ANNAMALAI UNIVERSITY

(Accredited with ‘A’ Grade by NAAC)

M.Sc. PHYSICS (TWO YEAR PROGRAMME)

Regulations & Curriculum-2019
ANNAMALAI UNIVERSITY
REGULATIONS FOR THE TWO-YEAR POST GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

These Regulations are common to all the students admitted to the Two-Year Master’s Programmes in the Faculties of Arts, Science, Indian Languages, Education, Marine Sciences, and Fine Arts from the academic year 2019-2020 onwards.

1. Definitions and Nomenclature

1.1 University refers to Annamalai University.

1.2 Department means any of the academic departments and academic centres at the University.

1.3 Discipline refers to the specialization or branch of knowledge taught and researched in higher education. For example, Botany is a discipline in the Natural Sciences, while Economics is a discipline in Social Sciences.

1.4 Programme encompasses the combination of courses and/or requirements leading to a Degree. For example, M.A., M.Sc.

1.5 Course is an individual subject in a programme. Each course may consist of Lectures/Tutorials/Laboratory work/Seminar/Project work/Experiential learning/ Report writing/viva-voce etc. Each course has a course title and is identified by a course code.

1.6 Curriculum encompasses the totality of student experiences that occur during the educational process.

1.7 Syllabus is an academic document that contains the complete information about an academic programme and defines responsibilities and outcomes. This includes course information, course objectives, policies, evaluation, grading, learning resources and course calendar.

1.8 Academic Year refers to the annual period of sessions of the University that comprises two consecutive semesters.

1.9 Semester is a half-year term that lasts for a minimum duration of 90 days. Each academic year is divided into two semesters.

1.10 Choice Based Credit System A mode of learning in higher education that enables a student to have the freedom to select his/her own choice of elective courses across various disciplines for completing the Degree programme.

1.11 Core Course is mandatory and an essential requirement to qualify for the Degree.

1.12 Elective Course is a course that a student can choose from a range of alternatives.

1.13 Value-added Courses are optional courses that complement the students’ knowledge and skills and enhance their employability.

1.14 Credit refers to the quantum of course work in terms of number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.

1.15 Credit Hour refers to the number of class hours per week required for a course in a semester. It is used to calculate the credit value of a particular course.

1.16 Programme Outcomes (POs) are statements that describe crucial and essential knowledge, skills and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.
1.17 **Programme Specific Outcomes (PSOs)** are statements that list what the graduate of a specific programme should be able to do at the end of the programme.

1.18 **Learning Objectives also known as Course Objectives** are statements that define the expected goal of a course in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.

1.19 **Course Outcomes (COs)** are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.

1.20 **Grade Point Average (GPA)** is the average of the grades acquired in various courses that a student has taken in a semester. The formula for computing GPA is given in section 11.3.

1.21 **Cumulative Grade Point Average (CGPA)** is a measure of overall cumulative performance of a student over all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters.

1.22 **Letter Grade** is an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, RA, and W.

### 2. Programme Offered and Eligibility Criteria

<table>
<thead>
<tr>
<th>Faculty of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Sc. Physics</td>
</tr>
<tr>
<td>A pass in B.Sc. Physics as major subject and Mathematics and Chemistry as ancillary subjects from any University with not less than 50% of marks in Part–III.</td>
</tr>
</tbody>
</table>

2.1 In the case of SC/ST and Differently-abled candidates, a pass is the minimum qualification for the above Programme.

3. **Reservation Policy**
   Admission to the programme will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. **Programme Duration**
   4.1 The Two Year Master’s Programme consists of two academic years.
   4.2 Each academic year is divided into two semesters, the first being from July to November and the second from December to April.
   4.3 Each semester will have 90 working days (18 weeks).

5. **Programme Structure**
   5.1 The Two Year Master’s Programme consists of Core Courses, Elective Courses (Departmental & Interdepartmental), and Project.
   5.2 **Core courses**
   5.2.1 These are a set of compulsory courses essential for each programme.
   5.2.2 The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.
   5.3 **Elective courses**
   5.3.1 **Departmental Electives (DEs)** are the Electives that students can choose from a range of Electives offered within the Department.
5.3.2 **Interdepartmental Electives (IDEs)** are Electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the departments of other faculties.

5.3.3 **Students shall take a combination of both DEs and IDEs.**

5.4. **Experiential Learning**

5.4.1. Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.

5.4.2. In-plant training/field trips/internships/industrial visits (as applicable) fall under this category.

5.4.3. Experiential learning is categorised as Core.

5.5. **Project**

5.5.1. Each student shall undertake a Project in the final semester.

5.5.2. The Head of the Department shall assign a Research Supervisor to the student.

5.5.3. The Research Supervisor shall assign a topic for research and monitor the progress of the student periodically.

5.5.4. Students who wish to undertake project work in recognised institutions/industry shall obtain prior permission from the University. The Research Supervisor will be from the host institute, while the Co-Supervisor shall be a faculty in the parent department.

5.6. **Value added Courses (VACs)**

5.6.1. Students may also opt to take Value added Courses beyond the minimum credits required for award of the Degree. VACs are outside the normal credit paradigm.

5.6.2. These courses impart employable and life skills. VACs are listed in the University website and in the Handbook on Interdepartmental Electives and VACs.

5.6.3. Each VAC carries 2 credits with 30 hours of instruction, of which 60% (18 hours) shall be Theory and 40% (12 hours) Practical.

5.6.4. Classes for a VAC are conducted beyond the regular class hours and preferably in the II and III Semesters.

5.7. **Online Courses**

5.7.1. The Heads of Departments shall facilitate enrolment of students in Massive Open Online Courses (MOOCs) platform such as SWAYAM to provide academic flexibility and enhance the academic career of students.

5.7.2. Students who successfully complete a course in the MOOCs platform shall be exempted from one elective course of the programme.
5.8. **Credit Distribution**  
The credit distribution is organized as follows:

<table>
<thead>
<tr>
<th>Credit distribution</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>65-75</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>15</td>
</tr>
<tr>
<td>Project</td>
<td>6-8</td>
</tr>
<tr>
<td><strong>Total (Minimum requirement for award of Degree)</strong></td>
<td><strong>90-95</strong>*</td>
</tr>
</tbody>
</table>

*Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 90-95 credits.

5.9. **Credit Assignment**  
Each course is assigned credits and credit hours on the following basis:

1 Credit is defined as:
- 1 Lecture period of one hour per week over a semester
- 1 Tutorial period of one hour per week over a semester
- 1 Practical/Project period of two or three hours (depending on the discipline) per week over a semester.

6. **Attendance**

6.1 Each faculty handling a course shall be responsible for the maintenance of Attendance and Assessment Record for candidates who have registered for the course.

6.2 The Record shall contain details of the students’ attendance, marks obtained in the Continuous Internal Assessment (CIA) Tests, Assignments and Seminars. In addition the Record shall also contain the organisation of lesson plan of the Course Instructor.

6.3 The record shall be submitted to the Head of the Department once a month for monitoring the attendance and syllabus coverage.

6.4 At the end of the semester, the record shall be duly signed by the Course Instructor and the Head of the Department and placed in safe custody for any future verification.

6.5 The Course Instructor shall intimate to the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students.

6.6 Each student shall have a minimum of 75% attendance in all the courses of the particular semester failing which he or she will not be permitted to write the End-Semester Examination. The student has to redo the semester in the next year.

6.7 Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness, representing the University in extracurricular activities and participation in NCC/NSS/YRC/RRC.
7. Mentor-Mentee System

7.2. To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.

7.3. The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.

7.4. The Mentors shall also help their mentees to choose appropriate electives and value-added courses, apply for scholarships, undertake projects, prepare for competitive examinations such as NET/SET, GATE etc., attend campus interviews and participate in extracurricular activities.

