UNIVERSITY OF KERALA

SYLLABI FOR FIRST DEGREE PROGRAMME IN

PHYSICS (CORE) WITH MATHEMATICS AND MACHINE LEARNING AS COMPLIMENTRIES

UNDER

CHOICE BASED-CREDIT & SEMESTER-SYSTEM (CBCSS)

(2020 admission onward)
AIM AND OBJECTIVES OF THE PROGRAMME
In this programme, we aim to provide a solid foundation in all aspects of Physics and to show a broad spectrum of modern trends in physics and to develop experimental, computational and mathematical skills of students. The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of physics by providing more or less complete and logical framework in almost all areas of basic Physics.

The programme also aims to
(i) Provide education in physics of the highest quality at the undergraduate level and generate graduates of the calibre sought by industries and public service as well as academic teachers and researchers of the future.
(ii) Attract outstanding students from all backgrounds.
(iii) Provide an intellectually stimulating environment in which the students have the opportunity to develop their skills and enthusiasms to the best of their potential.
(iv) Maintain the highest academic standards in undergraduate teaching.
(v) Impart the skills required to gather information from resources and use them.
(vi) Equip the students in methodology related to Physics.

Objectives
By the end of the first year (2nd semester), the students should have,
(i) Attained a common level in basic mechanics and properties of matter and laid a secure foundation in mathematics for their future courses.
(ii) Developed their experimental and data analysis skills through a wide range of experiments in the practical laboratories.

By the end of the fourth semester, the students should have
i. Been introduced to powerful tools for tackling a wide range of topics in Thermodynamics, Electrodynamics, Classical Mechanics and Relativistic Mechanics.
ii. Become familiar with additional relevant mathematical techniques.
iii. Further developed their experimental skills through a series of experiments which also illustrate major themes of the lecture courses.

By the end of the sixth semester, the students should have
i. Covered a range of topics in almost all areas of physics including Quantum Physics, Solid State Physics, Computational Physics, Electronics etc.
ii. Had experience of independent work such as projects, seminars etc. iii. Developed their understanding of core Physics.
Programme Specific Outcomes

<table>
<thead>
<tr>
<th>PSO No.</th>
<th>Upon completion of B.Sc. Physics Degree programme, the graduates will be able to</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSO - 1</td>
<td>Conceptual understanding of Physics and its practical applications and scope in the present world.</td>
</tr>
<tr>
<td>PSO - 2</td>
<td>Analysing the theory part with practical experiments, interpretation of experimental results, finding out errors, suggestions to improve the errors.</td>
</tr>
<tr>
<td>PSO - 3</td>
<td>Develop and construct practical model systems from their conceptual knowledge.</td>
</tr>
<tr>
<td>PSO - 4</td>
<td>Distinguish Microscopic and Macroscopic Systems.</td>
</tr>
<tr>
<td>PSO - 5</td>
<td>Acquire conceptual understanding of Physics to General real-world situations.</td>
</tr>
<tr>
<td>PSO - 6</td>
<td>Integrate the Quantum Mechanics to understand the fundamentals of other branches of physics such as Vibrational Spectroscopy</td>
</tr>
<tr>
<td>PSO - 7</td>
<td>Understand possible atomic and molecular energy levels and transitions and predict the existence of new elements</td>
</tr>
<tr>
<td>PSO - 8</td>
<td>Develop an idea regarding x-rays resonance spectroscopic techniques</td>
</tr>
<tr>
<td>PSO - 9</td>
<td>Students will use the knowledge of electronics and communication to analyze the contemporary communication systems and to design the system.</td>
</tr>
<tr>
<td>PSO - 10</td>
<td>Apply the Langrangian and Hamiltonian formalisms to solve various dynamical problems which involve constraints.</td>
</tr>
<tr>
<td>PSO - 11</td>
<td>Students will use the knowledge of Mechanics to describe the motion of objects in different force fields.</td>
</tr>
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</table>
## I. General Structure for the First-Degree Programme in Physics

<table>
<thead>
<tr>
<th>Sem. No.</th>
<th>Course title</th>
<th>Instructional hours/week</th>
<th>Credit</th>
<th>University Exam duration</th>
<th>Evaluation</th>
<th>Total credit</th>
</tr>
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<td>L</td>
<td>P</td>
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</tr>
<tr>
<td>I</td>
<td>EN1111 English Lang I</td>
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<tr>
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<tr>
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<td>Course</td>
<td>Credit</td>
<td>Hours</td>
<td>Notes</td>
<td></td>
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<td>PCH1231.7/EL1231)</td>
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<tr>
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II. Course structure: (1a). *Core Courses (theory)*

<table>
<thead>
<tr>
<th>Sem.</th>
<th>Title of paper</th>
<th>Number of hours per week</th>
<th>Number of credits</th>
<th>Total hours/semester</th>
<th>UE Duration</th>
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<tr>
<td>1</td>
<td>PY1141 – Basic mechanics &amp; Properties of matter</td>
<td>2</td>
<td>2</td>
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<td>3 hrs</td>
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<td>2</td>
<td>PY1241- Heat &amp; Thermodynamics</td>
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<td>36</td>
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<tr>
<td>3</td>
<td>PY1341– Electrodynamics</td>
<td>3</td>
<td>3</td>
<td>54</td>
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<td>4</td>
<td>PY1441– Classical &amp; Relativistic Mechanics</td>
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<td>PY1541– Quantum Mechanics</td>
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<td>PY1542–Statistical Mechanics Research</td>
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<td></td>
<td>Methodology and Disaster Management</td>
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<td>5</td>
<td>PY1543–Electronics</td>
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<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
<td>Lecture</td>
<td>Practicals</td>
<td>Theory</td>
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<tr>
<td>PY1544</td>
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<td>PY1642</td>
<td>Nuclear &amp; Particle Physics</td>
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<td>PY1643</td>
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<td>PY1661</td>
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FOR THE CORE COURSE:

<table>
<thead>
<tr>
<th>Sem</th>
<th>Title of Paper</th>
<th>Duration of Exam</th>
<th>Number Of Credits</th>
<th>Weightage IA</th>
<th>Weightage UE</th>
<th>Allotted hours</th>
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<tbody>
<tr>
<td>4</td>
<td>PY1442- Basic Physics Lab 1</td>
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<td>1</td>
<td>3</td>
<td>S1—2 144</td>
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<td>S4—2</td>
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<td>2</td>
<td>1</td>
<td>3</td>
<td>S5—2 72</td>
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<td></td>
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<td></td>
<td>S6—2</td>
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<td>PY1646- Advanced Physics Lab 3</td>
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<td>3</td>
<td>1</td>
<td>3</td>
<td>S5—2 72</td>
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<td></td>
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<td>S6—2</td>
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</table>
2(a). Complementary Courses (General structure)

<table>
<thead>
<tr>
<th>Semester</th>
<th>Theory</th>
<th>Practical</th>
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<tbody>
<tr>
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<td>Number of hours/week</td>
<td>Number of credits</td>
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<td>3</td>
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<tr>
<td>4</td>
<td>3</td>
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</tr>
</tbody>
</table>

III. QUESTION PAPER PATTERN

For all semesters
1. The examination has duration of 3 hours
2. Each question paper has four parts A, B, C & D.
3. Part A contains 10 questions and the candidate has to answer all questions. Each question carries 1 mark. The answer may be in the forms-one word/one sentence
4. Part B contains 12 short answer questions. Out of these 12 questions, the candidate has to answer 8 questions. Each question carries 2 marks.

5. Part C contains 9 questions of which the candidate has to answer 6 of them. Each question carries 4 marks.

6. Part D contains 4 long answer questions (essays) of which the candidate has to answer 2 questions. Each question carries 15 marks.

7. The total weightage for the entire questions to be answered is 80 marks.

<table>
<thead>
<tr>
<th>QUESTION PAPER PATTERN FOR TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question No</td>
</tr>
<tr>
<td>Part A : 1-10</td>
</tr>
<tr>
<td>Part B : 11-22</td>
</tr>
<tr>
<td>Part C : 23-31</td>
</tr>
<tr>
<td>Part D : 32-35</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

V. OPEN/ELECTIVE COURSES
During the programme the students have to undergo two open/elective courses. The students attached to the Physics department can opt one course from the Physics department (Elective course) and the other from any one of the other departments (Open course). The student has to do the open course during the fifth semester and the elective course during the sixth semester. As a beginning, the department will choose one open course for the fifth semester and one elective course for the sixth semester depending on the faculty and infrastructure available.

(a). Open Courses.
(b). Elective Courses.
   i) Photonics  ii) Nano science  iii) Computer hardware and networking  iv) Instrumentation  v) Space Science

VI. IMPLEMENTATION OF PROJECT WORK AND STUDY TOUR(RESEARCH INSTITUTE/SCIENCE MUSEUM VISIT)
As part of study the candidate has to do a project work. The aim of the project work is to bring out the talents of students and to introduce research methodology. The work may be chosen from any branch of Physics, which may be experimental, theoretical or computational. Emphasis should be given for originality of approach. The project shall be done individually or as a group of maximum 5 students. The projects are to be
identified during the 4\textsuperscript{th} semester with the help of the supervising teacher. The report of the project (of about 30-40 pages) in duplicate shall be submitted to the department by the end of the 6\textsuperscript{th} semester well before the commencement of the examination. The reports are to be produced before the external examiners appointed by the University for valuation.

STUDY TOUR
Students are directed to visit one research institute /science museum preferably within the state of Kerala. Scientifically prepared hand-written study tour report must be submitted by each student for ESE on the day of the examination of project evaluation.

VII. CONTINUOUS EVALUATION
There will be continuous evaluation (CE) based on continuous assessment and end semester examination (ESE) for each course. CE carries 20 marks based on specific components such as attendance, tests, assignments, seminars etc. and ESE 80 marks. Out of the 20 marks in internal assessment, 5 marks shall be given to attendance, 10 marks to test papers, 5 marks to seminar / assignments (minimum one test & one assignment). The components of the internal evaluation for theory and practical and their marks are given below.

(a). Theory

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>marks</th>
</tr>
</thead>
<tbody>
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<td>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Assignment</td>
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<td>3</td>
<td>Test paper</td>
<td>10</td>
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<tr>
<td></td>
<td>Total</td>
<td>20</td>
</tr>
</tbody>
</table>

The continuous evaluation (CE) shall be based on periodic written tests, assignments, viva/ seminar and attendance in respect of theory courses. \textbf{Written Tests}: Each test paper may have duration of minimum 3 hours. For each course there shall be a minimum of one written test during a semester. \textbf{Assignments}: Each student is required to submit one assignment for a theory course. \textbf{Seminar / Viva}: For each theory course, performance of a student shall also be assessed by conducting a viva – voce examination or seminar presentation based on topics in that course.
(b). Continuous Evaluation CE (Practical)

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Skill &amp; Punctuality</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory record</td>
<td>5</td>
</tr>
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<td>4</td>
<td>Test (internal exam)</td>
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<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

Lab skill is to be assessed based on the performance of the student in practical classes. Minimum one practical test paper and an internal viva – voce examination based on the experiments done in the lab are to be conducted in each practical course. The laboratory record should contain an index and a certificate page. Separate records are to be used for each practical course. **A candidate shall be permitted to attend an end semester practical examination only if he/she submit a certified record with a minimum of 10 experiments.** This is to be endorsed by the examiners.

The **evaluation of certified record** shall be according to the scheme given below.

<table>
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<th>No of experiments recorded</th>
<th>Marks</th>
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<td>10</td>
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<tr>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>14</td>
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<td>12</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
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</table>

(c) The allotment of marks for attendance shall be as follows.

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<th>Attendance</th>
<th>% of attendance</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Attendance less than 50%</td>
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</tr>
<tr>
<td>51%-60%</td>
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</tr>
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<td>61%-70%</td>
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</tr>
<tr>
<td>71%-80%</td>
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<tr>
<td>91%-100%</td>
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</tbody>
</table>

(d) Tests, Assignments and Seminars

For each course there shall be at least two class tests during a semester. Marks for the test in continuous evaluation shall be awarded on the basis of the marks secured for the better of the two tests. Valued answer scripts shall be made available to the students for perusal within 10 working days from the date of the test.
Each student shall be required to do one assignment and one seminar for each course. Valued assignments shall be returned to the students. The seminars shall be organized by the teacher in charge and the same shall be assessed by a group of teachers including the teacher in charge of that course.

VIII. END SEMESTER EXAMINATION (ESE)
The external theory examinations of all semesters shall be conducted by the University. There will be no supplementary examinations. For reappearance/improvement, as per university rules, the students can appear along with the next batch.

IX. EVALUATION OF PROJECT AND TOUR REPORT
The evaluation of the project shall be done by two external examiners according to the scheme given above. Each candidate shall be evaluated separately. There shall be a maximum of 12 candidates per session with two sessions per day. However, there shall be no continuous evaluation for the project.

