determine the splitting of spectral lines
11. To determine critical potentials with the help of Franck-Hertz’s experiment
12. To determine the coherence length and coherence time by diffraction grating method of Laser
13. Design a combinational circuit that represents the full adder or full subtractor for binary inputs
Note: Students are required to perform following experiments using programming language C.

1. Using the method of least square fit, find the equation of regression line for the given data
2. Using Gauss Siedel method find solution of given set of simultaneous equations
3. Using Gauss Quandrature method of numerical integration calculate integral of given function
4. Using Runge-Kutta second order method find numerical solution of the given first order ordinary differential equation
5. Using Runge-Kutta fourth order method find numerical solution of the given first order ordinary differential equation
6. To calculate the roots of an algebraic or transcendental equation by using Newton Raphson Method
7. To calculate the roots of an algebraic or transcendental equation by using Successive Bisection Method
8. To calculate the roots of an algebraic or transcendental equation by using False position Method
9. To calculate the roots of an algebraic or transcendental equation by using Successive substitution Method
10. Interpolation using Lagrange’s interpolation formula
11. Numerical integration by using Simpson’s
12. Using Monte-Carlo method integrate numerically the given function in one variable
PH-207 APPLICATION OF SOFTWARE PACKAGES

Software packages, system software and application software packages, general purpose application software packages, MS office Package, components of MS office, MS word: word documents, editing tools, font types, font size, other editing tools, inserting tables, figures, graphs, symbols and equations, equation editor, page layout, review tools: spelling, grammar and thesaurus

MS Excel: Excel worksheet, data types and range, calculation using Excel, inserting formulas, using common mathematical functions: Log, Exp, factorial, Random Numbers and sum; analysis of data using statistical functions such as: AVERAGE, MEDIAN, MODE, Standard Deviation, Normal distribution; linear regression, slope and intercept functions, graphs using Excel

Origin Software Package: Origin Worksheet, different types of graphs in Origin, drawing multiple graphs on single page, style, color and size, formatting axis and scales, tick labels and borders, graph labels and captions, adding error bars to the graphs, saving and printing graphs

Mathematica Software Package: Introduction to Mathematica Software package, numerical computation using Mathematica, symbolic computation, solution of equations in one variable and simultaneous equations, solution of differential equation, graphs using Mathematica.

Practicals
1. Exercise based on use of formatting tools in MS Word
2. Exercise based on inserting figures, graphs and tables in Word document
3. Exercise based on use of Equation Editor
4. Exercise based on use of formulas in MS Excel including mathematical functions
5. Exercise based on use of Statistical functions in MS Excel
6. Exercise based on creating graphs in MS Excel
7. Exercise based on creating graphs in ORIGIN
8. Exercise based on formatting graphs in ORIGIN
9. Exercise based on showing error bars on experimental data points in ORIGIN
10. Exercise based on numerical calculations using Mathematica
11. Exercise based on symbolic computation using Mathematica
12. Exercise based on Solution of differential Equations using Mathematica
13. Exercise based on Solution of equations in one variable using Mathematica
14. Exercise based on creating 2-D graphs in Mathematica
15. Exercise based on creating 3-D graphs in Mathematica

Books Suggested
M. Sc. Physics Syllabus  
(CBCS and CBSS based)


SEMESTER III

PH-301 ELECTRODYNAMICS AND PLASMA PHYSICS

UNIT-1
Electrostatics and Magnetostatics: Poisson and Laplace equations, Green’s theorem, formal solutions of electrostatic boundary value problem with Green’s function, method of electrostatic images: point charge in the presence of a grounded conducting sphere, point charge in the presence of a charged and insulated conducting sphere, conducting sphere in a uniform electric field.
Magnetic field of a current loop, boundary conditions on B and H, uniformly magnetized sphere in an external magnetic field.

UNIT-2
Time varying fields: Maxwell’s displacement current, Maxwell’s equations, vector and scalar potentials, gauge transformation, Lorentz gauge, Coulomb gauge, Green function for the wave equation, Poynting’s theorem and conservation of energy and momentum for a system of charged particles and electromagnetic fields.