8. Examinations

8.2. The examination system of the University is designed to systematically test the student's progress in class, laboratory and field work through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

8.3. There will be two CIA Tests and one ESE in each semester.

8.4. The Question Papers will be framed to test different levels of learning based on Bloom's taxonomy viz. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation/Creativity.

8.5. Continuous Internal Assessment Tests

8.5.1. The CIA Tests shall be a combination of a variety of tools such as class tests, assignments, seminars, and viva-voce that would be suitable to the course. This requires an element of Openness.

8.5.2. The students are to be informed in advance about the assessment procedures.

8.5.3. The pattern of question paper will be decided by the respective faculty.

8.5.4. CIA Test-I will cover the syllabus of the first two units while CIA Test-II will cover the last three units.

8.5.5. CIA Tests will be for two to three hours duration depending on the quantum of syllabus.

8.5.6. A student cannot repeat the CIA Test-I and CIA Test-II. However, if for any valid reason, the student is unable to attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

8.6. End Semester Examinations (ESE)

8.6.1. The ESE for the first/third semester will be conducted in November and for the second/fourth semester in May.

8.6.2. A candidate who does not pass the examination in any course(s) of the first, second and third semesters will be permitted to reappear in such course(s) that will be held in April and November in the subsequent semester/year.
8.6.3. The ESE will be of three hours duration and will cover the entire syllabus of the course.

9. Evaluation

9.1. Marks Distribution

9.1.1. Each course, Theory and Practical as well as Project/Internship/Field work/In-plant training shall be evaluated for a maximum of 100 marks.

9.1.2. For the theory courses, CIA Tests will carry 25% and the ESE 75% of the marks.

9.1.3. For the Practical courses, the CIA Tests will constitute 40% and the ESE 60% of the marks.

9.2. Assessment of CIA Tests

9.2.1. For the CIA Tests, the assessment will be done by the Course Instructor

9.2.2. For the Theory Courses, the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I &amp; Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Seminar</td>
<td>05</td>
</tr>
<tr>
<td>Assignment</td>
<td>05</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

9.2.3. For the Practical Courses (wherever applicable), the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I</td>
<td>15</td>
</tr>
<tr>
<td>Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Viva-voce and Record</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
</tr>
</tbody>
</table>

9.3. Assessment of End-Semester Examinations

9.3.1. Evaluation for the ESE is done by both External and Internal examiners (Double Evaluation).

9.3.2. In case of a discrepancy of more than 10% between the two examiners in awarding marks, third evaluation will be resorted to.

9.4. Assessment of Project/Dissertation

9.4.1. The Project Report/Dissertation shall be submitted as per the guidelines laid down by the University.

9.4.2. The Project Work/Dissertation shall carry a maximum of 100 marks.

9.4.3. CIA for Project will consist of a Review of literature survey, experimentation/field work, attendance etc.
9.4.4. The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.

9.4.5. The Project Evaluation Committee will comprise the Head of the Department, Project Supervisor, and a senior faculty.

9.4.6. The marks shall be distributed as follows:

<table>
<thead>
<tr>
<th>Continuous Internal Assessment (25 Marks)</th>
<th>End Semester Examination (75 Marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review-I: 10</td>
<td>Review-II: 15</td>
</tr>
<tr>
<td></td>
<td>Project / Dissertation Evaluation</td>
</tr>
<tr>
<td></td>
<td>Viva-voce</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

9.5. Assessment of Value-added Courses

9.5.1. Assessment of VACs shall be internal.

9.5.2. Two CIA Tests shall be conducted during the semester by the Department(s) offering VAC.

9.5.3. A committee consisting of the Head of the Department, faculty handling the course and a senior faculty member shall monitor the evaluation process.

9.5.4. The grades obtained in VACs will not be included for calculating the GPA.

9.6. Passing Minimum

9.6.1. A student is declared to have passed in each course if he/she secures not less than 40% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.

9.6.2. A candidate who has not secured a minimum of 50% of marks in a course (CIA + ESE) shall reappear for the course in the next semester/year.

10. Conferment of the Master's Degree

A candidate who has secured a minimum of 50% marks in all courses prescribed in the programme and earned the minimum required credits shall be considered to have passed the Master’s Programme.

11. Marks and Grading

11.1. The performance of students in each course is evaluated in terms Grade Point (GP).

11.2. The sum total performance in each semester is rated by Grade Point Average (GPA) while Cumulative Grade Point Average (CGPA) indicates the Average Grade Point obtained for all the courses completed from the first semester to the current semester.

11.3. The GPA is calculated by the formula

\[ \text{GPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \]

where, \( C_i \) is the Credit earned for the Course \( i \) in any semester;
\( G_i \) is the Grade Point earned by the student for the Course \( i \) and
\( n \) is the number of Courses passed in that semester.

11.4. CGPA is the Weighted Average Grade Point of all the Courses passed starting from the first semester to the current semester.

\[ \text{CGPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \]
where, \( C_i \) is the Credit earned for the Course \( i \) in any semester;
\( G_i \) is the Grade Point obtained by the student for the Course \( i \) and
\( n \) is the number of Courses passed in that semester.
\( m \) is the number of semesters

11.5. Evaluation of the performance of the student will be rated as shown in the Table.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
<th>Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>10</td>
<td>90 and above</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>80-89</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>70-79</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>60-69</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>55-59</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>50-54</td>
</tr>
<tr>
<td>RA</td>
<td>0</td>
<td>Less than 50</td>
</tr>
<tr>
<td>W</td>
<td>0</td>
<td>Withdrawn from the examination</td>
</tr>
</tbody>
</table>

11.6. Classification of Results. The successful candidates are classified as follows:

11.6.1. For First Class with Distinction: Candidates who have passed all the courses prescribed in the Programme in the first attempt with a CGPA of 8.25 or above within the programme duration. Candidates who have withdrawn from the End Semester Examinations are still eligible for First Class with Distinction (See Section 12 for details).

11.6.2. For First Class: Candidates who have passed all the courses with a CGPA of 6.5 or above.

11.6.3. For Second Class: Candidates who have passed all the courses with a CGPA between 5.0 and less than 6.5.

11.6.4. Candidates who obtain highest marks in all examinations at the first appearance alone will be considered for University Rank.

11.7. Course-Wise Letter Grades

11.7.1. The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

11.7.2. A student is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA.

11.7.3. A course successfully completed cannot be repeated for the purpose of improving the Grade Point.

11.7.4. A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade card of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd/Even semester in which the candidate has appeared for clearance of the arrears.

11.7.5. If a student secures RA grade in the Project Work/Field Work/Practical Work/Dissertation, he/she shall improve it and resubmit if it involves only rewriting/ incorporating the clarifications suggested by the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.
12. **Provision for Withdrawal from the End Semester Examination**

12.1. The letter grade W indicates that a candidate has withdrawn from the examination.

12.2. A candidate is permitted to withdraw from appearing in the ESE for one course or courses in **ANY ONE** of the semesters **ONLY** for exigencies deemed valid by the University authorities.

12.3. **Permission for withdrawal from the examination shall be granted only once during the entire duration of the programme.**

12.4. Application for withdrawal shall be considered **only** if the student has registered for the course(s), and fulfilled the requirements for attendance and CIA tests.

12.5. The application for withdrawal shall be made ten days prior to the commencement of the examination and duly approved by the Controller of Examinations. Notwithstanding the mandatory prerequisite of ten days notice, due consideration will be given under extraordinary circumstances.

12.6. **Withdrawal is not granted for arrear examinations of courses in previous semesters and for the final semester examinations.**

12.7. Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) when the course(s) are offered next.