The evaluation of project shall be according to the scheme given below.

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Originality of approach</td>
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<tr>
<td>Relevance of the topic</td>
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</tr>
<tr>
<td>Involvement</td>
<td>10</td>
</tr>
<tr>
<td>Viva-voce</td>
<td>15</td>
</tr>
<tr>
<td>Presentation of report</td>
<td>20</td>
</tr>
<tr>
<td>Research Institute/Science museum visit and Report</td>
<td>30</td>
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</table>

Evaluation of Tour report
The evaluation of tour report shall be according to the scheme given below

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation of the report</td>
<td>10</td>
</tr>
<tr>
<td>Certified report</td>
<td>20</td>
</tr>
</tbody>
</table>

X. EVALUATION OF PRACTICAL EXAMINATION
The practical examinations for the core subject shall be conducted by the University at the end of semesters 4 and 6 with a common time table and questions set by the University. Similarly, the practical examination for the complementary course shall be conducted by the University at the end of the 4th semester. The examiners shall be selected from a panel of experts prepared by the University. For each examination centre there shall be two external examiners and one internal examiner who is not in charge of the practical at that centre. The mark sheet duly certified by the head of
the institution should be sent to the University before the commencement of the end semester examinations.

The evaluation scheme for the end semester practical examinations shall be as follows.

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula, circuit, graph, brief procedure</td>
<td>20</td>
</tr>
<tr>
<td>Setting and experimental skill</td>
<td>15</td>
</tr>
<tr>
<td>Observations and tabulations</td>
<td>15</td>
</tr>
<tr>
<td>Substitution, calculation, result with correct unit</td>
<td>20</td>
</tr>
<tr>
<td>Certified record with 18 experiments</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
</tr>
</tbody>
</table>

For electronics experiments, the scheme shall be as follows.

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula, circuit, graph, brief procedure</td>
<td>20</td>
</tr>
<tr>
<td>Observations, skill and tabulations</td>
<td>25</td>
</tr>
<tr>
<td>Substitution, calculation, result with correct unit</td>
<td>25</td>
</tr>
<tr>
<td>Certified record with 18 experiments</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
</tr>
</tbody>
</table>

For computer experiments, the following scheme shall be followed.

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing the programme</td>
<td>30</td>
</tr>
</tbody>
</table>
Execution of the programme  20
Output/Result  20
Certified record with 18 experiments  10
Total  80

PY1141: BASIC MECHANICS & PROPERTIES OF MATTER

(36 HOURS-2 CREDITS)

MECHANICS (22 hrs) Course Outcome:

<table>
<thead>
<tr>
<th>CO.No.</th>
<th>Upon completion of this course, students will be able to</th>
<th>PSO addressed</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO –1</td>
<td>Correlate the knowledge gathered to the immediate experimental curriculum</td>
<td>PSO-1</td>
<td>Apply</td>
</tr>
<tr>
<td>CO –2</td>
<td>Distinguish the dynamics of rigid bodies of different shapes</td>
<td>PSO-1</td>
<td>Understand</td>
</tr>
<tr>
<td>CO –3</td>
<td>Explain the implications of conservation laws</td>
<td>PSO-1</td>
<td>Understand</td>
</tr>
<tr>
<td>CO –4</td>
<td>Interpret the flavour of classical fields from oscillations and waves</td>
<td>PSO-1</td>
<td>Understand</td>
</tr>
<tr>
<td>CO –5</td>
<td>Handle the known problems in elasticity, surface tension and viscosity in a more mathematically rigorous way</td>
<td>PSO-2</td>
<td>Apply</td>
</tr>
</tbody>
</table>

Unit 1- Dynamics of Rigid Bodies (7 hrs)

Equations of motion for rotating rigid bodies- angular momentum and M.I- Theorems on MI.- calculation of MI. of bodies of regular shapes- uniform rod, ring, disc, annular
ring, solid cylinder, hollow cylinder and solid sphere- KE of rotating and rolling bodies- torque- Determination of MI. of a fly wheel (theory, experiment and applications).

**Unit 2 - Conservation of energy (3 hrs)** Energy Conservation law- Work – power-Kinetic Energy – Work Energy theorem- Conservative Forces - potential energy- Conservation of energy for a particle- energy function-

**Unit 3-Oscillations (12 hrs)**

Simple harmonic motion – Energy of harmonic oscillators-simple pendulum-mass on a spring-oscillation of two particles connected by a spring- compound bar pendulum - interchange ability of suspension and oscillation-four points collinear with C.G about which the time period is the same-conditions for maximum and minimum periods - Determination of g using symmetric bar pendulum.Mechanical and electromagnetic wave motion- General equation of a wave motion-expression for a plane progressive harmonic wave- energy density for a plane progressive wave.

**PROPERTIES OF MATTER (14hrs)**

**Unit 4 - Elasticity (8 hrs)**

Modulus of elasticity (revision)Relations connecting the three elastic moduli- Poisson’s ratio- bending of beams- bending moment-cantilever-centrally loaded beams and uniformly bent beams-I section girders-torsion of a cylinder-expression for torsional couple -work done in twisting a wire-torsion pendulum-

**Unit 5 – Surface Tension (3 hrs)**

Surface tension-molecular explanation of ST.-angle of contact(revision)shapes of drops -expression for excess of pressure on a curved liquid surface -variation of ST. with temperature.

**Unit 6 – Fluid Dynamics (3 hrs)**

Streamline and turbulent flow-equation of continuity-Bernoulli’s theorem- venturimeter-viscosity-Newton’s law- Stoke’s formula.

**Books for Study:**


**Books for Reference:**

1. Properties of matter: Brijlal and Subramaniam, S.Chand & Co., 2004

**Topics for assignments /discussion in the tutorial session (sample)**

1. Physics-The fundamental science-historical development of mechanics-some implications of the principle of mechanics-The scope of mechanics.

2. Life of eminent physicists- Newton, Einstein, C.V.Raman, Edison.

3. Study of Young’s modulus for different types of wood.

4. Study of variation of surface tension for different detergents.

5. Study of viscosity of different types of ink and to arrive at knowledge of its fluidity.

6. Wide applications of Bernoulli’s equation.

7. Variation of surface tension with temperature by Jaeger’s method

**PY1241 –HEAT AND THERMODYNAMICS**

**(36 HRS-2 CREDITS)**

Course Outcome:

<table>
<thead>
<tr>
<th>CO.No.</th>
<th>Upon completion of this course, students will be able to</th>
<th>PSO addressed</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO –1</td>
<td>Compare thermal conductivity of various types of conductors.</td>
<td>PSO - 1,2</td>
<td>Analyse</td>
</tr>
<tr>
<td>CO –2</td>
<td>Differentiate between various thermodynamic processes.</td>
<td>PSO - 1</td>
<td>Analyse</td>
</tr>
</tbody>
</table>
### Unit 1- Transference of Heat (8 hrs)

Thermal conductivity - determination by Lee’s Disc method for bad conductor radial flow of heat, cylindrical flow, thermal conductivity of rubber, Weidman-Franz law. Radiation of heat, Stefan’s law, determination of Stefan’s constant, solar constant, determination of solar temperature

### Unit 2- Thermodynamics (18 hrs)


### Unit 3- Entropy (10 hrs.)

Definition of entropy, change of entropy in reversible and irreversible cycle, Clausius inequality and second law of thermodynamics, entropy and available energy, Entropy, probability and disorder. Nernst theorem and third law of thermodynamics. Phase transition, phase diagram, first order and second order phase transition (qualitative idea) Clausius-Clepeyron Equation

### Books for Study:

1. Thermal and Statistical Mechanics: S.K. Roy, NewAge International
2. Heat and Thermodynamics: D. S. Mathur, S. Chand & Co
3. Heat and Thermodynamics: Brijlal & Subramaniam, S. Chand & Co
Books for Reference:


PY 1341 ELECTRODYNAMICS

(54 Hours-3Credits).

<table>
<thead>
<tr>
<th>CO.No.</th>
<th>Upon completion of this course, students will be able to</th>
<th>PSO addressed</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO–1</td>
<td>Coulomb’s law, Application of Gauss law, Work and energy in electrostatics.</td>
<td>PSO-1</td>
<td>Apply</td>
</tr>
<tr>
<td>CO–2</td>
<td>have a unified surveillance of electromagnetic phenomena and be engaged to draw qualitative conclusions about them by managing a small number of physical concepts and laws</td>
<td>PSO-1</td>
<td>Understand</td>
</tr>
<tr>
<td>CO–3</td>
<td>Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.</td>
<td>PSO-1</td>
<td>Understand</td>
</tr>
<tr>
<td>CO–4</td>
<td>To impart knowledge on the concepts of Faraday’s law, induced emf and Maxwell’s equation</td>
<td>PSO-1</td>
<td>Understand</td>
</tr>
</tbody>
</table>

Unit 1-Electrostatic Field (10hrs)
Electric field: introduction, Coulomb’s law, Electric field, continuous distribution (Revision), Divergence and curl of electrostatic fields; Field lines, flux applications of gauss’s law, Curl of E, Electric potential: Introduction to potential, Comments on potential, Poisson’s and Laplace’s equations, potential of a localized charge distribution, Electrostatic boundary, Work and Energy in Electrostatics: The work done to move a charge, the energy of a point charge distribution, The energy of a continuous charge distribution. Unit 2-Electrostatic fields in matter (10 hrs)
Polarization: Dielectrics, induced dipoles, Polarization, The field of a polarized object: Bound charges, physical interpretation of bound charges and the field inside a dielectric Electric displacement: Gauss’s law in the presence dielectrics, Boundary conditions.
Unit 3-Magnetostatics (7hrs)
Introduction
The Biot-Savart law, Ampere’s force law (revision), Magnetic torque, Magnetic flux and gauss’s law for magnetic fields, magnetic vector potential, Magnetic intensity and Ampere’s circuital law, magnetic materials.

Unit 4-Electromagnetic Induction (7hrs)
Electromotive force: Ohm’s law Electromagnetic Induction Faraday’s law, the induced electric field, Maxwell’s equations, Magnetic charge,

Unit 5-Electromagnetic waves (6hrs)
Waves in one dimension: The wave equation Electromagnetic waves in vacuum: The wave equation for E and B, Monochromatic plane waves, Energy and momentum in electromagnetic waves. Unit 6-Transient currents(7hrs)
Growth and decay of current in LR and CR Circuits-Measurement of high resistance by leakage-Charging and discharging of a capacitor through LCR circuit.

Unit 7-Alternating current (7 hrs)
AC through series LCR (acceptor circuit) and parallel LCR circuit (rejecter circuit)- Q- factor, Power in AC-power factor. Books for Study:

2. Electricity and Magnetism:Murugesan, S.Chand & Co.

Books for Reference:

2. Electricity and Magnetism: E.M. Purcell, Berkley Physics course, Vol.2, MGH
5. Electromagnetic waves and radiating systems: Jordan & Balmain, PHI
7. Introduction to electrodynamics: Reitz & Milford Addison Wesley
Topics for discussion in Tutorial session/Assignments (sample)

1. Comment on how electrostatic energy is stored in a field

2. Discuss the electrostatic properties of conductors

3. What is meant by electrostatic shielding? In what way it helps us?

4. Discuss the peculiarities of electric displacement D and electric field E. How they are incorporated in Maxwell’s Equations

5. Discuss the properties of linear dielectrics. What differentiates adielectric to be linear or not?

6. Discuss applications of Ampere’s circuital law

7. Compare electrostatics and magnetostatics

8. Why magnetic forces cannot do work

9. Discuss about cyclotron motion & cycloid motion

10. Discuss whether there exists any stand-off between ohm’s law and Newton’s second law

11. A battery has an *emf*. Can this *emf* be a ‘force’? How will you interpret electromotive force?

12. Discuss the role of motional *emf* in power generation

13. Discuss the orthogonality of E, B and propagation vector k

14. A wave function can have a sinusoidal representation. Solve the wave equation for this function and discuss the various terms related to a wave such as amplitude, frequency, phase, wave number.