UNIT-3
Radiation by moving charges: Lienard-Wiechert potentials and fields for a moving point charge, electromagnetic fields of a uniformly moving point charge, total power radiated by an accelerated charge: Larmor’s formula and its relativistic generalization, angular distribution of radiation emitted by an accelerated charge.

UNIT-4
Dynamics of relativistic charged particle: Motion of charged particle in non-uniform static magnetic fields. Adiabatic invariance of flux through the orbit of particle, magnetic mirror. Lagrangian and Hamiltonian for a relativistic charged particle in external electromagnetic fields.

UNIT-5
Magnetohydrodynamics and Plasma Physics: Basic properties of plasma, Magnetohydrodynamic equations, Magnetic diffusion, viscosity and pressure, pinch effect. Qualitative aspects of instability in a pinched plasma column, High frequency plasma oscillations, short wave length limit of plasma oscillations and Debye screening distance.

Books Suggested
J. D. Jackson, Classical Electrodynamics, John Wiley.
L. D. Landu and E. M. Lifshitz, Electrodynamics of continuous media, Pargamon Press.
J. R. Reitz and F. J. Milford, Foundation of Electromagnetic Theory, Addition Wesley.
D. J. Griffith, Introduction to Electrodynamics, PHI.
UNIT-1

Digital Logic Circuits: Logic gates and logic families: DTL, TTL, Boolean algebra, development of Boolean expressions: SOP, Minimization techniques: using laws of Boolean algebra, Karnaugh map.

Number Systems and their inter conversion, data representation: fixed-point representation, floating point representation, error detection and correction: parity generator-checker, Hamming codes (1-bit detection-correction).

UNIT-2


UNIT-3

Architecture of 8085 microprocessor: register organization, bus organization, ALU and controls, classification of 8085 instructions, addressing modes, fetch and execution of instructions, data transfer: memory-mapped I/O and peripheral mapped I/O, interrupted driven data transfer, programmable interrupt controller, DMA data transfer, DMA controller, assembly language programming.

UNIT-4

Architecture of simple I/O devices: Hex keyboard, LED display, VDU and their interfacing, 8279 keyboard-display interface, CRT controller, Interfacing devices: I/O ports, programmable peripheral interface - 8255 A.

UNIT-5

Applications of 8085: Designing of a microcomputer system: Hardware design, software design, Transfer of data between two microcomputers in distributed processing, Temperature monitoring system, data acquisition system: 8085 based temperature monitoring system. Introduction to 16-bit microprocessors: Intel 8086: architecture, addressing modes and instruction set.

Books Suggested

Morris-Mano, Computer System Architecture, PHI.
R. S. Gaonkar, Microprocessor Architecture, Programming and Applications. Wiley Eastern Ltd.
M. Raffiquzzaman, Microprocessor: Theory and Application, Prentice Hall Of India.
Ghosh and Sridhar, Introduction to Microprocessor for Engineers and Scientists, Prentice Hall Of India.
D. V. Hall, Microprocessor and Interfacing, Tata McGraw Hill.
UNIT-1
Neutrino Physics: Pauli’s neutrino hypotheses, properties of neutrino, detection of neutrino and experimental existence of neutrino.

UNIT-2
Elementary particle Physics: Fundamental interactions in nature, intrinsic parity of pions, Strange particles associated production–strange quantum number, Gellmann–Nishijima formula, Weak interactions: General properties, Parity violation in weak interaction, tau-theta puzzle. CPT theorem (statement only), the quark model: quark model of particles, quark structures of mesons and baryons, elementary idea of colour quantum number.

UNIT-3
Nuclear Models: Classification of nuclear model, Fermi gas model, Motion in mean potential, energy level according to harmonic oscillator potential and infinite square well potential–effect of spin orbit interaction. Predictions of ground state spin of odd–A nuclei, failure of shell model and liquid drop model. Collective model: facts in support of nuclear collective model, collective vibrations and rotations, nuclear quadrupole moments, Nilson model–calculation of energy levels –prediction of ground state spin.