12.8. Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the candidate to qualify for First Class with Distinction.

13. **Academic misconduct**

Any action that results in an unfair academic advantage/interference with the functioning of the academic community constitutes academic misconduct. This includes but is not limited to cheating, plagiarism, altering academic documents, fabrication/falsification of data, submitting the work of another student, interfering with other students’ work, removing/defacing library or computer resources, stealing other students’ notes/assignments, and electronically interfering with other students’/University’s intellectual property. Since many of these acts may be committed unintentionally due to lack of awareness, students shall be sensitised on issues of academic integrity and ethics.

14. **Transitory Regulations**

Wherever there has been a change of syllabi, examinations based on the existing syllabus will be conducted for two consecutive years after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that, the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendation of the Head of the Department concerned.

15. **Notwithstanding anything contained in the above pages as Rules and Regulations governing the Two Year Master’s Programmes at Annamalai University, the Syndicate is vested with the powers to revise them from time to time on the recommendations of the Academic Council.**
## Programme Structure

(For students admitted from the academic year 2019 - 2020)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L</th>
<th>P</th>
<th>C</th>
<th>Inter. Mark</th>
<th>Exter. Mark</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>19PHYC101</td>
<td>Core 1: Classical and Statistical Mechanics</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19PHYC102</td>
<td>Core 2: Electronics</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19PHYC103</td>
<td>Core 3: Mathematical Physics-I</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19PHYP104</td>
<td>Core 4: Practical – I</td>
<td>-</td>
<td>9</td>
<td>6</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Elective 1: Interdepartmental Elective</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19PHYC201</td>
<td>Core 5: Mathematical Physics - II</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
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</tr>
<tr>
<td>19PHYC202</td>
<td>Core 6: Condensed Matter Physics - I</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19PHYC203</td>
<td>Core 7: Electromagnetic Theory</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<tr>
<td>19PHYP204</td>
<td>Core 8: Practical - II</td>
<td>-</td>
<td>9</td>
<td>6</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Elective 2: Interdepartmental Elective</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
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</tr>
<tr>
<td>19PHYE205</td>
<td>Elective 3: Department Elective</td>
<td>3</td>
<td>3</td>
<td>25</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>19PHYC301</td>
<td>Core 9: Quantum Mechanics – I</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19PHYC302</td>
<td>Core 10: Condensed Matter Physics - II</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19PHYC303</td>
<td>Core 11: Nuclear and Elementary Particle Physics</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19PHYP304</td>
<td>Core 12: Practical – III</td>
<td>-</td>
<td>9</td>
<td>6</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Elective 4: Interdepartmental Elective</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19PHYE305</td>
<td>Elective 5: Department Elective</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
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<td></td>
</tr>
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**TOTAL CREDITS** 93

1. Value Added Courses
2. Online Courses (SWAYAM, MOOC’s and NPTEL)
### DEPARTMENT ELECTIVE (DE) COURSES

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<th>Course Code</th>
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<th>Marks</th>
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<td>19PHYE205.1</td>
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**Notes:**

1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available.
2. Students may opt for any Value-added Courses listed in the University website.

L- Lectures; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination
PROGRAM OUTCOMES (POs):

By the end of the program, the students will be able to

<table>
<thead>
<tr>
<th>PO1</th>
<th>Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.</th>
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<tbody>
<tr>
<td>PO2</td>
<td>Resource Utilisation. Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments.</td>
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<tr>
<td>PO3</td>
<td>Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.</td>
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<tr>
<td>PO4</td>
<td>Critical thinking and Problem solving: Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions.</td>
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<tr>
<td>PO5</td>
<td>Project Management: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organisational skills and the ability to manage time and resources.</td>
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<tr>
<td>PO6</td>
<td>Individual and team work: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.</td>
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<tr>
<td>PO7</td>
<td>Effective Communication: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.</td>
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<tr>
<td>PO8</td>
<td>Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.</td>
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<td>PO9</td>
<td>Ethics: Commitment to professional ethics and responsibilities.</td>
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<td>PO10</td>
<td>Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline.</td>
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</table>

PROGRAM SPECIFIC OUTCOMES (PSOs):

By the end of the program, the students will be able to

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<thead>
<tr>
<th>PSO1</th>
<th>Understand principles of physics for the scientific phenomena in classical domain.</th>
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<tr>
<td>PSO2</td>
<td>Understand the mathematical techniques for describing in depth knowledge of physical concepts.</td>
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<td>PSO3</td>
<td>Understand and apply statistical methods for describing the classical and quantum particles in various physical systems and processes.</td>
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<td>PSO4</td>
<td>Understand and apply inter-disciplinary concepts and for understanding and describing the natural phenomena.</td>
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<td>PSO5</td>
<td>Understand the principles of Quantum mechanics for knowing the physical systems in quantum arena.</td>
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<td>PSO6</td>
<td>Provide exposure in various specializations of Physics (Solid State Physics/Nuclear Physics/Particle Physics).</td>
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<td>PSO7</td>
<td>Provide exposure to modern experimental/theoretical methods for measurement, observation and fundamental understanding of physical phenomena/systems.</td>
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<tr>
<td>PSO8</td>
<td>Engage in research and life-long learning to adapt to changing environment.</td>
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</table>
MAPPING OF PROGRAMME SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

By the end of the program, the students will be able to

<table>
<thead>
<tr>
<th>Programme Specific Outcomes (PSOs)</th>
<th>Programme Outcomes (POs)</th>
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SEMESTER - I  | 19PHYC101 - CLASSICAL AND STATISTICAL MECHANICS | Credit:4 Hours:4

LEARNING OBJECTIVES:

- To develop familiarity with the physical concepts and facility with the mathematical methods of classical mechanics
- The main goal of this course is to acquire fundamental knowledge of classical and quantum statistical mechanics.
- Construct a bridge between macroscopic thermodynamics and microscopic statistical mechanics by using mathematical methods and fundamental physics for individual particles.

UNIT – 1: MECHANICS OF A PARTICLE AND SYSTEM OF PARTICLES


UNIT – 2: CANONICAL TRANSFORMATIONS

UNIT – 3: MAXWELL – BOLTZMANN STATISTICS


UNIT – 4: EQUIPARTITION OF ENERGY AND PARTITION FUNCTION

Principle of equipartition of energy – Partition function and their properties – Connection between the partition function and thermodynamic quantities – Mean values obtained from distribution law – Gibb’s paradox – Explanation and proof for occurrence of paradox – Sackur – Tetrode equation and its significance.

UNIT – 5: QUANTUM STATISTICS


TEXT BOOKS:

SUPPLEMENTARY READING:

COURSE OUTCOMES (COs):

By the end of the course, the students will able to

CO1: Formulate scientific questions about the mechanics of a particle and system of particles.
CO2: Use D'Alembert's principle to derive the Lagrange equations of motion.
CO3: Identify the differences of Bose -Einstein, Fermi-Dirac and Maxwell – Boltzmann statistics.
CO4: Describe the relationship between the statistical mechanics with thermodynamics.
LEARNING OBJECTIVES:

- To gain in-depth knowledge about semiconductor devices.
- To learn amplifiers, oscillators using transistors.
- To study the applications of operational amplifiers.
- To familiarise various classifications of Semiconductor Memories and
- To know about the fabrication concepts of Integrated circuits.

UNIT - 1: SEMICONDUCTOR DEVICES

UJT, JFET, MOSFET - Operation and static characteristics. SCR - Two transistor analogy, static characteristics, Half wave, Full wave and bridge rectifier. DIAC, TRIAC - static characteristics.