15. Complex representation of wave function has good advantage. Why? Discuss the linearity of wave function. (use complex notation)

16. Discuss AC through LC, LR and CR circuits
17. Show that sharpness of resonance is equal to Q-factor

18. What is a choke coil? Discuss the advantage of using a choke coil instead of a resistor

**PY1441 CLASSICAL AND RELATIVISTIC MECHANICS**

*(54 Hours-3 Credits).*

Course Outcome:

<table>
<thead>
<tr>
<th>CO.No.</th>
<th>Upon completion of this course, students will be able to</th>
<th>PSO</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO-1</td>
<td>Handle the mechanics of a single and a system of particles (both charged and uncharged) under different force fields</td>
<td>PSO-10</td>
<td>Understand</td>
</tr>
<tr>
<td>CO-2</td>
<td>Explain the importance of symmetry transformation and conservation of momentum and energy.</td>
<td>PSO-11</td>
<td>Apply</td>
</tr>
<tr>
<td>CO-3</td>
<td>Describe the motion of particles in central force field including planetary motion</td>
<td>PSO-10</td>
<td>Remember</td>
</tr>
<tr>
<td>CO-4</td>
<td>Solve different mechanical problems in classical mechanics using Lagrangian formalism</td>
<td>PSO-10</td>
<td>Apply</td>
</tr>
<tr>
<td>CO-5</td>
<td>Generalize Hamiltonian mechanics to solve various problems in classical mechanics</td>
<td>PSO-10</td>
<td>Apply</td>
</tr>
</tbody>
</table>

**Unit 1 - Particle Dynamics (5 hrs)**

Mechanics of a particle – equation of motion of a particle – Motion of a charged particle in electromagnetic field – mechanics of a system of particles. **Unit 2 - Conservation laws (6 hrs)**

Linear uniformities of space and conservation of linear momentum – rotational invariance of space and law of conservation of angular momentum – homogeneity of flow of time and conservation of energy.

**Unit 3 - Motion in central force field (10 hrs)**

Unit 4 - Collisions (6 hrs)
Conservation laws- Conservation of momentum- laboratory and centre of mass systems- kinetic energies in the lab and CM systems- Cross-section of elastic scattering

Unit 5. Lagrangian Dynamics (9hrs)
Constraints-generalized coordinates- principle of virtual work-D’ Alembert’s principle, Lagrange’s equation from D’Alembert’s principle-applications of Lagrange’s equation in simple pendulum, Atwood’s machine and compound pendulum, Comparison of Lagrangian approach with Newtonian approach.

Unit 6. Hamiltonian Dynamics (5hrs)
Generalized momentum and cyclic coordinates- Hamiltonian function H- conservation of energy- Hamilton’s equation - examples of Hamiltonian dynamics- one dimensional harmonic oscillator

Unit 7. Frames of Reference, Galilean transformation and Special theory of relativity (13hrs)

Books for Study:

Books for Reference:

PY1541 - QUANTUM MECHANICS

(72 HRS-4 CREDITS)

Course Outcome:
<table>
<thead>
<tr>
<th>CO.No.</th>
<th>Upon completion of this course, students will be able to</th>
<th>PSO addressed</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO –1</td>
<td>Review and Compare the concepts of Classical Mechanics and Quantum Mechanics</td>
<td>PSO 1, PSO 2</td>
<td>Knowledge, Remember</td>
</tr>
<tr>
<td>CO –2</td>
<td>Discriminate between Particle and Wave nature</td>
<td>PSO - 4, PSO - 5</td>
<td>Knowledge, Remember</td>
</tr>
<tr>
<td>CO –3</td>
<td>Underline the postulates of Quantum Mechanics</td>
<td>PSO - 4, PSO - 5</td>
<td>Knowledge, Remember</td>
</tr>
<tr>
<td>CO –4</td>
<td>Verify the concepts of Quantum Mechanics with examples and introduce Schrodinger equation</td>
<td>PSO - 2</td>
<td>Application</td>
</tr>
<tr>
<td>CO –5</td>
<td>Visualize the wave function</td>
<td>PSO - 2</td>
<td>Application</td>
</tr>
<tr>
<td>CO –6</td>
<td>Mathematical formulation of observables and wavefunctions</td>
<td>PSO - 2</td>
<td>Synthesis</td>
</tr>
<tr>
<td>CO –7</td>
<td>Apply Schrodinger equation in various physical systems (LHO, Particle in a box etc)</td>
<td>PSO - 2, PSO - 6</td>
<td>Analysis</td>
</tr>
<tr>
<td>CO-8</td>
<td>Justify the phenomena of Specific Heat of Solids, Tunneling Effect, Photoelectric Effect</td>
<td>PSO - 2, PSO - 6</td>
<td>Creation</td>
</tr>
</tbody>
</table>
Unit 1 – The Emergence of Quantum Mechanics (18 hrs)
Limitations of classical physics, Black body radiation curve-Optical spectra —
photoelectric effect -specific heat of solids -Plank’s quantum hypothesis, Einstein’s
theory of photoelectric effect -Compton effect- Quantum theory of specific heat of
solids, -Bohr model- hydrogen atom- Bohr postulates-The correspondence principle.

Unit 2-Wave Mechanics (22 hrs)
Wave nature of particles-electron diffraction- standing wave of electron in the orbit
uncertainty principle -uncertainty relation among canonically conjugate
pairs-application- non-existence of electrons in the nucleus-ground state energy of
hydrogen atom- width of spectral lines-Properties of wave function-Conditions for
Physical Acceptability of Wave Function, Normalization and orthogonality condition.
Superposition Principle-wave packets, relation between - Particle velocity- group
velocity and phase velocity- Probability Interpretation of Wave Function -Statistical
Interpretation of Wave function -probability current density in one dimension-
Expectation value- Time dependent Schrodinger equation,-Time independent
Schrodinger equation - stationary states.

Unit 3-One Dimensional Energy Eigen Value Problems (14hrs)
Free particle Schrodinger equation–square-well potential with infinite walls- Square
well potential with finite walls, square potential barrier– The Harmonic oscillator-
(Schrodinger method)-

Unit 4- General Formalism of Quantum Mechanics (18hrs)
Linear vector space, Linear operator, Eigen values and Eigen functions-, Hermitian
operator, Postulates of Quantum Mechanics-Equation of motion-Schrodinger
representation- Momentum representation

Books for Study:

   2nd Edn., 2010
   2002
4. Quantum Mechanics: Leonard I. Schiff, TMH, 3rd Edn., 2010
Books for Reference:

2. Introduction to Quantum Mechanics: David J. Griffith, Pearson Education, 2nd Ed. 2005
4. Quantum Mechanics: Bruce Cameron Reed, Jones and Bartlett, 2008.
6. Shaum’s outline series
## PY1542: STATISTICAL PHYSICS, RESEARCH METHODOLOGY AND DISASTER MANAGEMENT

(72 HRS- 4 CREDITS)

### Course Outcome:

<table>
<thead>
<tr>
<th>CO.No.</th>
<th>Upon completion of this course, students will be able to</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO-1</td>
<td>Able to define phase space, microstate, macrostate and ensemble</td>
</tr>
<tr>
<td></td>
<td>Learn to distinguish different statistical distributions and judge which distribution applies to a given system</td>
</tr>
<tr>
<td>CO-2</td>
<td>Able to solve problems based on the principles of statistical mechanics</td>
</tr>
<tr>
<td>CO-3</td>
<td>Understand the objectives, motivation and significance of research</td>
</tr>
<tr>
<td>CO-4</td>
<td>Identify the key elements and prepare a research design</td>
</tr>
<tr>
<td>CO 5</td>
<td>Able to write a review of literature</td>
</tr>
<tr>
<td>CO-6</td>
<td>Understand the different steps in research process</td>
</tr>
<tr>
<td>CO-7</td>
<td>Able to select a good research question based on the criteria of good research</td>
</tr>
<tr>
<td>CO-8</td>
<td>Understand the components of thesis and able to write a thesis/report</td>
</tr>
<tr>
<td>CO-9</td>
<td>Understand the basic ideas of error measurement</td>
</tr>
<tr>
<td>CO-10</td>
<td>Define and distinguish various types of errors</td>
</tr>
<tr>
<td>CO-11</td>
<td>Able to estimate uncertainty in measurements and judge whether our measurements are consistent with standard values</td>
</tr>
<tr>
<td>CO-12</td>
<td>Familiar with natural hazards and disasters</td>
</tr>
<tr>
<td>CO-13</td>
<td>Understand the impact of climate change on natural disasters</td>
</tr>
<tr>
<td>CO-14</td>
<td>Understand the primary steps in pre disaster and post disaster activity</td>
</tr>
<tr>
<td>CO-15</td>
<td>Familiar with research innovations for disaster risk reduction</td>
</tr>
<tr>
<td>CO-16</td>
<td>Able to manage public health during disasters</td>
</tr>
<tr>
<td>CO-17</td>
<td>Able to know the management of radiation emergency</td>
</tr>
</tbody>
</table>

**Unit 1- Statistical Physics (18 hrs)**

Statistical probability, Macro and Micro states, Phase space, Statistical ensemble, Postulate of equal probability, Maxwell Boltzmann distribution, Velocity distribution, Indistinguishability of identical particles, Bose Einstein and Fermi Dirac distribution function, comparison of three statistics
Unit 2 Research Methodology (18 hrs)

Research - Objectives and motivation in research – different types of research- research approaches- Significance of research- Research methods and methodology – Research and scientific method- Various steps in a research process- importance of literature survey- criteria of good research.

Thesis/ Report writing - preliminary section (Title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface acknowledgement), Main Text (abstract, introduction, experimental section, results and discussion), Conclusions, references, scope for future study.

Unit 3 Error Analysis (12 hrs)

Significant figures- Basic ideas of error measurement, uncertainties of measurement, importance of estimating errors, dominant errors, random errors, systematic errors, rejection of spurious measurements.

Estimating and reporting of errors, errors with reading scales, absolute and relative errors, and standard deviation, Variance in measurements, error bars and graphical representation.

Unit 4 – Disaster Management (24hrs)

Global natural disasters: Natural hazards and natural disasters, Recent major disasters and their relief efforts, Impact of global climate change and major natural disasters, Human adaptability of natural disasters, Fragile natural eco-environment, Disaster reduction activity, achievements, challenges and future development Earth quake disaster and their and their effects, Advancement in research of earthquake disaster, earthquake and tsunami warnings, earthquake disaster prevention, earthquake disaster mitigation

Health emergencies and diseases: environmental health and diseases, disasters and emergencies, steps in disaster management, pre-disaster activity, role of water supply, need for protecting large scale water supply schemes, assessment of damaged and available and water resources, water quality testing- Personal hygiene, control of communicable diseases and prevention of epidemics, measures for controlling communicable diseases and epidemics. Radiation emergencies, health consequence of radiation, measures to prevent sudden health emergencies due to radiation

Books for Study:

2. Elements of Statistical Mechanics: Kamal Singh and S. P. Singh- S. Chand & Co,1999
9. Introduction to Disaster Management: Satish Modh, Macmillan, 2010

Books for Reference:
1. Statistical Mechanics: S. Rajagopal
2. Introduction to Statistical Physics: Kerson Huang - CRC Press, 2001

PY1543-ELECTRONICS
(72 HOURS-4 CREDITS)

Course Outcome:

<table>
<thead>
<tr>
<th>CO.No</th>
<th>Upon completion of this course, students will be able to</th>
<th>PSO addressed</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO – 1</td>
<td>Describe semiconductor properties in different diodes.</td>
<td>PSO - 9</td>
<td>Remember</td>
</tr>
<tr>
<td>CO – 2</td>
<td>Explain the applications of different junction diodes</td>
<td>PSO – 2,9</td>
<td>Apply</td>
</tr>
<tr>
<td>CO – 3</td>
<td>Distinguish different feedback networks</td>
<td>PSO - 9</td>
<td>Understand</td>
</tr>
<tr>
<td>CO – 4</td>
<td>Design single stage transistor amplifiers, oscillators and operational amplifiers.</td>
<td>PSO – 2,9</td>
<td>Analyze</td>
</tr>
<tr>
<td>CO – 5</td>
<td>Explain the working of special devices, FET, MOSFET, UJT</td>
<td>PSO - 9</td>
<td>Understand</td>
</tr>
<tr>
<td>CO – 6</td>
<td>Understand the concept of modulation</td>
<td>PSO - 9</td>
<td>Understand</td>
</tr>
</tbody>
</table>
Unit 1. Circuit Theory (4 hours)

Kirchhoff’s law- Ideal voltage and current sources- Thevenin’s and Norton’s theorem, Maximum power transfer theorem

Unit 2. Diode Circuits(14 hours)

Extrinsic semiconductors-n- type and – p-type semiconductors-PN junction junction under forward and reverse biased conditions-r m s value and peak inverse voltage- diode characteristics-ac and dc resistances- half wave and full wave rectifiers- (average dc value of current, ripple factor and efficiency)- different types of filters(shunt capacitor, LC and RC)- break down mechanism in diodes- Zener diode-voltage regulator

Unit 3. Transistors(16 hours)

Theory of BJT operation- CB,CE and CC characteristics-alpha , beta and gamma – relation between transistor currents- biasing circuits(CE configuration)- stability factors-selection of operating point-ac and dc load lines-Q point-collector feedback; base resistor and potential divider methods- BJT amplifiers- input and output impedances-graphical analysis of CE amplifier(frequency response, band width and gain in dB)- emitter follower.