UNIT-4

UNIT-5
Experimental Techniques: Scintillation counters, Cherenkov counters; Semi-conductor detectors, Nuclear Emulsion techniques, Solid state nuclear track detectors, Proton synchrotron.

Books Suggested
W. E. Burcham and M. Jobes, Nuclear and particle physics, Addison Wesley
S. N. Ghoshal, Nuclear Physics, S. Chand & Co. Ltd., New Delhi
R. R. Roy and B. P. Nigam, Nuclear Physics, New Age Int.(P) Ltd.
J. Singh: Fundamentals of Nuclear Physics, Pragati Prakashan
B. K. Agarwal, Nuclear Physics Lokbharti Publication, Allahabad
R. M. Singru, Introductory Experimental Nuclear Physics
B. L. Cohen, Concept of Nuclear Physics, Tata McGraw Hills
UNIT-1
Synthesis and preparation of materials: Gas to solid synthesis and preparation- vapour deposition, chemical vapour deposition. Liquid to solid synthesis and preparation- crystal growth from the melt, liquid quenching, crystallization from solution, sol-gel method, ion exchange and intercalation. Solid to solid synthesis and preparation-solid state reaction, high pressure preparation and synthesis, glass ceramics.

UNIT-2

UNIT-3

UNIT-4

UNIT-5
Reduced Dimensionality: Basic concepts underlying 0D, 1D system and their applications, Fullerenes and quantum dots. One dimensional system: One dimensional metal, Peierls distortion, conjugated polymers, Nano-tubes, quantum wires. Two dimensional systems: Layered crystals, quantum wells, quantum Hall effect.

Books Suggested
Thomas, Transmission Electron Microscopy,
Tolansky, Multiple Beam Interferometery.
Heavens, Thin Films.
Chopra, Physics of Thin Films.
Aschoft and Mermin, Solid State Physics, New York.
Mott and Davis, Electronic Processes in Non crystalline Materials, Oxford Univ. Press.
1. To study Boolean algebraic expressions
2. To construct and study R-S flip-flop and clocked R-S flip-flop using logic gates
3. To construct and study J-K flip-flop using logic gates
4. To construct and study 4 bit buffer register using flip-flop ICs
5. To construct and study 4 bit shift left and shift right registers using flip-flop ICs and hence convert them into ring counter
6. To construct and study 4 bit Asynchronous counter using flip-flop ICs
7. To construct and study 4 bit Synchronous counter using flip-flop ICs
8. Design and study of ADC and DAC circuits
9. Write an assembly language program to find the sum of a series of 8 bit numbers
10. Write an assembly language program to find the smallest of the series of 8 bit numbers
11. Write an assembly language program to find the largest of the series of 8 bit numbers
12. Write an assembly language program to arrange a series of 8 bit numbers into ascending order
13. Write an assembly language program to arrange a series of 8 bit numbers into descending order
14. Write an assembly language program to find the product of two 8-bit numbers
15. Write an assembly language program to divide an 8-bit number by an 8-bit number
16. Write an assembly language program to find square root of a perfect/imperfect 8-bit number
17. Write an assembly language program to find the sum of a series of 16-bit numbers
1. To study the random nature of radioactive decay and to find the standard deviation
2. Find the efficiency of G. M. detector for gamma source also verify Inverse square law for gamma rays
3. To determine Linear and mass attenuation coefficient for gamma source, also estimate efficiency of GM detector for gamma Source
4. Determination of Range and End point energy of Beta Source by half-thickness method, also estimate efficiency of GM detector for Beta Source
5. Measurement of voltage and current of wind energy based D.C. supply with change in
   i. Direction of wind
   ii. Speed of wind imposed on the blades
6. Study of voltage and current of the solar cells in series and parallel combination also study the Power Curve to find the maximum power point
7. Preparation and study of nano TiO₂ solar cell in presence of Sun light and hydrogen lamp
8. Determination of Curie temperature of given Ferromagnetic material
9. Study of dielectric function and determination of A.C. electrical conductivity of given dielectric material
10. Study of dispersion relations of mono and di-atomic basis using Lattice dynamic Kit
11. Study of Hall Effect in Semiconductor (Si/ Ge)
12. Determination of Electrical resistivity of semiconductor by four probe method
13. Study of Electron Spin Resonance in crystals and determination of ‘g’ factor
Solar Cell Materials: Need for sustainable energy sources, sun’s energy & its advantages, fundamentals of solar cells, p-n junction under illumination, generation of photovoltage, light generated current, I-V equation of solar cell, solar cell characteristics, upper limits of cell parameters, short circuit current, open circuit voltage, fill factor, efficiency, losses in solar cells, types of solar cells: inorganic, organic and hybrid solar cells.