UNIT - 2: AMPLIFIERS AND OSCILLATORS


UNIT - 3: OPERATIONAL AMPLIFIERS - APPLICATIONS


UNIT - 4: SEMICONDUCTOR MEMORIES


UNIT - 5: INTEGRATED CIRCUITS
Basic monolithic ICs - epitaxial growth - masking and etching - diffusion of impurities. Transistors for monolithic circuit, monolithic diodes, resistors, capacitors and Inductors. Monolithic circuit layout. Logic families - RTL, TTL, CMOS, interfacing CMOS and TTL.

**TEXT BOOKS:**


**SUPPLEMENTARY READING:**


**COURSE OUTCOMES (COs):**

By the end of the course, the students will be able to

**CO1:** Understand the concept of various semiconductor devices by learning their characteristics.

**CO2:** Analyze the parameters of amplifiers, oscillators using transistors and familiarize with applications of operational amplifiers.

**CO3:** Understand the classifications of Semiconductor Memories.

**CO4:** Understand the concepts of Integrated circuits.

**MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)**

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**SEMMESTER - I**

**19PHYC103 - MATHEMATICAL PHYSICS – I**

Credit:4

Hours:4

**LEARNING OBJECTIVES:**

- To develop knowledge in mathematical physics and its applications.
- To develop expertise in mathematical techniques required in physics.
- To enhance problem solving skills.
- To enable students to formulate, interpret and draw inferences from mathematical solutions.

**UNIT – 1: VECTOR ANALYSIS AND VECTOR SPACES**
Concept of gradient, divergence and curl - Gauss’s divergence theorem, Green’s theorem and Stoke’s theorem (statement and proof) - Orthogonal curvilinear coordinates - Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates (Theory).

Linearly dependent and independent sets of vectors - Inner product (problems)- Schmidt’s orthogonalization process.

UNIT – 2: MATRICES

Types of Matrices and their properties, Rank of a Matrix, Eigenvalue Equations and their solutions, Theorems on Matrices; Diagonalisation and Diagonalisation of different matrices; Cayley-Hamilton’s theorem; Problems.

UNIT – 3: TENSOR ANALYSIS


UNIT – 4: COMPLEX VARIABLE


UNIT – 5: GROUP THEORY

Definition - Subgroups - Cyclic groups and abelian groups - Homomorphism and isomorphism of groups - Classes - Symmetry operations and symmetry elements - Representations of groups - Reducible and irreducible representations - Character tables for simple molecular types (C_{2v} and C_{3v} point group molecules).

TEXT BOOKS:


SUPPLEMENTARY READING:

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

**CO1**: Develop knowledge in mathematical physics and its applications.

**CO2**: Understand the use of complex variables for solving definite integral.

**CO3**: Understand the applications of group theory in all the branches of Physics problems.

**CO4**: Enable students to formulate, interpret and draw inferences from mathematical solutions.

**MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)**

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**SEMESTER - I**

19PHYP104- PRACTICAL – I

**Credit:** 6

**Hours:** 9

**LEARNING OBJECTIVES:**

- To gain knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To provide a hands-on learning experience such as in measuring the basic concepts and applications of microprocessor.

*(Any Sixteen Experiments)*

1. Young’s modulus of a specimen plate- by Newton’s interference method.
2. Bi-prism on spectrometer- Wavelength (λ) and Refractive index (μ) of a liquid-using Laser source.
3. Charge of an electron- Spectrometer
4. Study of Hall effect in semiconductors.
5. Polarizability of Liquids- Hollow prism on spectrometer.
6. Hg-Cu spectrum- Hartmann’s constants and wavelength.
7. Planck’s constant.
8. Zeeman Effect.
9. Thermoluminescence
11. Microprocessor 8085 - Addition, Subtraction, Multiplication & Division
12. Microprocessor 8085 - Logical operation
13. Microprocessor 8085 - Solving expression, Factorial of N Numbers
14. Microprocessor 8085 - Code conversion
15. Microprocessor 8085 – Flashing and Rolling of Name display
16. Microprocessor 8085 – Stepper Motor
17. Microprocessor 8085 – ADC Interfacing
18. Microprocessor 8085 – DAC Interfacing
19. Microprocessor 8085 – Biggest and Smallest Numbers
20. Microprocessor 8085 – Ascending and Descending Order

COURSE OUTCOMES (COS):

CO1: Understand the basic laws and theories regarding the various properties of the materials.
CO2: Understand the given concepts and its physical significance
CO3: Apply the theory to design the basic electronic circuits
CO4: Provide a hands-on learning experience and understand the basic concepts and applications of microprocessor.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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SEMESTER - II

LEARNING OBJECTIVES:

- To develop knowledge in mathematical physics and its applications.
- To develop expertise in mathematical techniques required in physics.
- To enhance problem solving skills.
- To enable students to formulate, interpret and draw inferences from mathematical solutions.

UNIT - 1: DIFFERENTIAL EQUATIONS

Homogeneous linear equations of second order with constant coefficients and their solutions – ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods – extended power series method for indicial equations.

UNIT - 2: SPECIAL FUNCTIONS – I

Gamma and Beta function- Legendre’s differential equation: Legendre polynomials - Generating functions - Recurrence relation - Rodrigue’s formula - Orthogonality; Bessel’s differential equation: Bessel polynomials - Generating functions - Recurrence relation - Rodrigue’s formula – Orthogonality.

UNIT - 3: SPECIAL FUNCTIONS – II

UNIT – 4: PARTIAL DIFFERENTIAL EQUATIONS

Solution of Laplace Differential Equation - Two dimensional flow of heat in cartesian and cylindrical co-ordinates. Solution of heat flow equation in one dimension - Solution of wave equation - Transverse vibrations of a stretched string (Theory).

UNIT – 5: INTEGRAL TRANSFORMS


TEXT BOOKS:


SUPPLEMENTARY READING:


COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1: Develop knowledge in mathematical physics and its applications.
CO2: Develop expertise in mathematical techniques required in physics.
CO3: Use differential equations and special functions to solve mathematical problems of interest in Physics.
CO4: Enable students to formulate, interpret and draw inferences from mathematical solutions.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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LEARNING OBJECTIVES:

- This course gives an insight into the basic elements of the physics of solid and in particular the study of the structure of crystalline solids and their physical properties.
- To develop a deep understanding of how condensed matter is characterized on the atomic scale.
- Understanding of Lattice vibrations, approximations, phonons and heat capacity to know the correlation between the structure and thermal properties of the materials.

UNIT - 1: CRYSTAL PHYSICS: CRYSTAL STRUCTURE

Lattice representation - Simple symmetry operations - Bravais Lattices, Unit cell, Wigner-Seitz cell - Miller planes and spacing - Characteristics of cubic cells - Structural features of NaCl, CsCl, Diamond, ZnS – Close packing.


UNIT - 2: DIFFRACTION OF WAVES AND PARTICLES BY CRYSTALS


UNIT - 3: CRYSTAL IMPERFECTIONS AND ORDERED PHASES OF MATTER


UNIT - 4: LATTICE DYNAMICS

Theory of elastic vibrations in mono and diatomic lattices - Phonons – Dispersion relations - Phonon momentum.

Heat Capacity
Specific heat capacity of solids – Dulong and Petit’s law - Vibrational modes - Einstein model - Density of modes in one and three dimensions - Debye Model of heat capacity.

Anharmonic Effects
Explanation for Thermal expansion, Conductivity and resistivity – Umklapp process.

UNIT – 5: THEORY OF ELECTRONS
Energy levels and Fermi-Dirac distribution for a free electron gas – Periodic boundary condition and free electron gas in three dimensions – Heat capacity of the electron gas – Ohm’s law, Matthiessen’s rule – Hall effect and magnetoresistance – Wiedemann – Franz law.