Unit 4. Power amplifiers: (5 hours)

Amplifier classes and efficiency - class A operation - transformer coupled class A amplifier - class B amplifier - push pull amplifier - basic ideas of class C operation - distortion in amplifiers.

Unit 5. Feedback & Oscillator circuits (8 hours)

Feedback principles – advantages of negative feedback - positive feedback - principle of sinusoidal feedback- oscillation - Barkhausen criterion for oscillations - RC phase shift, Hartley Oscillator, Colpitt’s, Oscillator (derivations not required).

Unit 6. Modulation (5 hours)

Fundamentals of modulation - AM, FM - frequency spectrum of AM - power in AM - demodulation of AM signal - frequency spectrum for FM

Unit 7. Special devices: (8 hours)


Unit 8. Operational amplifiers (IC741)(12 hours)


1. Basic electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI, 2009
2. Basic Electronics-Solid State: B. L. Theraja, S. Chand Ltd., 2005

**Books for Reference:**


**Topics for assignments/discussion in the tutorial session (sample)**

1. Electronic projects using flip flops.
2. Electronic projects using logic gates.
4. Electronic projects using timer 555.
5. Electronic projects using IC 311.
6. Constant voltage power supplies.
7. Constant current sources.
8. Oscillators of different frequencies.
9. Low range frequency generators.
10. High range frequency generators.
11. Voltage regulated dc power supplies with variable output.
12. Voltage regulated dual power supplies with variable output.
13. Instrument for the measurement of capacitance.
15. Effect of temperature on electronic components.

**PY1544-ATOMIC & MOLECULAR PHYSICS**

(72 HOURS-4 CREDITS) Course

Outcome:

<table>
<thead>
<tr>
<th>CO.No.</th>
<th>PSO</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO –1</td>
<td>PSO - 7</td>
<td>Know, Remember</td>
</tr>
<tr>
<td>Recall the basics of atom model and draw the energy level diagram of hydrogen spectrum and correlate Classical and Quantum mechanics through Bohr's correspondence principle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO –2</td>
<td>PSO - 7</td>
<td>Apply</td>
</tr>
<tr>
<td>Visualise the spin orbit interaction through coupling schemes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO –3</td>
<td>PSO - 7</td>
<td>Analysis/synthesis/creation</td>
</tr>
<tr>
<td>Predict and explain the atomic configuration of atoms using Pauli’s exclusion principle</td>
<td></td>
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</tr>
<tr>
<td>CO –4</td>
<td>PSO - 7</td>
<td>Apply</td>
</tr>
<tr>
<td>Sketch the allowed optical and hyperfine spectra and understand the effect of external fields on the spectra of atoms</td>
<td></td>
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</tr>
<tr>
<td>CO –5</td>
<td>PSO - 8</td>
<td>Analysis/synthesis/creation</td>
</tr>
<tr>
<td>Develop ideas regarding production, properties classification and importance of x-rays and explore structure and elemental composition using x-rays</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CO –6  Understand and sketch the possible energy levels and transition of molecules and relate the molecular energy spectrum with the symmetry of the molecule  PSO - 7  Apply

CO –7  Elucidate the relation of allowed energy levels and chemical environment and its spectrum of atoms through resonance spectroscopic technique  PSO - 8  Analysis /synthesis /creation

Unit 1- Vector Atom Model (10hrs)


Unit 2- Atomic Spectra (14hrs)


Unit 3- X-ray Diffraction (8 hrs)


Unit 4- Molecular spectra (28 hrs)

Electromagnetic spectra-molecular energies-classification of molecules- rotational spectra of diatomic molecules-rotational energy levels-selection rules-rotational spectrum-isotope effect- bond length and atomic mass.
Diatomic vibrational spectra-vibrational energy levels-selection rule-vibrational transitions-Rotation-Vibration transitions-IR spectrometer
Raman scattering- classical description of Raman scattering, quantum theory of Raman scattering- vibrational Raman spectra-diatomic molecules-polyatomic molecules-rotational Raman spectra Raman spectrometer.
Electronic spectra sequences and progressions-Frank-Condon principle-

Unit 5- Resonance Spectroscopy (12 hrs)
NMR principle-Resonance condition-NMR spectrometer-chemical shift-indirect spin-spin Interaction- applications of NMR spectroscopy-


Mossbauer spectroscopy- principle -isomer shift.

Books for Study:
1. Modern Physics: G. Aruldas and P. Rajagopal, PHI, New Delhi, 2005
3. Atomic and Nuclear Physics: N. Subramaniam & Brijlal, S. Chand& Co.

Books for Reference:
1. Fundamentals of Molecular Spectroscopy: Banwell, TMH
4. Atomic and Nuclear Physics: Dr. V. W. Kulkarni-Himalaya Publishing House

PY 1551-OPEN COURSES
(54 HOURS-2 CREDITS) FOR EACH COURSE

PY 1551.1. BIO PHYSICS (54 HOURS)

Unit 1 (18 hrs)

Bio mechanics- biophysics and fluid flow—Gas transport—physics of audition Physics of vision (chapter 1 to 5 of Reference 3)

Unit 2 Cellular – Molecular biophysics (18 hrs)

Cell -components-proteins-nucleic acids—physics of bio-membranes Thermodynamics of bio systems (Chapter 6 to 9 of reference 3)

Unit 3 (18 hrs)

Radiation biophysics

**Books for Study**

1. Essentials of Biophysics: P. Narayanan, 2nd Edn. New Age publishers
3. Elementary bio physics, P.K.Srivastava, Narosa publishing house, New Delhi
4. Introduction to Biophysics, Pranab kumar banerjee, S.Chand & co, New Delhi
5. Biological science, Green, Stout, & Taylor, Cambridge university press

**Reference**

**PY 1551.2 ASTRONOMY AND ASTROPHYSICS**

(54 Hours)

**Unit 1: Introduction to Astronomy (10 hours)**

What is Astronomy – Branches of Astronomy - The celestial sphere and stellar magnitudes: constellations, stellar magnitudes, apparent magnitudes – The celestial coordinate system – Precession of Earth’s axis.

**Unit 2: History of Modern Astronomy (14 hours)**

Ptolemy’s model of Universe – Copernican and Galilean contributions – Laws of planetary motion: Tycho Brahe’s observations, Kepler’s laws – Newton and his law of Universal law of Gravity – Einstein’s special and general theories of relativity

*(topics in this unit are intended as brief qualitative introductions only)*

**Unit 3: The Solar system (15 hours)**


**Unit 5: Outer Universe (15 hours)**

Properties of stars: luminosity, colour and surface temperature – Spectral types of stars – Hertzsprung-Russel diagram – Evolution of a Sun-like star – Fate of highmass stars: Supernova, Neutron stars and Black holes *(qualitative description only)* – Brief familiarization of Milky Way galaxy, Types of galaxies according to shape.

**Sources for Study:**
2. Introduction to Astronomy and Cosmology – Ian Morison (Wiley)
3. https://theplanets.org/solar-system/ Additional Reference:

1. Planet Earth, Cesare Emiliani, (Cambridge University Press)
3. Introduction to Astrophysics – Baidyanadh Basu

PY 1551.3- APPLIED PHYSICS(54HOURS)

UNIT-1.ELECTRIC AND ELECTRONIC EQUIPMENTS (14 hrs)

Electric motor-principles of working, Microwave oven-principle-technical specifications-applications-advantages, public address system-Block diagram representation- function of each unit-CD player and drives-VD player and drivesTelephonic communication(Cable and cellular)-principles (qualitative study using block diagram) -Cell phone-SIM card-technical specifications-Radio –History of radio revolution-different types of radios-Television-working(qualitative)-Touch screens & ATM ( Automatic Telling machine)

UNIT-2- X-RAY AND ITS APPLICATIONS (11 hrs)

Discovery of X-rays, Gas filled tube, Coolidge X-ray tube, Properties of X-ray, Xray spectra-continues and characteristic spectra, C T Scan-basic principle-applications and advantages –MRI Scan-Principle, applications and advantages.

UNIT-3- LASERS (13 hrs)


UNIT-4- HOLOGRAPHY(6 hrs)

Introduction, principle of holography, Recording of the hologram, Reconstruction of the image-applications.

UNIT-5-FIBRE OPTIC COMMUNICATION (10 hrs)
Introduction, optical fibre, Necessity of cladding, optical fibre system, Total internal reflection, propagation of light through an optical fibre, critical angle of propagation , Modes of propagation- Types of rays-classification of optical fibres-Applications

References

3. Television Engineering & Video System, R.g.Gupta,TMH.
4. Electrical Technology (Vol 1& 2),B.L.Theraja
5. A Text book of Optics by DR. N. Subrahmanyam Brijlal,Dr MN Avadhanulu- S.Chand & Company Pvt Ltd
6. Modern Physics by R.Murugesan & Kiruthiga Siva Prasath
   S.Chand & Company Pvt Ltd
7. Atomic and Nuclear Physics By Dr.V.W.Kulkarni-Himalaya Publishing House

PY1551.4. ENVIRONMENTAL PHYSICS
(54 HOURS)

Unit 1 Essentials of Environmental physics (18 hrs)

Structure and thermodynamics of the atmosphere; composition of air; Greenhouse effect; Transport of matter; energy and momentum in nature; Stratification and stability of the atmosphere; Laws of motion; Hydrostatic equilibrium; General circulation of the tropics; Elements of weather and climate in India.

Unit 2 Environmental pollution and Degradation(18 hrs)

Factors governing air, water and noise pollution; Air and water quality standards; Waste disposal; Heat island effect; Land and sea breeze; Puffs and Plumes; Gaseous and particulate matter; Wet and dry deposition; Dispersal mechanism of air and water pollutants; Mixing height and turbulence; Gaussian plume models; Dispersion models; Environmental degradation; Thermal and radioactive pollution; Nuclear radiation; Health hazards and safety.

Unit 3 Environmental Changes and remote sensing (18 hrs)

Energy sources and combustion processes; Renewable sources of energy; Solar energy, Wind energy, Bio energy, hydro power; fuel cells; and nuclear energy;Forestry and bio-energy; Deforestation; Degradation of soils; Agriculture and land use changes; Changing composition of local and global environment; Remote sensing techniques.
Books for Study:


PY1551.5. ENERGY PHYSICS
(54 HOURS)

Unit I (7 hrs)

Unit 2 (10 hrs)
Solar energy - Solar radiation measurements, solar energy collector, principle of the conversion of solar radiation in to heat, Solar energy storage, solar heaters, space cooling, solar ponds, solar cookers, solar distillation, solar furnaces, solar green houses, merits and demerits of solar energy.

Unit 3 (9 hrs)
Wind energy: Basic principle of wind energy conversion, basic components of wind energy conversion system (WECS), wind energy collectors. application of wind energy.

Unit 4 (9 hrs)
Biomass energy, classification, photosynthesis, biomass conversion process, Gober gas plants, wood gasification, ethanol from wood, merits and demerits of biomass as energy source

Unit 5 (9 hrs)
Energy from Oceans and Chemical energy resources: Ocean thermal energy Conversion, energy from waves and tides – basic ideas, nature, applications, merits and demerits.

Unit 6 (10 hrs)
Patterns of energy consumption in domestic, industrial, transportation and agricultural sectors – energy crisis and possible solutions – energy options for the developing
countries – energy storage-primary and secondary cells – fuel cells (basics) – impact due to non-conventional energy sources – global warming.