Superconductors: Idea of superconductors, thermodynamic and electromagnetic properties of superconductors, high temperature superconductors (HTS), rare earth cuprates: Bi-based and Ti-based cuprates structural aspects and properties of cuprates HTS and application.

Practicals
1. Preparation of bulk hetero-junction or Dye-Sensitized Solar Cells (DSSC)
2. Current-voltage characteristics (I-V) of the solar cell in dark and under illumination conditions
3. Measurement of photovoltaic parameters of a solar cell: open circuit voltage (Voc), short circuit current (Jsc), fill factor (FF) and power conversion efficiency (η)
4. Synthesis of nanomaterials (Al2O3) by ball mill method
5. Synthesis of CdSe and InP quantum dots
6. Synthesis of MWCNT
7. Synthesis of rare earth cuprates by ball mill
8. Synthesis of Bi-based cuprates by ball mill
9. Synthesis of Ti-based cuprates by ball mill
10. Study of temperature dependent of Hall coefficient of superconductors
11. Measurement of Hc and Tc of superconductors

Books Suggested
S. K. Kulkarni, Nanotechnology: Principles and Practices
C. S. Solanki, Solar Photovoltaics; fundamentals, technologies & applications, PHI Learning Pvt. Ltd.
P. J. Reddy: Science & technology of photovoltaics, BS publications.
J. P. Shrivastava, Elements of Solid State Physics, PHI, Learning Pvt. Ltd. New Delhi
Semester IV

PH-401 COMMUNICATION AND MICROWAVE ELECTRONICS

UNIT-1
Modulation and demodulation: Amplitude and frequency modulation (mathematical expressions and wave shapes), Transistor collector AM circuit, Square law detector, Transistor reactance variation frequency modulator circuit, Foster–Seeley discriminator, superhetrodyne receiver, SSB generation circuit, PAM, PWM, PPM, ASK, FSK BPSK and DBPSK.

UNIT-2
Television and satellite: Block diagram of black & white and colour television transmitter and receiver, TV channels, interlace scanning and bandwidth of a channel, TV cameras, Basics of satellite communication, orbital and geostationary satellites and their applications.

UNIT-3
Transmission line: Equivalent circuit of a transmission line and its voltage and current equations, characteristic impedance and propagation constant of a transmission line, impedance properties, reflection coefficient and VSWR; Vector wave equation, rectangular waveguide and field equations for TE mode, Micro-strip lines and their characteristics, optical fibers and its parameters.

UNIT-4
Microwave devices: Structure and working of two cavity klystron, reflex klystron and its working, Magnetron, Gunn diode and its characteristics, PIN diode and its use as microwave modulator, Read diode, IMPATT and TRAPATT.

UNIT-5
Microwave measurements: horn antenna characteristics, VSWR, unknown impedance and complex permittivity; block diagram of RADAR and its working, radar range equation, pulse radar.

Books suggested
S. P. Sharma, Basic Radio and Television, TMH
H. Taub and D. L. Schilling, Principle of Communication Systems, TMH
H. A. Atwater, Introduction to Microwave Theory, McGraw-Hill.
S. Y. Liao, Microwave Devices and Circuits, PHI
M. L. Sisodia and G. S. Raghvanshi, Basic Microwave Techniques and Laboratory Manual, Wiley
J. Gower, Optical Communication Systems, PHI
B. P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press
B. R. Vishvakarma, Electromagnetic Fields and Applications, NBC International
UNIT-1
Interaction of gamma rays with matter: Gamma ray attenuation, Law of absorption, Linear & mass absorption coefficient, half thickness and radiation length, Interaction mechanism, photoelectric absorption, Compton scattering and pair production, qualitative description of photoelectric, Compton and pair production cross sections.