TEXT BOOKS:


SUPPLEMENTARY READING:


COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

**CO1**: Describe different types of crystal structures.
**CO2**: Understand the types of lattice vibrations and heat conduction.
**CO3**: Describe and understand the various imperfections in crystals.
**CO4**: Understand the band-structure of the solid.

**MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)**

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LEARNING OBJECTIVES:

- To understand the nature of electric and magnetic fields and the intricate connection between them.
- To develop a strong background in electromagnetic theory, understand and use various mathematical tools to solve Maxwell equations in problems of wave propagation and radiation.
- To develop skills on solving analytical problems in electromagnetism.

UNIT - 1: ELECTROSTATICS

Coulomb’s law; the electric field – line, flux and Gauss’s Law in differential form - the electrostatic potential; conductors and insulators; Gauss’s law - application of Gauss’s law – curl of E - Poisson’s equation; Laplace’s equation – work and energy in electrostatics – energy of a point charge distribution – energy of continuous charge distribution – induced charges – capacitors. Potentials: Laplace equation in one dimension and two dimensions – Dielectrics – induced dipoles – Gauss’s Law in the presence of dielectrics.

UNIT - 2: MAGNETOSTATICS


UNIT - 3: ELECTROMOTIVE FORCE


UNIT - 4: ELECTROMAGNETIC WAVES

UNIT 5: APPLICATION OF ELECTROMAGNETIC WAVES

Boundary conditions at the surface of discontinuity – Reflection and refraction of E.M waves at the interface of non – Conducting media – Kinematic and dynamic properties – Fresnel’s equation – Electric field vector ‘E’ parallel to the plane of incidence and perpendicular to the plane of incidence – Reflection and transmission co-efficients at the interface between two non–Conducting media – Brewster’s law and degree of polarization – Total internal reflection.

TEXT BOOKS:


SUPPLEMENTARY READING:


COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1: Applying vector calculus operations and developing knowledge of vector fields and scalar fields

CO2: Describing the fundamental nature of static fields, including steady current, static electric and magnetic fields

CO3: Formulating potential problems within electrostatics, magnetostatics and stationary current distributions in linear, isotropic media etc.,

CO4: Applying Maxwell’s equations and their application to boundary conditions, wave equations, and Poynting’s power-balance theorem.

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LEARNING OBJECTIVES:

➢ To gain knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
➢ To study the aspects related to the application side of the experiments
➢ To understand the usage of basic laws and theories to determine various properties of the materials given.
➢ To provide hands-on learning experience such as in measuring the basic concepts and applications of laser and microprocessors.

(Any Sixteen Experiments)

1. Michelson Interferometer – Wavelength Determination
2. Energy gap – Four Probe Apparatus.
3. Elastic constants of Glass- Cornu’s interference method (Hyperbolic fringes).
4. Solar Spectrum
5. Thermistor characteristics-Band gap energy
6. Reflection grating-Spectrometer
7. Ultrasonic diffractometer – Velocity and compressibility of liquids
10. Magnetostriction
11. Numerical Aperture and Acceptance Angle-Fibre Optics
12. Microprocessor 8086 I – Addition and Subtraction (16 & 32 bits)
13. Microprocessor 8086 II – Multiplication and Division (16 & 32 bits)
14. Microprocessor 8086 - Biggest and Smallest Numbers
15. Microprocessor 8086 - Code conversion
16. Microprocessor 8086 - Solving expression, Factorial of N Numbers
17. Microprocessor 8086 – Sum of elements in an array and factorial
18. Microprocessor 8086 – Sorting of N Elements (Ascending and Descending Order)
19. Microprocessor 8086 – String Operations
20. Wave form generations using 8086.

COURSE OUTCOMES (COS):

CO1: Understand the basic laws and theories regarding the various properties of the materials.
CO2: Understand the given concepts and its physical significance
CO3: Apply the theory to design the basic electrical circuits
CO4: provide a hands-on learning experience and understand the basic concepts and applications of laser and microprocessor.

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LEARNING OBJECTIVES:

- To study the fundamentals of wave mechanics.
- To study the stationary state and eigen spectrum of systems using time dependent Schrödinger equation.
- To solve the exactly soluble eigen value problems.
- To know the matrix formulation of quantum theory and how it can be used to understand the equation of motion.
- To understand the theory of identical particles and angular momentum.

UNIT– 1: FOUNDATIONS OF WAVE MECHANICS


Matter waves- Equation of motion- Schrödinger equation for the free particle – physical interpretation of wave function-normalized and orthogonal wave functions-expansion theorem-admissibility conditions- stationary state solution of Schrödinger wave equation - expectation values-probability current density- Ehrenferts theorem.

UNIT– 2: STATIONARY STATE AND EIGEN SPECTRUM

Time independent Schrödinger equation - Particle in a square well potential – Bound states – eigen values, eigen functions –Potential barrier – quantum mechanical tunnelling-alpha emission.


UNIT– 3: EXACTLY SOLUBLE EIGENVALUE PROBLEMS


UNIT– 4: MATRIX FORMULATION OF QUANTUM THEORY, EQUATION OF MOTION & ANGULAR MOMENTUM

Angular momentum - commutation relation of $J_z, J_+, J_-$ - eigen values and matrix representation of $J^2, J_z, J_+$. Spin angular momentum – spin $\frac{1}{2}$, spin-1- addition of angular momenta- Clebsch-Gordan coefficients.

UNIT– 5: SCATTERING THEORY

Kinematics of scattering process - wave mechanical picture- Green’s functions – Born approximation and its validity – Born series – screend cumblic potential scattering from Born approximation.


TEXT BOOKS:


SUPPLEMENTARY READING:


COURSE OUTCOMES (COs):

By the end of the course, the student should be able to

**CO1:** Study the stationary state and eigen spectrum of systems using time dependent Schrodinger equation.

**CO2:** Know to solve the exactly soluble eigen value problems.

**CO3:** Know the matrix formulation of quantum theory and how it can be used to understand the equation of motion.

**CO4:** Understand the theory of identical particles and Angular momentum.

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LEARNING OBJECTIVES:

- This course develops analytical thinking to understand the phenomenon that decide various properties of solids.
- Provides a valuable theoretical introduction and overview of the fundamental application of physics of solids.
- To impart the basic knowledge about superconductors and high temperature superconductors.

UNIT - 1: THEORY OF DIELECTRICS


UNIT - 2: THEORY OF FERROELECTRICS AND PIEZO ELECTRICS


UNIT - 3: MAGNETIC PROPERTIES OF MATERIALS


UNIT - 4: SUPERCONDUCTIVITY

ground state - Flux quantisation in a super conduction ring - Duration of persistence currents -
Single particle tunnelling - DC Josephson effect - AC Josephson effect - Macroscopic quantum
interference – High temperature super conductors – Applications.

UNIT - 5: PHYSICS OF NANOSOLIDS

Definition of nanoscience and nanotechnology – Preparation of nanomaterials – Surface
to volume ratio – Quantum confinement – Qualitative and Quantitative description – Density of
states of nanostructures – Excitons in Nano semiconductors – Carbon in nanotechnology –
Buckminsterfullerene – Carbon nanotubes – Nano diamond – BN nano tubes – Nanoelectronics –
Single electron transistor – Molecular machine – nano biometrics.

TEXT BOOKS:
1. Charles Kittel, Introduction to solid state physics, Wiley India Pvt. Ltd., New Delhi, 7th
2. K.K.Chattopadhyay, A.N.Banerjee, Introduction to Nanoscience and Nanotechnology,
   PHI Learning Private Ltd., Delhi 2014.
3. S.O. Pillai, Problems and Solutions in Solid State Physics, New Age international
   publishers, New Delhi, 1994.