**Books for Study:**


**Books for Reference:**


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**PY 1641 SOLID STATE PHYSICS**

(72 HOURS - 4 CREDITS)

Course Outcome:

<table>
<thead>
<tr>
<th>CO.No</th>
<th>Upon completion of this course, students will be able to address</th>
<th>PSO</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO – 1</td>
<td>Able to distinguish types of crystals according to their structure</td>
<td>Distinguish</td>
<td></td>
</tr>
<tr>
<td>CO – 2</td>
<td>Able to illustrate the concepts of unit cell and lattice of crystals</td>
<td>Illustrate</td>
<td></td>
</tr>
<tr>
<td>CO – 3</td>
<td>Able to discuss diffraction of X rays by crystals and to demonstrate its experimental techniques</td>
<td>Discuss, Demonstrate</td>
<td></td>
</tr>
</tbody>
</table>

40
<table>
<thead>
<tr>
<th>CO – 4</th>
<th>Learn to explain crystal bonding</th>
<th>Explain</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO – 5</td>
<td>Able to describe and evaluate mechanical, electrical and magnetic properties of metals</td>
<td>Describe, Evaluate</td>
</tr>
<tr>
<td>CO – 6</td>
<td>Learn to discuss various electron models and band theories of conductors, semi conductors and insulators</td>
<td>Discuss</td>
</tr>
<tr>
<td>CO – 7</td>
<td>Learn to discuss and evaluate dielectric properties of materials</td>
<td>Discuss, Evaluate</td>
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<tr>
<td></td>
<td>Able to interpret optical phenomena in dielectrics</td>
<td>Interpret</td>
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<td></td>
<td>Able to discuss types of magnetic properties of materials</td>
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<tr>
<td>CO – 8</td>
<td>Able to formulate theories regarding different magnetic properties of matter</td>
<td>Discuss</td>
</tr>
<tr>
<td>CO – 9</td>
<td>Learn to explain different physical characteristics of superconductors</td>
<td>Formulate</td>
</tr>
<tr>
<td></td>
<td>Able to illustrate theoretical formulation of superconductors</td>
<td>Explain</td>
</tr>
<tr>
<td>CO – 10</td>
<td></td>
<td>Illustrate</td>
</tr>
</tbody>
</table>
Unit 1 Crystal Structure (18 hrs)
Types of bonding

Unit 2 Conduction in Metals - Free electron model (12 hrs)

Unit 3 Band theory (10 hrs)
Bloch theorem - Kronig Penny model - Band Gaps - Conductors - Semiconductors and insulators - P and N type Semiconductors - Conductivity of Semiconductors - Mobility - Hall Effect - Hall coefficient.

Unit 4 Dielectric Properties of Materials (12 hrs)
Polarization - Local Electric Field at an Atom - Depolarization Field - Electric Susceptibility - Polarizability - Clausius Mosotti Equation - Classical Theory of Electric Polarizability - Normal and Anomalous Dispersion - Cauchy and Sellmeir relations - Langevin- Debye equation - Complex Dielectric Constant - Optical Phenomena - Application: Plasma Oscillations - Plasma Frequency - Plasmons

Unit 5 Magnetic Properties of Matter (12 hrs)

Unit 6 Superconductivity (8 hrs)
Critical Temperature - Critical magnetic field - Meissner effect - Type I and type II Superconductors - London’s Equation and Penetration Depth - Isotope effect - BCS theory - Tunnelling and Josephson effect (Qualitative study)

Books for Study:
Books for Reference:

1. Introduction to Solid State Physics: Charles Kittel, 8th Edn., Wiley India Pvt. Ltd., 2004

PY 1642NUCLEAR AND PARTICLE PHYSICS
(72 HOURS-4 CREDITS)

Course Outcome:

<table>
<thead>
<tr>
<th>CO.No.</th>
<th>Upon completion of this course, students will be able to</th>
<th>PSO addressed</th>
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</thead>
<tbody>
<tr>
<td>CO –1</td>
<td>General properties of nucleus and concept of binding energy and nuclear forces.</td>
<td></td>
</tr>
<tr>
<td>CO –2</td>
<td>Various nuclear models</td>
<td></td>
</tr>
<tr>
<td>CO –3</td>
<td>Natural radioactivity, alpha decay, beta decay, positron emission, electron capture etc.</td>
<td></td>
</tr>
<tr>
<td>CO –4</td>
<td>Nuclear reactions, its types, Q-value of a nuclear reaction</td>
<td></td>
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<tr>
<td>CO –5</td>
<td>Particle accelerators, Nuclear fission, Nuclear fusion and the source of stellar energy</td>
<td></td>
</tr>
<tr>
<td>CO –6</td>
<td>Fundamental particles and their properties.</td>
<td></td>
</tr>
</tbody>
</table>
Unit 1. General Properties of Nuclei (14 hrs)
Constituents of nucleus and their Intrinsic properties-quantitative facts about size-
mass- charge density (matter energy), binding energy- average binding energy and its
variation with mass number- main features of binding energy versus mass number
curve- nuclear stability- angular momentum- parity- magnetic moment- electric
quadrupole moments- Nuclear forces-meson theory.

Unit 2. Nuclear Models (11 hrs)
Liquid drop model -semi empirical mass formula and significance of various terms,
condition of nuclear stability. Shell model-evidence for nuclear shell structure, nuclear
magic numbers, basic assumptions of shell model, Collective model.

Unit 3. Radioactivity: (12 hrs)
Alpha decay-basics of α-decay processes, theory of α-emission, Gamow’s theory,
Geiger Nuttall law, β -decay- energy kinematics for β -decay, positron emission,
electron capture, neutrino hypothesis, Gamma decay: Gamma ray emission & kinematics,
internal conversion.

Unit 4. Nuclear Reactions (9 hrs)
Types of Reactions, Conservation Laws, kinematics of reactions, Q-value- reaction rate-
reaction cross section- reaction mechanism-Concept of compound nucleus.

Unit 5. Particle Detectors & Accelerators (6 hrs)
GM counter-scintillation counter- Linear accelerator- Cyclotron- Synchrotronbetatron.

Unit 6 – Nuclear fission and fusion (12 hrs)
Nuclear fission-energy released in fission-Bohr and Wheeler’s theory-chain reaction -
multiplication factor-critical size-atom bomb-nuclear reactors-breeder reactors-uses of
nuclear reactors. Nuclear fusion-sources of stellar energy-thermonuclear reactions-
hydrogen bomb-controlled thermo-nuclear reactions-magnetic bottle-Tokamak- inertial
confinement-nuclear power in India.

Unit 7. Particle physics: (8 hrs)Particle interactions- basic features- types of
particles and its families-Symmetries and Conservation Laws-baryon number-
Lepton number- Isospin- Strangeness and charm- concept of quark model-
Cerenkov radiation.

Books for Study
5. Atomic and Nuclear Physics: N. Subramaniam and Brijlal, S. Chand & Co.
7. Introduction to Elementary Particles: D. Griffith, John Wiley & Sons

**Books for Reference:**
2. Nuclear Physics: Kaplan, Narosa publications
3. Introductory nuclear Physics: Kenneth S. Krane, Wiley India Pvt. Ltd., 2008
5. Quarks and Leptons: F. Halzen and A.D. Martin, Wiley India, New Delhi

**PY1643- CLASSICAL AND MODERN OPTICS**

(72 HRS-4 CREDITS) Course

**Outcome:**

<table>
<thead>
<tr>
<th>CO.No</th>
<th>PSO</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>PSO 1</td>
<td>Knowledge</td>
</tr>
<tr>
<td></td>
<td>PSO 2</td>
<td>Remember</td>
</tr>
<tr>
<td></td>
<td>PSO 3</td>
<td>Application</td>
</tr>
<tr>
<td><strong>CO – 1</strong></td>
<td>Review the principle of superposition, Explain interference, Produce interference by division of amplitude and division of wavefront, classification of fringes, Determine optical flatness</td>
<td>PSO - 1</td>
</tr>
<tr>
<td></td>
<td>PSO - 2</td>
<td>Remember</td>
</tr>
<tr>
<td></td>
<td>PSO - 3</td>
<td>Application</td>
</tr>
<tr>
<td><strong>CO – 2</strong></td>
<td>Distinguish between Fresnel and Fraunhofer diffraction, Demonstrate single slit and double slit Diffraction, Identify plane transmission grating and explain resolving power of a grating</td>
<td>PSO - 1</td>
</tr>
<tr>
<td></td>
<td>PSO - 2</td>
<td>Remember</td>
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<td></td>
<td></td>
<td>Application</td>
</tr>
<tr>
<td>CO – 3</td>
<td>Explain Dispersion and Demonstrate Dispersion</td>
<td>PSO - 1</td>
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<td>PSO - 2</td>
<td></td>
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<tr>
<td>CO – 4</td>
<td>Describe Polarization, Classification, Produce and Analyze different types.</td>
<td>PSO - 1</td>
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<td>PSO - 2</td>
<td>PSO - 3</td>
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<td>PSO - 3</td>
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<tr>
<td>CO – 5</td>
<td>Recall the applications of Laser, Describe the conditions to obtain Laser, Analyze different types of Lasers, Define Non Linear Optics and extend the ideas to Second Harmonic Generation</td>
<td>PSO - 1</td>
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<td>PSO - 2</td>
<td>PSO - 3</td>
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<tr>
<td></td>
<td>PSO - 3</td>
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<tr>
<td>CO – 6</td>
<td>Classify different types of optical fibres, Employ Optical fibre in different Applications, Construct a model of an effective Fibre optic communication system</td>
<td>PSO - 1</td>
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<td>PSO - 2</td>
<td>PSO - 3</td>
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<tr>
<td></td>
<td>PSO - 3</td>
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<tr>
<td>CO – 7</td>
<td>Underline the basis of Holography, Classify different types of Hologram, Discover its application in modern world</td>
<td>PSO - 1</td>
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<td>PSO - 2</td>
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<td>PSO - 2</td>
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</tbody>
</table>

**Unit 1. Interference of light (12 hrs)**

The principle of superposition - coherent sources – Double slit interference (theory of interference fringes and band width) - Interference by division of wave front and amplitude – Fresnel’s biprism-interference in thin films-classification of fringes-wedge shaped films-testing
of optical flatness-Newton’s rings(reflected system)-refractive index of a liquid- Michelson interferometer – determination of wavelength

**Unit 2. Diffraction (14 hrs)**


**Unit 3. Dispersion (5 hrs)**

**Unit 4. Polarisation (12 hrs)**


**Unit 4. Laser (14 hrs)**


**Unit 5. Fibre Optics (8 hrs)**

Introduction, optical fibre, the numerical aperture, coherent bundle, pulse dispersion in step index fibre, graded index fibre, single mode fibre, multimode fibre, Fibre optic sensors (qualitative), fibre optic communication (qualitative), Advantages of fibre optic communication system.

**Unit 6. Holography: (7 hrs)**

Principle of holography, recording of holograms, reconstruction of images (Theory not needed), application of holography, different types of holograms, transmission and reflection types.

**Books for Study:**
Books for Reference:

1. Fundamentals of Optics: Jenkins and White, MCH
5. Electronic Communications: Dennis Roddy & John Coolen, Pearson, 1995

Topics for assignments/discussion in the tutorial session (sample)

1. Michelson’s interferometer-Standardization of metre.
2. Diffraction at a rectangular aperture and circular aperture
3. Optical activity-Fresnel’s theory of optical rotation.
4. Resolving power of prism and telescope
5. Constant deviation spectrometer.
6. Laurent’s half shade polarimeter.
8. Laser applications.
10. Determination of refractive index of liquid by Newton’s rings method.

11. Comparison of radii of curvature by Newton’s rings method.

PY1644-DIGITAL ELECTRONICS AND COMPUTER SCIENCE (72HRS-4 CREDITS) Course Outcome:

<table>
<thead>
<tr>
<th>CO.No.</th>
<th>PSO</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO-1</td>
<td>Upon completion of this course, students will be able to understand the different number system and their mathematical operations.</td>
<td></td>
</tr>
<tr>
<td>CO-2</td>
<td>Understand boolean algebra and logic gates</td>
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<tr>
<td>CO-3</td>
<td>Analyze Karnaugh’s map</td>
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<tr>
<td>CO-4</td>
<td>Analyze the arithmetic and sequential circuits.</td>
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</tr>
<tr>
<td>CO-5</td>
<td>Differentiate between software and hardware</td>
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<tr>
<td>CO-6</td>
<td>Get a deep knowledge of various memories used in computer.</td>
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</tr>
<tr>
<td>CO-7</td>
<td>Be trained in programming C++ language</td>
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</tr>
<tr>
<td>CO-8</td>
<td>Attain the basic knowledge about the internal architecture and addressing modes of intel 8085 micro processor.</td>
<td></td>
</tr>
</tbody>
</table>

Unit-1 (22hrs)

**Number systems** :- Decimal number system-binary number system-conversion 2of binary number to decimal and decimal number to binary-binary addition and subtraction-21’s complement-2’s complement-binary subtraction using 2’s complement-signed arithmetic operation-conversion of real numbers-conversion of decimal fraction to binary fraction-binary coded decimal -hexadecimal number system-conversion of hexadecimal number to decimal,
decimal to hexadecimal, binary to hexadecimal and hexadecimal to binary-real or floating point representation of numbers-ASCII code.

**Boolean algebra and logic gates:** - Logic gates AND, OR, NOT, NAND,NOR

And Ex-OR gate-realization of other logic functions using NAND / NOR gates-tri state logic gate-Boolean laws- Demorgan’s theorem-Simplification of Boolean equations using Boolean laws. Karnaugh map

**Arithmetic circuits:** - Half adder-full adder-controlled inverter-binary adder- subtractor.

**Sequential circuits:** - Flip-Flop, S-R Flip Flop, J-K Flip-flop, Master slave JK Flip- Flop

Unit2 (11hrs)

**Basics of computers:** - Hardware- input and output units- memory unit-ALU-control unit– basicopperational concepts -Software – operating systems

**The memory systems:** - Basic concepts-semiconductor RAM- internal organization memory chips-static memories-asynchronous and synchronous DRAM-structure of large memories– ROM,PROM,EPROM, EEPROM–flash memory-speed size and cost-Basic concepts of cache memory and virtual memories. Secondary storage-magnetic hard disks-optical disks-magnetic tape systems.