UNIT-2
Gamma decay: Width of decaying states, selection rules and transition probability for gamma emission. Internal electron conversion, Angular correlation studies, resonant scattering and absorption of gamma radiation, Mössbauer effect, Mössbauer Parameters and Applications of Mössbauer Spectroscopy

UNIT-3
Nuclear Forces and Two Nucleon Problem: saturation of nuclear forces, charge independence and spin dependence, exchange forces, Ground state of the deuteron using square well potential, relation between range and depth of potential, radius of the deuteron, mixing of orbitals in deuteron.

UNIT-4
Nuclear Reactions: Theories of Nuclear Reactions; Partial wave analysis of reaction Cross section; Compound nucleus formation and breakup. Resonance scattering and reaction-Breit-Wigner dispersion formula for s-waves (l = 0), direct reactions: stripping and pick-up reactions, the optical model

UNIT-5
Nucleon-Nucleon Scattering: Partial wave analysis of the low energy neutron-proton scattering, scattering length, effective range theory, scattering of neutrons by protons in ortho and para hydrogen, A qualitative discussion of proton-proton scattering at low energy, Main features of the One Boson Exchange Potentials (OBEP) no derivation.

Books Suggested
W. E. Burcham and M. Jobes, Nuclear and particle physics, Addison Wesley
S. N. Ghoshal, Nuclear Physics, S. Chand & Co. Ltd., New Delhi
R. R. Roy and B. P. Nigam, Nuclear Physics, New Age Int.(P) Ltd., Publishers
J. Singh, Fundamentals of Nuclear Physics, Pragati Prakashan
B. K. Agarwal, Nuclear Physics Lohkharti Publication Allahabad
R. M. Singru, Introductory Experimental Nuclear Physics
B. L. Cohen, Concept of Nuclear Physics, Tata McGraw Hills
UNIT-1
Group Theory: Symmetry elements, symmetry operations and point groups, symmetry operations on molecular motions, symmetry species and character tables, nature of a group. Symmetry operations and representation of a group, reducible and irreducible representation, characteristics of irreducible representation, characters of representations, classes, analysis of a reducible representations, the characters for the reducible representation of molecular motion.

UNIT-2
Types of Molecular Energy States and Molecular Spectra: Concept of molecular potential, Separation of electronic and nuclear wave functions, Born-Oppenheimer approximation, Types of spectra, Regions of spectra.
Pure rotational spectra (Microwave or Far Infra Red spectroscopy): Salient features of rotational Spectra, Rotation spectra of Polyatomic molecules, Linear, symmetric top, spherical top and Asymmetric top molecules.

UNIT-3
Vibrational Rotational Spectra (Near Infra Red spectroscopy): Salient features of Vibrational rotational spectra, Vibrating diatomic molecules as anharmonic oscillator, Vibrational spectra of polyatomic molecules, normal coordinates and and normal modes of vibration

UNIT-4
Raman Spectra: Raman effect and its salient features, quantum mechanical explanation of Raman effect, Vibrational Raman Spectra, Pure rotational Raman Spectra, Vibrational-rotation Raman spectra, Raman spectra and molecular structure, Advantages of IR over Raman.
Instrumentation for Raman spectroscopy, Applications Raman and Fraud.

UNIT-5
Spin Resonance Spectroscopy: Nature of Spinning Particles, Interaction between nuclear spin and magnetic field, Nuclear magnetic resonance, Nuclear quadrupole resonance, Electron spin resonance, Hyperfine structure of E.S.R absorptions.