SUPPLEMENTARY READING:
2. M.A. Wahab, Solid State Physics, structure and properties of the materials. Narosa,
   New Delhi, 1999.
5. Kwan Chi Kao, Dielectric Phenomena in solids with emphasis on physical concepts of

COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1: Understand the dielectric properties of the solid systems.
CO2: Understand the ferroelectric and piezoelectric properties of the solid systems and
      its application.
CO3: Understand deeply the electrical and magnetic properties of crystalline solids
      with theoretical background.
CO4: Understand the theoretical basis of nanotechnology and carbon in
      nanotechnology.

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LEARNING OBJECTIVES:

- To understand the forces of binding the nucleons in detail and the perspective of various models proposed with dipole and quadropole moments of the nucleus.
- To make them realize the cause of various nuclear particles in the strong short range interaction among the nucleons.
- To understand the concepts of elementary particles.

UNIT - 1: NUCLEAR FORCES


UNIT - 2: NUCLEAR MODELS


UNIT - 3: NUCLEAR REACTIONS

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

UNIT - 4: NUCLEAR FISSION AND FUSION

Nuclear fission- Energy release in fission reaction - Distribution of fission products-neutron emission in fission - Fissile and fertile materials - Bohr Wheeler theory. Nuclear chain reaction - Four factor formula - Nuclear reactors - Classification of reactors - Critical size of a reactor - Reactor materials.

Nuclear fusion – nuclear reaction in stars – Fusion reactors – Pinched discharge - Stellarator – Magnetic mirror systems.
UNIT - 5: ELEMENTRY PARTICLE PHYSICS


TEXT BOOKS:
3. V. Devanathan Nuclear Physics, Alpha Science International Ltd. 2011

SUPPLEMENTARY READING:
3. H. Enge, Addision-Wesley, Introduction to Nuclear Physics, Reading MA., 1975

COURSE OUTCOMES (COs):

By the end of the Course, the student will be able to

CO1: Understand about nuclear forces and their dependence on various parameters.
CO2: Compare various nuclear models and properties of the nucleus.
CO3: Understand the Nuclear energy sources through various nuclear reactions.
CO4: Know the causes for short range interaction inside the nucleons with mathematical formulations.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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LEARNING OBJECTIVES:

- To gain knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To provide a hands-on learning experience such as in measuring the basic concepts and applications of microcontroller.

(Any Sixteen Experiments)

1. Low field Hysteresis
2. Susceptibility of liquids using Guoy-Balance
3. Susceptibility of liquids by Quinke’s method
4. Photo elastic constant
5. Hysteresis loop tracer
6. Cu-Salt (visible) Spectrum
7. Molecular constants-CN Band
8. Channel Spectrum
10. Ultrasonic velocity of liquid mixtures- Interferometer
12. G.M. Counter characteristics
13. Microcontroller 8051 Experiment-I (Addition and Subtraction and Logical operations)
14. Microcontroller 8051 Experiment-III(Multiplication and Division and Solving expressions)
15. Microcontroller 8051 Experiment-III (Logical operations, 1’s and 2’s compliment)
16. Array Operations-I Microcontroller 8051(Sum of elements, biggest and smallest numbers)
17. Array Operations-II Microcontroller 8051(Ascending and descending order)
18. Microcontroller 8051 - Code conversion
19. Microcontroller 8051 – ADC interfacing
20. Microcontroller 8051 - Stepper motor interfacing

COURSE OUTCOMES (COS):

CO1: Understand the basic laws and theories regarding the various properties of the materials.
CO2: Understand the given concepts and its physical significance
CO3: Apply the theory to design the basic electrical circuits
CO4: provide a hands-on learning experience and understand the basic concepts and applications of microcontroller.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)
LEARNING OBJECTIVES:

- To learn about the approximation methods for time independent and time dependent perturbation theory.
- To understand the kinematics of scattering process and partial wave analysis.
- To study the theory of relativistic quantum mechanics and field quantization.
- To study the quantum theory of atomic and molecular structures.

UNIT– 1 APPROXIMATION METHODS FOR TIME INDEPENDENT PROBLEMS


UNIT– 2: APPROXIMATION METHODS FOR TIME DEPENDENT PERTURBATION THEORY


UNIT– 3: VARIATION METHOD


UNIT– 4: QUANTUM THEORY OF ATOMIC AND MOLECULAR STRUCTURE

Central field approximation: Residual electrostatic interaction-spin-orbit interaction- Determination of central field: Thomas Fermi statistical method-Hartree and Hartree-Fock approximations (self consistent fields) – Atomic structure and Hund’s rule.

Born-Oppenheimer approximation – An application: the hydrogen molecule Ion (H$_2^+$) – Molecular orbital theory: LCAO- Hydrogen molecule.

UNIT– 5: RELATIVISTIC QUANTUM MECHANICS & QUANTIZATION OF THE FIELD

Schrodinger relativistic equation- Klein-Gordan equation-charge and current densities – interaction with electromagnetic field- Hydrogen like atom – nonrelativistic limit- Dirac relativistic equation: Dirac relativistic Hamiltonian – probability density- Dirac matrices-plane

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

TEXT BOOKS:


SUPPLEMENTARY READING:


COURSE OUTCOMES (COs):

By the end of the Course, the students will be able to

CO1: Apply and appreciate the approximation methods to various problems
CO2: Identify the time dependent and time independent cases
CO3: Grasp the developments in relativistic quantum mechanics
CO4: Evaluate the quantum field parameters

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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LEARNING OBJECTIVES:

- To educate the students about the fundamental aspects of Rotational and Vibrational Spectroscopy.
- To import knowledge regarding the fundamental aspects of Resonance Spectroscopy.
- To expose the students to the effective applications of various molecular Spectroscopic techniques to study the chemical and structural properties of materials.

UNIT – 1: MICROWAVE SPECTROSCOPY


UNIT – 2: INFRARED SPECTROSCOPY

Vibrational energy of a diatomic molecule- Infrared selection rules-Vibrating diatomic molecule-Diatomic vibrating rotator- Vibrations of polyatomic molecules-Fermi resonance-Rotation vibration spectra of polyatomic molecules- Normal modes of vibration in crystal-Interpretation of vibrational spectra- Group frequencies- IR spectrophotometer-Instrumentation- Sample handling techniques-Fourier Transform Infrared spectroscopy-Applications

UNIT – 3: RAMAN SPECTROSCOPY


UNIT – 4: NUCLEAR MAGNETIC AND ELECTRON SPIN RESONANCE SPECTROSCOPY


UNIT – 5: NUCLEAR QUADRUPOLE RESONANCE AND MOSSBAUER SPECTROSCOPY

Mossbauer effect - recoilless emission and absorption - hyperfine interaction - chemical isomer shift - magnetic hyperfine and electric quadruple interactions – Instrumentation – applications.

**TEXT BOOKS:**

**SUPPLEMENTARY READING:**

**COURSE OUTCOMES (COs):**

By the end of the Course, the student will be able to

CO1: Appreciate the principle of spectroscopy in different regions of the EM spectrum.

CO2: Relate the theory of spectroscopy to the study of molecular structure.

CO3: Identify the appropriate spectral technique as an analytical tool to investigate the characteristics of materials.

CO4: Outline and correlate for providing solution to interdisciplinary problem.

**MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)**

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**LEARNING OBJECTIVES:**

- To distinguish nanomaterials from bulk materials.
- To apply their acquired knowledge in research level to synthesis and characterize the nanomaterials.
- To identify the various techniques to investigate the different properties such as optical, structural and morphology of nanoparticles.
- To select the nanomaterials for various applications.
UNIT – 1: INTRODUCTION


UNIT – 2: SPECIAL NANOMATERIALS


UNIT – 3: PROPERTIES


UNIT – 4: SYNTHESIS

Synthesis of nano materials: Physical vapour deposition - Chemical vapour deposition - Sol gel - Ball milling technique - Reverse miceller technique - Electro deposition. Nanostructures fabrication by physical techniques – Nano lithography – Nanomanipulator.