Unit-3: Programming in C++ (25 hrs)

Features of c++ - basic structure of c++ program – library files-header files – preprocessor directives- inbuilt functions- output using cout- input with cin - constants and variables – data types – declaration of variables – integer variables, character variables, floating point types, type bool - assigning values to variables–manipulators-operators and expressions– arithmetic operators, relational operators, logical operators, short hand operators-control statements-for loops , while loop, do…while loop- if statement, if……else, else….if constructions, switch statement- break, continue, goto statements-user defined functions-function definition, function declaration, function header and body, function call and execution, passing arguments to functions, returning values from functions, overloaded functions, inline functions, default arguments, scope rule for functions- storage classes- Arrays-array elements, array initialization, multidimensional arrays, passing arrays to functions-strings-basics of structures and pointers in c++, classes and objects (introduction only)-basic file operationsserial and sequential files, reading and writing -simple examples of c++ programs for solving problems in physics-compilation and execution of data.

Unit 4: Introduction to microprocessors (14 hrs)

Microprocessors and microcontrollers (definition only)-intel 8085- 8 bit microprocessor-pin disruption - 8085 instructions - addressing modes(definition only)- interrupts (definition only) -assembly language - simple programs- addition, subtraction.
Books for study:

2. Digital principles and Applications: Malvino and Leach. TMH, New Delhi, 4th Edn.
6. Object oriented programming in C++: Robert Lfere, Galgotia publications Pvt Ltd.,
3Edn., 2004
8. Object oriented programming with C++: E. Balaguruswami, 5Edn., Tata Mc Graw Hill
13. Microprocessor-Architecture, Programming and applications with 8085: R.S. Gaonkar,

Books for Reference: -

1. Introduction to digital electronics: NIIT, PHI.

PRACTICAL

PY1442- Basic Physics Lab 1
(minimum 18 experiments to be done)

1. Fly Wheel - Moment of Inertia
2. Compound Bar Pendulum – Symmetric
3. Compound Bar Pendulum – Asymmetric
4. Uniform Bending—Y---Pin and Microscope
5. Uniform bending—Y- optic lever method
6. Non-uniform bending-Y-Optic lever & telescope
7. Rigidity modulus – Static torsion
8. Torsion pendulum I- By Torsional oscillations
9. Torsion pendulum I- By Equal masses
11. Kater’s pendulum-Acceleration due to gravity
12. Melde’s string------Frequency of fork
13. Phase transition-determination of M.P of wax.
14. Determination of thermal conductivity of rubber
15. Lee’s disc-determination of thermal conductivity of a bad conductor
17. Viscosity-Variable pressure head arrangement
18. Surface tension-Capillary rise
19. Sonometer-frequency of A.C
21. Determination of m and Bh using deflection and vibration magnetometers.
22. Potentiometer- Resistivity.

References


2. An advanced course in practical physics, Chathopadhyaya, Rakshit and Saha, New central agency, Kolkata.


**PY1645-Advanced Physics Lab 2**

**(Minimum 18 experiments to be done)**

1. Spectrometer-A, D and n of a solid prism.

2. Spectrometer – Dispersive power and Cauchy’s constants

3. Spectrometer Grating—Normal incidence- N & wavelength
4. Spectrometer-i-d curve

5. Spectrometer- Hollow prism

6. Liquid lens-refractive index of liquid and lens

7. Newton’s Rings—Reflected system

8. Air wedge-diameter of a wire


10. Potentiometer-Calibration of ammeter

11. Potentiometer –Reduction factor of T.G

12. Potentiometer –Calibration of low range voltmeter

13. Potentiometer – Calibration of high range voltmeter


15. Carey Foster’s bridge-Resistivity

16. Carey Foster’s bridge-Temperature coefficient of resistance.

17. Mirror galvanometer-figure of merit.

18. BG- Absolute capacity of a condenser

19. Conversion of galvanometer into ammeter and calibration using digital Multimeter


22. Study of network theorems-Thevenin’s & Norton’s theorems and maximum power transfer theorem.

23. Circular coil-Study of earth’s magnetic field using compass box.
24. Absolute determination of m and Bh using box type and Searle’s type vibration magnetometers.

25. Searle’s vibration magnetometer—comparison of magnetic moments.

References


2. An advanced course in practical physics, Chathopadhyaya, Rakshit and Saha, New central agency, Kolkata.


PY1646—Advanced Physics Lab 3
(Minimum 18 experiments to be done – 4 from Computer Science)

ELECTRONICS

1. PN junction Diode (Ge & Si) characteristics—To draw the characteristic curves of a PN junction diode and to determine its ac and dc forward resistances.

2. Full wave (centre tapped) rectifier—To construct a full wave rectifier using junction diode and to calculate the ripple factor with and without shunt filter (10 readings for RL 100 to 5000 ).

3. Full wave (centre tapped) rectifier—To construct a full wave rectifier using junction diode and to study effect of L,C, and LC filters on the ripple factor (for different RL).

4. Bridge rectifier—To construct a bridge rectifier using junction diodes and to calculate the ripple factor with and without shunt filter (10 readings for RL 100 to 5000 ).

5. Bridge rectifier—Dual power supply—To construct a dual power supply using bridge rectifier and measure the output voltages for different pair of identical load resistors.

6. Zener diode characteristics—To draw the I-V characteristic of a Zener diode and to find the breakdown voltage and the dynamic resistance of the diode.

7. Zener diode as a voltage regulator—To construct a voltage regulator using Zener diode and to study the output voltage variation (i) for different RL and (ii) for different input voltage with same RL.
8. Transistor characteristics-CE-To draw the characteristic curves of a transistor in the CE configuration and determine the current gain, input impedance and output impedance.

9. Transistor characteristics-CB-To draw the characteristic curves of a transistor in the CB configuration and determine the current gain, input impedance and output impedance.

10. Single stage CE amplifier-To construct a single stage CE transistor amplifier and study its frequency response.

11. OP amp. IC741- Inverting amplifier-To construct an inverting amplifier using IC741 and determine its voltage gain.

12. OP amp. IC741- Non inverting amplifier

To construct a non inverting amplifier using IC741 and determine its voltage gain.

13. OP amp. IC741- Differentiator-To construct an OP amp. Differentiator, determine its voltage gain and study the output response to pulse and square wave.

14. OP amp. IC741- Integrator-To construct an OP amp. Integrator, determine its voltage gain and study the output response to pulse and square wave.

15. Phase shift oscillator-To construct a phase shift oscillator using transistor and measure the frequency of the output waveform.

16. Logic gates- OR and AND-To verify the truth tables of OR and AND gates using diodes.

17. Logic gate- NOT-To verify the truth tables of NOT gate using a transistor.

18. Network theorems (Superposition, Thevenin’s & Norton’s theorems)

To verify the (i) Superposition, (ii) Thevenin’s & (iii) Norton’s theorems

19. RC-Filter circuits (Low pass)

To construct an RC –low pass filter circuit and to find the upper cut off frequency.
20. RC-Filter circuits (High pass)-To construct an RC–high pass filter circuit and to find the lower cut off frequency.

**Computer Science (C++ Programs)**

1. Program to find the roots of a quadratic equation (both real and imaginary root)
2. Program to find the dot product and cross product of vectors
3. Program to plot the functions Sin x, Tan x and e^x
4. Program to find the matrix addition, multiplication, trace, transpose and inverse.
5. Program to convert hexadecimal to decimal number, decimal to hexadecimal number, binary to hexadecimal numbers and hexadecimal to binary numbers
6. Program to find the result of binary addition and subtraction.
7. Program to find the moment of inertia of regular bodies about various axes of rotation.
8. Program to find the velocity of a rolling body (without sliding) at any point in an inclined plane
9. Program to study the motion of a spherical body in a viscous fluid
10. Program to study the motion of projectile in central force field
11. Program to study the planetary motion and Kepler’s law
12. Monte carlo simulation

**References:**

1. Basic electronics and linear circuits; N.N. Bhargava, D.C. Kulshreshtha, S.C.Gupta
2. OP- Amps and linear integrated circuits; Ramakant A. Gayakwad
3. Basic electronics; Santiram Kal
4. Basic electronics; B. L. Theraja
5. Principles of electronics; V. K. Mehta
6. A first course in Electronics; Anwar A. Khan, Kanchan K. Dey
PY1661. ELECTIVE COURSES

(54 HOURS-2 CREDITS) FOR EACH COURSE

PY1661.1 ELECTRONIC INSTRUMENTATION

Unit 1 (14 hrs)
Basic concepts of measurements- Instruments for measuring basic parameters- ammeter- voltmeter- multimeter- digital voltmeter- accuracy and resolution of DVM.

Unit 2 – Oscilloscopes (14 hrs)
Cathode ray tubes- CRT circuits- vertical deflection system- delay line- horizontal deflection system- multiple trace- oscilloscope probes and transducer- storage oscilloscopes.

Unit 3 – Transducers (10 hrs)
Basic principles- classification of transducers- Passive and Active transducers- strain gauges- temperature measurements- thermistors- photosensitive devices.

Unit 5 – Signal Generation and Analysis (16 hrs)
Sine wave generator- frequency synthesizer- sweep generator- astable multivibrator- laboratory pulse generator- function generator- wave analysers- harmonic distortion analyzer- wave meter- spectrum analyzer (qualitative idea only).

Books for Study:

1. Modern Electronic Instrumentation and Measurement Techniques: Albert D.Helfrick & William D.Cooper, PHI, Ltd.
4. Electronic Instruments and Instrumentation Technology: M.M.S.Anand, PHI Ltd.

Books for Reference:


PY1661.2. SPACE SCIENCE
54 HOURS-2CREDITS)

Unit 1. Universe (12 hrs) [Book3]

Large Scale Structure of the Universe: Astronomy and Cosmology, Our Galaxy,Galaxy types, Radio sources, Quasars, Structures on the largest scale, Coordinates and catalogues of astronomical objects, Expansion of the Universe

Unit 2. The evolution of Stars (9hrs) [Book4]


Unit 3. The active Sun (10 hrs) [Book2]


The earth’s Atmosphere (15 hrs) [Book 1]

Introduction, Nomenclature and temperature profile, Temperature distribution in the troposphere, Temperature of stratosphere, temperature of mesosphere and thermosphere, Temperature variability, The pressure profile, Scale height, Density variation.The Ionosphere: Effect on scale height, Ionospheric electric fields, Ionization profile, Layer of charge, Ionospheric hydrogen and Helium.

Magnetosphere (8 hrs) [Book 2]

Books for Study


2. Earth’s Proximal Space- Chanchal Uberoi (2000), Universities Press (India)


Books for reference


2. Introductory Course on Space Science and Earth’s environment-Degaonkar (Gujarat University, 1978)

3. Introduction to Ionosphere and magnetosphere- Ratcliffe (CUP, 1972)


7. Introduction to Space Physics- Kivelson and Russel

8. Introduction to Astrophysics – Baidyanadh Basu

PY1661.3. PHOTONICS
(54 HOURS)

Unit 1: (5 hrs)
Photons in semiconductors—energy band and charge carriers—direct and indirect gap semiconductor—Different type of semi conducting materials—generation, recombination and injection electron hole injection homo and hetero junctions—quantum wells, quantum dots and quantum wires.

Unit 2: (6 hrs)

Unit 3: (10 hrs)

Unit 4: (10 hrs)
Semiconductor photon detectors—The external photo effect—photo electron emission—The internal photo effect—properties of semiconductor photo detectors—quantum efficiency—responsivity devices with gain—response time—photoconductors—gain—spectral response—p-n photo diodes—PIN photo diodes—hetero structure photo diode—Schotky barrier photodiodes—array detectors—avalanche photodiodes (basics).

Unit 5: (8 hrs)

Unit 6: (7 hrs)

Unit 7: (8 hrs)
Photonic switching and computing-photonic switches-switches-opto mechanical, electro optic, acoustooptic and magneto optic switches-all optical switches-optical computing-digital optical computing-analog optical processing.

**Book for Study:**
1. Fundamentals of Photonics: BFA Saleh and M.C. Teich, John Wiley & Sons, Inc. *Books*

**Books for Reference:**
1. Semiconductor optoelectronic devices: Pallab Bhattacharya, Printice Hall of India.
2. Optics and Photonics- An introduction: F. Graham Smith and Terry A. King, John Wiley & Sons, Inc.
3. Lasers and Non linear Optics: B.B. Laud, New Age International Pvt Ltd.