Books Suggested
Sidney F. A. Kettle, Symmetry and Structure: Readable Group Theory for Chemist, Wiley
Claire Vallance, Molecular symmetry, Group theory & Applications, Wiley
UNIT-1
Elastic properties of crystals: Different type of elastic constants, energy density, elastic waves in cubic crystals in different directions.
X-ray crystal analysis: Reciprocal lattice, geometrical structure factor and intensity for SC, BCC, FCC, monatomic diamond and polyatomic crystals. Different techniques as the Laue, the powder and rotating methods.

UNIT-2
Dielectric properties in A.C fields: complex dielectric constant and dielectric losses, Debye equations, dielectric polarization and optical absorption. Long distance order theory of alloy by Bragg and Williams.
Ferroelectric properties: dipole theory, thermodynamics of ferroelectric transitions, second and first order transition, Ferroelectric domains, Piezoelectric and pyroelectric materials and applications.

UNIT-3
Defects in crystals: Point defects, Schottky defects, Frenkel defects, Line defects, colour centres, excitations, Planer defects.

UNIT-4

UNIT-5
Superconductivity: Meissner effect, London equations, Type-1 and Type-2 superconductors thermodynamic properties, cooper pair and derivation of BCS Hamiltonian and BCS results. Superconducting tunnelling, DC and A.C Josephson effect, Super current quantum interference, Fullerenes preparation. Properties and applications. High temperature superconductors and their structure, applications.

Books Suggested
A. J. Dekker, Solid State Physics, Macmillan India Ltd, Delhi.
PH-405 COMMUNICATION AND MICROWAVE ELECTRONICS LABORATORY

1. Design and study of amplitude modulation and demodulation circuits
2. Design and study of frequency modulation and demodulation circuits
3. Design and study of pulse width modulation and demodulation circuits
4. Design and study of pulse position modulation and demodulation circuits
5. Design and study of pulse amplitude modulation and demodulation circuits
6. Study of optical fiber parameters
7. Waveform analysis using storage CRO
8. Study of reflex klystron characteristics
9. Study of Gunn diode characteristics and PIN modulator
10. Determination of unknown impedance by VSWR measurements at microwave frequency
11. Determination of real part of relative complex permittivity of a solid sample by two point method at microwave frequency
12. Study of horn antenna characteristics
13. Measurements of complex permittivity of liquid at microwave frequencies
14. Study of micro-strip components characteristics
15. Design and study of ASK, FSK, BPSK and DBPSK modulation and demodulation.
16. Study of RADAR characteristics
1. K-emission spectrum of Copper using a plane oscillating crystal spectrograph
2. K-absorption edge of Bromine using a 20 cm curved crystal spectrograph
3. K-absorption edge of Nickel using a 20 cm curved crystal spectrograph
4. Laue photograph of muscovite mica crystal
5. L-emission spectrum of Tungsten using 40 cm/20 cm curved crystal spectrograph
6. Absorption spectrum of Iodine and calculation of dissociation energy
7. Spectrum of C-N and determination of vibrational constants
8. Fine Structure constant using Yellow and Green doublets of Sodium
9. XRD of standard Silicon and characterization of peaks
10. Study of glow curve of a crystal using thermo luminescence analyzer
11. UV-VIS spectrum of a given solution in varying concentration
12. To determine the velocity of Ultrasonic wave in a given liquid
Analog and digital signals,
Block diagram of regulated DC power supply and its use in biasing the electronics circuits,
Block diagram of digital multimeter and its uses in voltage, current and resistance measurements,
Block diagram of function generators (sine, square and triangular wave) and their characteristics,
Block diagram of frequency counter and its working and uses,
Block diagram of various cathode ray oscilloscopes and their uses in frequency, phase and voltage measurement,
Origin of bio-electric signals associated with various organs,
Electric cardio gram (ECG) and its application in heart functioning,
Sonography (ultrasound imaging) and its application in diagnosis

Practicals
1. Measurements of voltage, current and resistance by DMM
2. Study of waves generation by function generator
3. Study of waves using CRO
4. Use of digital storage oscilloscope (DSO) in waveform study
5. Study of DC power supply
6. Study of function generator
7. Study of ultra sound generation and its application

Books Suggested
A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI
R. S. Khandpur, Handbook of Biomedical Instrumentation, TMH