UNIT – 5: CHARACTERIZATION AND APPLICATIONS


TEXT BOOKS:


SUPPLEMENTARY READING:

COURSE OUTCOMES (COs):
By the end of the course, the student will be able to

CO1: Distinguish nanomaterials from bulk materials.
CO2: Apply their acquired knowledge in research level to synthesis and characterize the nanomaterials.
CO3: Identify the various techniques to investigate the different properties such as optical, structural and morphology of nanoparticles.
CO4: Select the nanomaterials for various applications.

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SEMESTER - IV 19PHYP404 - PRACTICAL – IV
Credit:6
Hours:9

LEARNING OBJECTIVES:

➢ To gain knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
➢ To study the aspects related to the application side of the experiments
➢ To understand the usage of basic laws and theories to determine various properties of the materials given.
➢ To provide a hands-on learning experience such as in measuring the basic concepts and applications of microcontroller.

(Any Sixteen experiments)

1. Spectrophotometer
2. Co-efficient of linear expansion-Interference Method.
3. R.F. Oscillator- Dipolemoment of Liquids
4. Susceptibility of Salt solutions/ Solids-Guoy method
5. Susceptibility of liquid mixture- Quincke’s method-Calculation of Bohr magneton.
6. Phase diagram-Two component system.
7. Molecular constants –AlO Band
8. Molecular constants- CN Band.
10. Optical rotation of quartz.
11. G.M. Counter -Absorption co-efficient of a foil.
12. F.P. Etalon.
13. Dielectrics of Solids
15. Stark Effect.
17. 8051 Micro controller - Setting bits and Masking bits in an 8-bit number.
18. Microcontroller 8051 - Generate a delay.

**COURSE OUTCOMES (COS):**

**CO1:** Understand the basic laws and theories regarding the various properties of the materials.
**CO2:** Understand the given concepts and its physical significance
**CO3:** Apply the theory to design the basic electrical circuits
**CO4:** provide a hands-on learning experience and understand the basic concepts and applications of microcontroller.

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**SEMESTER - IV 19PHYPJ405- PROJECT**

**Credit : 6**

**Hours: 9**

**Learning Objectives:**
To learn the basics of research work by carrying out selective academic and applied projects.

**Course outcomes:**
At the end of the course, the students will

**CO1:** Acquire the practical knowledge of understanding research problems.
**CO2:** Gain knowledge basic principles of various components of research
**CO3:** Apply the principles of chemistry in various fields

**MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)**

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LEARNING OBJECTIVES:

- To learn the architecture of 8085 microprocessor and its programming.
- To study the architecture of 8086 microprocessor.
- To familiarize the architecture of 8051 microcontroller and its programming.
- To study the interfacing devices of microprocessor 8085.

UNIT – 1: MICROPROCESSORS 8085 ARCHITECTURE


UNIT – 2: 8085 ASSEMBLY LANGUAGE PROGRAMMING

Instruction set: Data transfer operations - Arithmetic operations Logical operations – Branching and machine control operations. Addressing modes. Writing assembly language programs: Looping, counting and indexing. Counters and time delays - Stack - subroutine. Translation from assembly language to machine language.

UNIT – 3: MICROPROCESSOR 8086


UNIT – 4: MICROCONTROLLER 8051 ARCHITECTURE AND PROGRAMMING


UNIT – 5: INTERFACING OF MICROPROCESSOR 8085

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

TEXT BOOKS:

SUPPLEMENTARY READING:

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Describe basic concept and architecture of 8085 microprocessor and implement programs in 8085.

CO2: Learn the architecture of 8086 microprocessor.

CO3: Understand the architecture of 8051 microcontroller and develop assembly language programs.

CO4: Discuss concept of interfacing in microprocessor 8085.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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SEMESTER - II 19PHYE205.2 - PHYSICS OF THE EARTH

LEARNING OBJECTIVES:

- To understand the physical structure and behaviour of the earth as well as geomagnetic properties of rocks in the Earth’s crust.
- To study the elastic behaviour in earth by applying various theories and hypothesis.
- To highlight the concept of solar system and behaviour of planets in this system.

UNIT –1: SOLAR SYSTEM

The earth and the solar system – Important physical parameters and properties of the planet earth; Stress and Strain, Wave and motion, Seismic waves. Travel time Tables and Velocity – Depth curves – Variation of Density within the Earth.
UNIT – 2: GRAVITATION


UNIT – 3: THERMAL HISTORY OF EARTH


UNIT – 4: ELASTIC PROPERTIES


UNIT – 5: GEOMAGNETISM AND PALAEO MAGNETISM


TEXT BOOKS:


SUPPLEMENTARY READING:


COURSE OUTCOMES (COs):

By the end of the semester, the students will be able to

CO1 : Think and analyse the concept of the Earth and its properties.
CO2 : Accumulate the various concepts proposed by theories and laws.
CO3 : Enlighten the concept solar system.
CO4: Acquire basic knowledge about geomagnetism and palaeomagnetism.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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LEARNING OBJECTIVES:

- To create an awareness among the students regarding the forms of energy and the availability of their resources
- To educate regarding the utilization and conservation of energy
- To impart a knowledge about the Sustainable forms of energy

UNIT – 1: CONVENTIONAL ENERGY SOURCES

Energy sources and their availability – Various forms of energy – Renewable and conventional energy systems – Comparison – Coal, oil and natural gas.

UNIT – 2: SOLAR ENERGY


UNIT – 3: THERMAL ENERGY STORAGE


UNIT – 4: PHOTO CONVERSION

Photovoltaic conversion - Principle and working of solar cells - Conversion efficiency - Single crystal and Polycrystalline silicon - Cadmium sulphide - Cadmium telluride.

UNIT – 5: SUSTAINABLE FORMS OF ENERGY

Reserves of Energy Resources – Environmental aspects of energy extraction, conversion and utilization – challenges associated with the non-sustainable energy sources with regard to future Supply and the environment

Hydrogen: principle of operation and system components-comparisons among energy uses, resources, and technologies-technical and economic challenges in the integration of sustainable energy form-potential solutions and application.

TEXT BOOKS:


SUPPLEMENTARY READING:

COURSE OUTCOMES (COs):
By the end of the course, the student will be able to

CO1: Be aware of various forms of energy and the effective utilization of their resources.
CO2: Be exposed to the practical usage of solar energy.
CO3: Be exposed to the practical usage of thermal energy.
CO4: Acquire an in depth knowledge about the sustainable forms of energy.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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SEMESTER - III 19PHYE305.1 – INSTRUMENTATION Credit : 3 Hour : 4

LEARNING OBJECTIVES:
➢ To understand the types of transducer for a particular measurement.
➢ To develop knowledge in digital, analytical and biomedical instruments for different applications.
➢ To know the functioning of medical imaging instruments.

UNIT – 1: TRANSDUCERS

Basic functional elements of measuring system-Transducers: Definition-Parts-Classification-Types of primary sensing element.
Piezo electric transducers: Principle, theory and working of piezo electric crystals.

UNIT – 2: DIGITAL INSTRUMENTATION


UNIT – 3: ANALYTICAL INSTRUMENTATION

Principle, working, Instrumentation and applications of UV-Vis Spectrophotometer, ICP-AES, (Inductively coupled plasma-Atomic emission spectroscopy), SEM (Scanning Electron Microscope) and AFM (Atomic Force Microscopy).