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**Core Course – XII (ELECTIVE) 54 hrs (Credit – 2)**

**PY 1661.4: NANO SCIENCE AND TECHNOLOGY**

**Module 1: Introduction : (6 Hrs)**

Length scales in Physics- nanometre- Nanostructures: Zero, One Two and Three dimensional nanostructures (Chapter 3, Text 2)

Band Structure and Desnsity of State at nanoscale: Energy Bands, Density of States at low dimensional structures. (Chapter 3, Text 1)

**Module 2: Electrical Transport in Nanostructure: (15 hours)**

Electrical conduction in metals, The free electron model. Conduction in insulators/ionic crystals - Electron transport in semiconductors - Various conduction mechanisms in 3D (bulk), 2D(thin film) and low dimensional systems: Thermionic emission, field enhanced thermionic emission (Schottky effect). (Chapter 4, Text 1)

**Module 3: Introductory Quantum Mechanics for Nanoscience: (8 hrs)**

Size effects in small systems, Quatum behavious of nanometric world: Applications of Schrödinger equation – infinite potential well, potential step, potenial box; trapped particle in 3D (nanodot), electron trapped in 2D plane (nanosheet), electrons moving in 1D (nanowire, nanorod, nanobelt), Excitons, Quantum confinement effect in nanomaterials (Chapter 5, Text 1)

**Module 4: Growth Techniques of Nanomaterials (Elementary ideas only): (9 hrs)**
Top down vs bottom up techniques, Lithographic process, Non Lithographic techniques: Plasma arc discharge, sputtering. Evaporation: Thermal evaporation, Electron beam evaporation. Chemical Vapour Deposition (CVD). Pulsed Laser Deposition, Molecular Beam Epitaxy, Sol-Gel Technique, Electrodeposition., Ball-milling. (Chapter 6, Text 1)

**Module 5: Characterization tools of nanomaterials: (Qualitative ideas only) (10 hrs)**


**Module 6: Applications of nanotechnology: (Elementary ideas only) (6 hrs)**

Buckminster fullerene, Carbon nanotube, nano diamomd, BN Nanotune, Nanoelectronics - single electron transistor (no derivation), Molecular machine, Nanobiometrics (Chapter 8, Text 1).

**Applications of nanotechnology: (Elementary ideas only)** Potential applications, Expected benefits from nanotechnologies, Can nanotechnology helps in addressing various challenges?, Energy and Energy Efficiency, new energy producers, Medicine, security, Other Applications. (Text book-2, Chapter 5, 6, 7 &8, Nanotechnology: Technology Revolution of 21st Century, Rakesh Rathi, S Chand & Company, New Delhi.).

Text books:

1. Introduction to Nanoscience & Nanotechnology by K. K. Chattopadhyay and A. N. Banerjee, Publisher: PHI Learning and Private Limited
2. Nanotechnology, Rakesh Rathi, S Chand & Company, New Delhi
3. NANO: The Essentials, T.Pradeep, McGraw Hill Education (India) Private Limited

References:


62
PY1661.5. COMPUTER HARDWARE & NETWORKING (54 HRS)

Unit 1 - 3 hrs
P.C. Architecture Functional block diagram of a computer. Processors Introduction to Microprocessor. CISC, RISC processors Type of Processors and their specification. (Intel: Celeron, Pentium family-PII, PIII, PIV, dual core, core 2duo - AMD-K5, K6 series

Unit 2 - 10 hrs
Motherboards: Motherboard components Types, Form factor. Different components of Motherboard (BIOS, CMOS, BICMOS, RAM, CMOS Battery, I/O slots, I/O connectors), Riser architecture, Main Memory (SIMM, DIMM, RIMM), extended/expanded/cache memories. Chipsets (Intel & AMD) ROM, DRAM, SDRAM, CDRAM, RDRAM, WRAM. Bus standards: Types of Buses (PC, ISA, MCA, AGP, PCI, USB, IEEE FireWire). Add on Cards Different latest Add on Cards (TV Tuner Card, DVR card, Video Capture, Internal Modem, Sound Card)

Unit 3 - 9 hrs Drivers:

1. Floppy Disk Drive- Floppy Drive Components (overview only)
2. Hard Disk Drive (HDD)

Types, Capacity, Hard Disk Components (Media, Read/Write Head, Spindle Motor Head Actuator), Connector, Jumper setting, trouble shooting in HDD. Hard Disk Controller (HDC) – Block diagram, Working, Interfacing (IDE, SCSI, ATA and SATA series) Configuration of HDD - Installation, Formatting, File Format (FAT, NTFS). Pen drive, i-pods

3. Optical Disk Drive

Types (ROM, R/W, DVD ROM, DVD R/W), Capacity, Difference between CD & DVD (capacity, format) - trouble shooting.

Unit 4 - 5 hrs

Peripherals. Keyboard and Mouse - operation

Types of VDU (CRT, LCD, and TFT), Resolution, and Dot pitch - Printers – Types (dot matrix, inkjet, laser) Scanner - operation. Power conditioning Device: SMPS - Block diagram, operation - UPS - Types (online, off line, Hybrid) - trouble shooting in all these devices.

Unit 5 - 4 hrs

Viruses & Vaccines- Virus - Introduction, infection methods, Types of viruses, Different symptoms of virus attack, precautions. Vaccine - Method of vaccine, Different types of Antivirus used in PC, Firewalls

Unit 6 - 7 hrs

NETWORKING ESSENTIALS
Introduction-Need for networking-Network Topology-OSI Model-Types of networks (LAN, WAN, MAN)

Protocols-LAN Protocols- Classification, Examples, Ethernet networking-WAN Protocols- PPP, X.25, PPTP, L2TP, ISDN

Unit 7-- 8 hrs

LAN Connectivity Devices- NIC, Repeater, Hub, Switch, Bridge.Internet Connectivity Device Routers, Gateways, CSU/DSU-TCP/IP Protocol Suite-What is TCP/IP, Importance, OSI vs TCP/IP

Unit 8- 6 hrs

IP Addressing-Overview, Address classes, Network ID, Host ID and Subnet Mask,Addressing guidelines, Reserved IP Address, Subnetting and Supernetting(overview)

Unit 9 -2 hrs

Emerging Technologies-Wireless Technology - Bluetooth, WAP-Mobile Technology- GSM, CDMA, GPRS

Books for Study:
6. Dougloew, “Networking All in One Desk Reference”-3Edn, Wiley India Pvt Ltd

Books for Reference:


5. Vishnu Priya Sing & Meenakshi Singh, “Computer Hardware Course”, Computech


**Internet Resources:**

www.edugrid.ac.in/webfolder/courses/cn/cn_resourses.htm

www.howstuffwork.com

www.e-tutes.com

www.learnthat.com

www.intel.com

www.amd.com

http://en.wikipedia.org
### COMPLIMENTARY COURSE MATHEMATICS

**Complementary Course in Mathematics for First Degree Programme in Physics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Sem.</th>
<th>Title of Course</th>
<th>Contact hrs/week</th>
<th>No. of Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM 1131.1</td>
<td>1</td>
<td>Calculus with applications in Physics – I</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>MM 1231.1</td>
<td>2</td>
<td>Calculus with applications in Physics – II</td>
<td>4</td>
<td>3</td>
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<tr>
<td>MM 1331.1</td>
<td>3</td>
<td>Calculus and Linear Algebra</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>MM 1431.1</td>
<td>4</td>
<td>Complex Analysis, Special Functions and Probability Theory</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>
Module 1: Differentiation with applications to Physics (18 Hours) (The following topics should be quickly reviewed before going to advanced topics; students should be asked to do more problems from exercises, and these problems should be included in assignments:) Differentiation of products of functions; the chain rule; quotients; implicit differentiation; logarithmic differentiation; Leibnitz theorem
The following topics in this module should be devoted more attention and time.

Special points of a function (especially, stationary points); curvature; theorems of differentiation – Rolle’s, Mean Value Theorems
The topics in this module can be found in chapter 2, sections 2.1.2, to 2.1.7, text [1] (Re-view of ideas through problems), chapter 2, sections 2.1.8, 2.1.9, 2.1.10, text [1]
More exercises related to the topics in this module can be found in chapter 2 and chapter 3 of reference [1].

Module 2: Integration with applications to Physics (18 Hours) Integration by parts; reduction formulae; infinite and improper integrals; plane polar coordinates; integral inequalities; applications of integration (finding area, volume etc) The topics in this module can be found in chapter 2, sections 2.2.8 to 2.2.13, text [1] More exercises related to the topics in this module can be found in chapter 4, chapter 5 and chapter 7 of reference [1].

Module 3: Infinite series and limits (18 Hours) Definition, Summation of series of various types (Arithmetic series; geometric series; arithmetico-geometric series; the difference method; series involving natural numbers; transformation of series) Convergence of infinite series (Absolute and conditional con- vergence; series containing only real positive terms; alternating series test) Operations with series (Sum and product)
Power series (Convergence of power series; operations with power series) Taylor series (Taylors theorem need not be proved, but the statement should be explained through problems); approximation errors; standard Maclaurin series The topics in this module can be found in chapter 4, sections 4.1 to 4.6, text [1] More exercises related to the topics in this module can be found in chapter 9 of reference [1] and chapter 1 of reference [2].

Module 4: Vector algebra (18 Hours)
Scalars and vectors, Addition and subtraction of vectors, Multiplication by a scalar, Basis vectors and components, Magnitude of a vector, Multiplication of vectors (Scalar product; vector product; scalar triple product; vector triple product), Equations of lines, planes and spheres, using vectors to find distances (Point to line; point to plane; line to line; line to plane)
The topics in this module can be found in chapter 7, sections 7.1 to 7.8, text [1] 
More exercises related to the topics in this module can be found in chapter 11 of reference [1] and chapter 6 of reference [2].

Texts

References


Module 1: Complex numbers and hyperbolic functions (18 hours)
Basic operations (Addition and subtraction; modulus and argument; multiplication; complex conjugate; division), Polar representation of complex numbers (Multiplication and division in polar form), de Moivers theorem (trigonometric identities; finding the nth roots of unity; solving polynomial equations), Complex logarithms and complex powers, Applications to differentiation and integration, Hyperbolic functions (Definitions; hyperbolic trigonometric analogies; identities of hyperbolic functions; solving hyperbolic equations; inverses of hyperbolic functions; calculus of hyperbolic functions)

The topics in this module can be found in chapter 3, sections 3.1 to 3.7 of text [1]
More exercises related to the topics in this module can be found in chapter 6 of reference [1] and chapter 13 of reference [4].

Module 2: Partial differentiation (18 Hours)
Basics, The total differential and total derivative, Exact and inexact differentials, theorems of partial differentiation, The chain rule, Change of variables, Taylors theorem for many-variable functions, Stationary values of many-variable functions, Stationary values under constraints

The topics in this module can be found in chapter 5, sections 5.1 to 5.9 of text [1]
More exercises related to the topics in this module can be found in chapter 13 of reference [1].

Module 3: Multiple integrals (18 Hours)
Double integrals, Triple integrals, Applications of multiple integrals (Areas and volumes), Change of variables in multiple integrals (Areas and volumes), change of variables in double integrals; evaluation of some special infinite integrals, change of variables in triple integrals; general properties of Jacobians

The topics in this module can be found in chapter 6, sections 6.1 to 6.4 of text [1]
More exercises related to the topics in this module can be found in chapter 14 of reference [1].

Module 4: Vector differentiation (18 Hours)
Differentiation of vectors, Composite vector expressions; differential of a vector, Integration of vectors, Space curves, Vector functions of several arguments, Surfaces, Scalar and vector fields

Vector operators, Gradient of a scalar field; divergence of a vector field; curl of a vector
The topics in this module can be found in chapter 10, sections 10.1 to 10.9 of text [1]. More exercises related to the topics in this module can be found in chapter 3 of reference [3].

Texts


References

Module 1: Ordinary Differential Equations (30 Hours)

First-order ordinary differential equations: General form of solution, First-degree first-order equations (Separable-variable equations; exact equations; inexact equations, integrating factors; linear equations; homogeneous equations; isobaric equations; Bernoulli’s equation; miscellaneous equations)

Higher-degree first-order equations (Equations soluble for p; for x; for y; Clairaut’s equation)

Higher-order ordinary differential equations: Linear equations with constant coefficients, (Finding the complementary function \( y_c(x) \); finding the particular integral \( y_p(x) \); constructing the general solution \( y_c(x) + y_p(x) \); linear recurrence relations; Laplace transform method) Linear equations with variable coefficients (The Legendre and Euler linear equations; exact equations; partially known complementary function; variation of parameters; Green’s functions; canonical form for second-order equations)

General ordinary differential equations – Dependent variable absent; independent variable absent; non-linear exact equations; isobaric or homogeneous equations; equations homogeneous in \( x \) or \( y \) alone; equations having \( y = Ae^x \) as a solution

The topics in this module can be found in chapter 14 and chapter 15 of text [1]

More exercises related to the topics in this module can be found in chapter 1, 2 and 3 of reference [3].