UNIT – 4: BIO-MEDICAL INSTRUMENTATION


Principle, block diagram and functioning of ECG, EEG and EMG.

UNIT – 5: MEDICAL IMAGING INSTRUMENTATION


Computed Tomography: Principle-CAT scanning-Instrumentation-Contrast scale-Scanning components.

TEXT BOOKS:
2. Dr.Rajendra Prasad, Electronic Measurements and Instrumentation, Khanna Publishers, 2002

SUPPLEMENTARY READING:
COURSE OUTCOMES (COs):

By the end of the Course, the students will be able to

**CO1:** Select the types of transducer for a particular measurement.

**CO2:** Test and use the digital instruments for different applications.

**CO3:** Understand the various analytical and biomedical instrumentation and their uses.

**CO4:** Know the functioning of medical imaging instruments.

**MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)**

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SEMESTER - III  19PHYE305.2- BIO-MEDICAL INSTRUMENTATION  Credit:3  Hours:3

**LEARNING OBJECTIVES:**

- To gain the knowledge about the bio medical instruments used for measuring bio-electric potentials and the electrodes used for sensing the bio potentials.
- To understand the working principles of imaging equipments and bio medical instruments used for determining the physiological parameters.
- To update the knowledge of various lasers used for medical applications for the students.

**UNIT – 1: BIO-ELECTRIC POTENTIALS**


**UNIT – 2: BIO-POTENTIAL ELECTRODES**

Biopotential Electrodes – Types of Electrodes - Microelectrodes – Body surface electrodes – Depth and Needle electrodes- Chemical electrodes – Distortion in measured bioelectric signals using electrodes-Electrode paste

**UNIT – 3: IMAGING EQUIPMENTS**

Ultrasonic Imaging-Reflection-Scattering-A mode display-B mode display-T-M mode display-Ultrasonic imaging instrumentation-Biomedical applications- Magnetic Resonance Imaging (MRI)-Principle-Instrumentation-Advantages of MRI over other medical imaging techniques- Thermography-Endoscopy

**UNIT – 4: MEASUREMENT OF PHYSIOLOGICAL PARAMETERS**

Blood Pressure Measurement-Introduction-Direct Measurement using Catheters-Advance of Direct Method-Indirect Method-Oscillometric measurement method-

UNIT – 5: LASER IN MEDICINE


TEXT BOOKS:


SUPPLEMENTARY READING:


COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

**CO1:** Understand the importance of bio medical instruments and accuracy of the measured physical parameters and their practical implementation in the medical field.

**CO2:** Understand experimentally recording data, its inference to diagnose the diseases.

**CO3:** Understand various techniques and its relevance in various defects in the body parts.

**CO4:** Solve the health issues from the bio medical instruments and applicability in physics concepts may give the clear idea about the health issues.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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SEMESTER - III 19PHYE305.3 - PETRO PHYSICS Credit:3 Hours:3
LEARNING OBJECTIVES:

- To understand the various magnetites and behaviour of the remenance properties.
- To study the geomagnetic elements of the earth and various magnetometer instruments.
- To understand the classification and properties of rock forming minerals.
- To highlight the concept of seismic waves and various dating methods.

UNIT – 1


UNIT – 2

Geomagnetic elements of the earth – Field variation and detection - The Magnetic observatory – mapping of secular variations. Diurnal variation of magnetic disturbances – initial susceptibility of rocks – single and multidomain cases – Curie point determination and its importance.

Laboratory and field instruments for magnetic measurements – Astatic magnetometer – spinner magnetometer – Fluxgate magnetometer, Proton procession magnetometer – Theory, practice and applications.

UNIT – 3

Classification of rock forming minerals – physical properties of minerals with special reference to optical properties – elementary details of a polarizing microscope and petrographic analysis.


UNIT – 4


UNIT – 5

TEXT BOOKS:

SUPPLEMENTARY READING:
5. Dobrin, Introduction to Geophysical prospecting, Mcgraw Hill Book Co.

COURSE OUTCOMES (COs):
By the end of the course, the student will be able to

CO1: Understand the various magnetites and behaviour of the remenance properties.
CO2: Study the geomagnetic elements of the earth and various magnetometer instruments.
CO3: Understand the classification and properties of of rock forming minerals
CO4: Highlight the concept of seismic waves and various dating methods.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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SEMESTER - III 19PHYE305.4 - MEDICAL PHYSICS

LEARNING OBJECTIVES:

➢ To gain the knowledge about the bio medical instruments used for measuring bio-electric potentials and the electrodes used for sensing the bio potentials.
➢ To understand the working principles of imaging equipments and bio medical instruments used for determining the physiological parameters.
➢ To update the knowledge of various nuclear medicine and biological effects of radiation.

Unit – 1: Bio-Electric Potentials


Unit – 2: Digital X-ray imaging and Computed Tomography


Unit – 3: Imaging with Ultrasound and MRI


Unit – 4: Physics of Nuclear Medicine and Biological effects of Radiation


Unit – 5: Medical Imaging Instrumentation


TEXT BOOKS:


SUPPLEMENTARY READING:

3. Ramesh Chandra, Nuclear Medicine Physics, , Lea and Febiger. 5th Edition

COURSE OUTCOMES (COs):

By the end of the course, the student will be able to
CO1: To gain the knowledge about the biomedical instruments used for measuring bioelectric potentials and the electrodes used for sensing the bio potentials.

CO2: To understand the working principles of imaging equipments used for determining the physiological parameters.

CO3: To understand the working principles of biomedical instruments used for determining the physiological parameters.

CO4: To update the knowledge of various nuclear medicine and biological effects of radiation.

| MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs) |
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| CO1 | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |
| CO2 | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |
| CO3 | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |
| CO4 | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |

SEMESTER - III 19PHYE305.5 – BIOPHYSICS Credit:3 Hours:3

LEARNING OBJECTIVES:

- To understand the applications of various microscopic tools in cell biology.
- To understand the fundamentals of macromolecular structure.
- To understand the analytical techniques in characterizing biomolecular interactions and its structure.

Unit – 1: CELL ORGANIZATION

Cell as the basic structural unit- Origin & organization of Prokaryotic and Eukaryotic cell- Cell size & shape- Fine structure of Prokaryotic & Eukaryotic cell organization (Bacteria, Cyanobacteria, plant & Animal cell)- Internal architecture of cells- cell organelles- compartment & assemblies membrane system- Ribosome- Polysomes- Lysosomes- Peroxisomes- Connection between cell & its environment- Extracellular Matrix.

Unit – 2: TOOLS IN CELL BIOLOGY


Unit – 3: MACROMOLECULAR STRUCTURE

Nucleic acid structure: Chemical structure of the nucleic acid - Conformational possibilities of monomers and polymers- Double helix structure of DNA- Polymorphism of DNA-DNA nanostructures and the structure of transfer RNA.

Unit – 4: SEPERATION TECHNIQUES


Unit – 5: OPTICAL & DIFFRACTION TECHNIQUES

Circular Dichroism and optical rotator dispersion:- Plane, circular and elliptical polarization of light- Absorption by oriented molecules- Dichroic ratio of proteins and nucleic acids- Circular dichroism (CD) - optical rotatory dispensor (ORD) - Relation between CD and ORD- Application of ORD in conformation and interactions of biomolecules.


TEXT BOOKS:


SUPPLEMENTARY READING:


COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Have in-depth knowledge of the structure of cells and the macromolecular structure.

CO2: Understand the basic principles of the various microscopic techniques presented in the course, their advantages and limitations.

CO3: Provide an introduction to various separation techniques that are used in biological samples.

CO4: Understand the different processes of optical and diffraction techniques.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

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