Module 2: Vector Integration – Line, surface and volume integrals (18 hours)

Evaluating line integrals; physical examples; line integrals with respect to a scalar connectivity of regions, Green’s theorem in a plane, Conservative fields and potentials, Surface integrals, Evaluating surface integrals; vector areas of surfaces; physical examples, Volume integrals, Volumes of three-dimensional regions, Integral forms for grad, div and curl, Green’s theorems (without proof); other related integral theorems; physical applications, Stokes theorem and related theorems (without proof), Related integral theorems; physical applications

The topics in this module can be found in chapter 11 of text [1]

More exercises related to the topics in this module can be found in chapter 3 of reference [2].

Module 3: Fourier series (18 Hours)

Basic definition, Simple Harmonic Motion and Wave Motion; Periodic Functions, Applications of Fourier Series, Average Value of a Function, Fourier Coefficients, Dirichlet Conditions, Complex Form of Fourier Series, Other Intervals, Even and Odd Functions, Parsevals Theorem, Fourier Transforms

The topics in this module can be found in chapter 7 of text [2]
Module 4: Basic Linear Algebra (24 Hours)
Matrices and row reduction, Determinants, Cramer’s rule for solving system of equations, vectors, lines and planes, linear combinations, linear functions, linear operators, linear dependence and independence, special matrices like Hermitian matrices and formulas, linear vector spaces, eigen values and eigen vectors, diagonalizing matrices, applications of diagonalization.

The topics in this module can be found in chapter 3 of text [2].
More exercises related to the topics in this module can be found in chapter 7 and 8 of reference [3].

Text

References
Module 1: Advanced Complex Analysis (36 Hours) Functions of a complex variable, Analytic functions, the Cauchy-Riemann relations, Contour integrals Cauchy’s theorem, Cauchy’s integral formula, Laurent series, the residue theorem, methods of finding residues, evaluation of definite integrals using residue theorem, residues at infinity, conformal mapping and some of its applications.

The topics in this module can be found in chapter 14 of text [1]
More exercises related to the topics in this module can be found in chapter 14, 15, 16 and 17 of reference [4].

Module 2: Special functions (18 Hours)
The Factorial Function, Definition of the Gamma Function; Recursion Relation, The Gamma Function of Negative Numbers, Some Important Formulas Involving Gamma Functions, Beta Functions, Beta Functions in Terms of Gamma Functions

The topics in this module can be found in chapter 11 of text [1]
More exercises related to the topics in this module can be found in chapter 13 of reference [3].


The topics in this module can be found in chapter 15, sections 15.1 to 15.9 of text [1]
More exercises related to the topics in this module can be found in chapter 23 of reference [3].

Texts

References
FIRST DEGREE PROGRAMME for B.Sc. Physics

Complementary MACHINE LEARNING

SCHEME AND SYLLABI [w.e.f. 2020 Admission]

The goal of this programme is to equip the students with the concepts, principles and methods of artificial intelligence and machine learning. There are practical sessions in each semester. It is mandatory to submit a fair record of practical done and print-out of the output of the same duly certified at the time of ESE of practical course. ESE of the practical course will be held under the supervision of external examiners duly appointed by the University.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Title of the course</th>
<th>Hours/Week</th>
<th>No. of credits</th>
<th>Total Hrs/week</th>
<th>ESE Duration</th>
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<tbody>
<tr>
<td>I</td>
<td>MI 1131.1: Python Programming</td>
<td>2   2  2</td>
<td>72</td>
<td>3 hrs</td>
<td>20</td>
<td>80</td>
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<tr>
<td>II</td>
<td>MI 1231.1: Artificial Intelligence</td>
<td>2 2 2</td>
<td>72</td>
<td>3 hrs</td>
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<td>80</td>
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<tr>
<td>III</td>
<td>MI 1331.1: Knowledge Representation And Intelligence Agents</td>
<td>3 2 3</td>
<td>90</td>
<td>3 hrs</td>
<td>20</td>
<td>80</td>
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<tr>
<td>IV</td>
<td>MI 1431.1: Machine Learning</td>
<td>3 2 3</td>
<td>90</td>
<td>3 hrs</td>
<td>20</td>
<td>80</td>
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<td></td>
<td>MI 1432.1: Machine Learning using Python Lab</td>
<td>2 2</td>
<td>2</td>
<td>2 hrs</td>
<td>20</td>
<td>80</td>
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</table>

Division of marks (Lab examination)

1. First program should be sufficiently simple – 25 marks
   (Logic – 10 marks, Successful compilation – 10 marks, Result – 5 marks)
2. Second program should be based on advanced concepts – 30 marks
   (Logic – 15 marks, Successful compilation – 10 marks, result – 5 marks)
3. Viva Voce – 15 marks
4. Lab Record – 10 marks

Total Marks - 80 marks

Semester I Course Code: MI 1131.1 Credits: 2 Hrs/Week: 2+2

PYTHON PROGRAMMING

COURSE OUTCOMES: At the end of the Course, the Student will be able to

| CO1 | Remember features, operators |

Module 2: Decision Making, Loops, Nested Loops, Control Statements, Types of Loops, List Comprehensions, Set Comprehensions, Dictionary Comprehensions, Nested Dictionaries. Function Definition - Function Calling, Function Arguments, Anonymous (Lambda) Functions, filter() function, reduce() function, Recursive Functions, Function with more than one return value. Built-in Modules, Creating Modules, import Statement, Locating Modules, Namespaces and Scope, The dir() function, The reload() function, Packages in Python.


Module 4: Regular expressions- Introduction, match() function, search() function, search and replace, regular expression modifiers, regular expression patterns, Character classes, special character classes, repetition cases, findall() method, compile() method. Introduction to numpy – Creating arrays, indexing, data types. Plotting with matplotlib – bar plot, histogram, pie chart, scatterplot. Pandas - Data frame, descriptive statistics, indexing and selecting data.

TEXT BOOK

REFERENCES
1. https://www.w3schools.com/python/numpy_intro.asp

SAMPLE LAB EXERCISES
1. To write, test, and debug simple Python programs.
2. To implement Python programs with conditionals and loops.
3. Use functions for structuring Python programs.
4. Programs using Python strings, lists, tuples, and dictionaries.
5. Read and write data from/to files in Python.
6. Programs to demonstrate creating and handling of modules and packages
7. Programs involving regular expressions
8. Programs to draw simple bar chart, pie chart, histogram and scatterplot

<table>
<thead>
<tr>
<th>Semester II</th>
<th>Course Code: MI 1231.1</th>
<th>Credits: 2</th>
<th>Hrs/Week: 2+2</th>
</tr>
</thead>
</table>

ARTIFICIAL INTELLIGENCE

COURSE OUTCOMES: At the end of the Course, the Student will be able to

<table>
<thead>
<tr>
<th>CO1</th>
<th>Remember features of AI and knowledge-based systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Understand basic parsing techniques</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply search and control strategies</td>
</tr>
<tr>
<td>CO4</td>
<td>Analyse different matching techniques</td>
</tr>
<tr>
<td>CO5</td>
<td>Evaluate the performance of various searching algorithms</td>
</tr>
<tr>
<td>CO6</td>
<td>Create AND-OR graphs</td>
</tr>
</tbody>
</table>

COURSE CONTENT

Module 1: Overview of Artificial Intelligence: What is AI, The importance of AI; Knowledge: Introduction, Definition and Importance of knowledge, Knowledge-Based Systems, Representation of Knowledge, Knowledge Organization, Knowledge Manipulation, Acquisition of Knowledge.


Module 4: Natural Language Processing: Introduction, Overview of Linguistics, Grammars and Languages, Basic Parsing Techniques, Semantic Analysis and Representation Structures, Natural Language Generation, Natural Language Systems

TEXT BOOK
- Dan W. Patterson, Introduction to Artificial Intelligence And Expert Systems, PHI Learning 2014

REFERENCES
- Elaine Rich, Kevin Knight, Shivashankar B Nair, Artificial Intelligence, Third Edition, McGraw Hill Education (India) PVT LTD
SAMPLE LAB EXERCISES
1. Python program to accept a user name and print them in reverse order with a space between them.
2. Python program that accepts a word from the user and reverse it.
3. Write a Python Program to count the character frequency (number of each character in a string).
4. Python program to count occurrences of each word in a string.
5. Write a Python program to find the list of words that are longer than N from a given list of words.
6. Write a Python program to read a list of words and returns the longest one.
7. Write a Python function that takes two lists and returns True if they have at least one common member.
8. Write a module to check whether a string is palindrome. Import the module to see whether a string is a palindrome.
9. Write a Python program to delete the sentences from a file, if it contains a particular word.
10. Write a Python program to print the contents of a file in reverse order.
11. Write a Python program with regular expression to check the validity of password entered by the user.
12. Write a program to draw the Bar chart of rainfall for the last 10 years.

<table>
<thead>
<tr>
<th>Semester III</th>
<th>Course Code: MI 1331.1</th>
<th>Credits: 3</th>
<th>Hrs/Week: 3+2</th>
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KNOWLEDGE REPRESENTATION AND INTELLIGENCE AGENTS

COURSE OUTCOMES: At the end of the Course, the Student will be able to

<table>
<thead>
<tr>
<th>CO1</th>
<th>Remember time and space complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Understand types of intelligent agents</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply heuristic search techniques</td>
</tr>
<tr>
<td>CO4</td>
<td>Analyse the efficiency of different search techniques</td>
</tr>
<tr>
<td>CO5</td>
<td>Evaluate efficiency of algorithms</td>
</tr>
<tr>
<td>CO6</td>
<td>Create search graphs</td>
</tr>
</tbody>
</table>

COURSE CONTENT

Module 1: Concepts in algorithm analysis – the efficiency of algorithms, average and worst – case analysis, Asymptotic notation, time and space complexity.

Module 2: Techniques - brute force, divide and conquer, decrease and conquer, dynamic programming, shortest paths, backtracking


TEXT BOOK

REFERENCE
- Kevin Knight, Elaine Rich, Artificial Intelligence, 3rd Edn, Pearson, Chennai

SAMPLE LAB EXERCISES
1. Implementation of brute force algorithm
2. Implementation of divide and conquer algorithm
3. Implementation of decrease and conquer algorithm
4. Implementation of shortest paths algorithm
5. Implementation of Heuristic search techniques
6. Implementation of AO* algorithm
7. Implementation of Depth First Search method
8. Implementation of Breadth First Search method
9. Implementation of Best first search method

<table>
<thead>
<tr>
<th>Semester IV</th>
<th>Course Code: M1 1431.1</th>
<th>Credits: 3</th>
<th>Hrs/Week: 3+2</th>
</tr>
</thead>
</table>

MACHINE LEARNING

COURSE OUTCOMES: At the end of the Course, the Student will be able to

| CO1 | Remember applications of machine learning |
| CO2 | Understand different learning techniques |
| CO3 | Apply clustering of raw data |
| CO4 | Analyse the performance of classification methods |
| CO5 | Evaluate hierarchical methods |
| CO6 | Create a semi supervised learning model |

COURSE CONTENT

Module 2: Classification – Introduction, Decision Trees, Naïve Bayes Classification, Multinomial Naïve Bayes Classification, Support Vector Machines, K-Nearest Neighbours, Random Forest


TEXT BOOK

REFERENCES
- Vinod Chandra S S, Anand H S, Artificial Intelligence and Machine Learning, Prentice Hall of India, New Delhi, 2014

SAMPLE LAB EXERCISES
1. Program to implement simple linear regression.
2. Program to implement multiple linear regression.
3. Program to implement polynomial regression.
4. Program to implement logistic regression.
5. Write a program to implement a decision tree classification.
6. Write a program to implement Naïve Bayesian classification.
7. Write a program to implement support vector machines.
8. Write a program to implement KNN algorithm.
9. Write a program to implement random forest.
10. Write a program to implement K-means.
11. Write a program to implement hierarchical clustering.
12. Write a program to implement linear discriminant analysis.

| Semester IV | Course Code: MI 1431.2 | Credits: 3 | Hrs/Week: 3+2 |
MACHINE LEARNING USING PYTHON LAB

Students should undergo the similar type of lab exercises given each semester and write at least 6 programs in the final record. The distribution of marks in the ESE is as follows

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A</td>
<td>One question from MI 1131.1/MI 1231.1 Lab exercise</td>
<td>25</td>
</tr>
<tr>
<td>Part B</td>
<td>One question from MI 1331.1/MI 1431.1 Lab exercise</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Record</td>
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</tr>
<tr>
<td></td>
<td>Viva-Voce</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>