M.Sc. PHYSICS
CHOICE BASED CREDIT SYSTEM
(CBCS)

Syllabus
2024 - 2026

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

DEPARTMENT OF PHYSICS

FACULTY OF ARTS, SCIENCE, COMMERCE, MANAGEMENT

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act, 1956)

(Accredited with A+ garde by NAAC in the Second Cycle)

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Coimbatore - 641 021, Tamil Nadu, India

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
POST GRADUATE PROGRAMMES
(M.Sc. M. Com and M.A)

REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS - 2024

The following regulations are effective from the academic year 2024 -2025 and are applicable to the candidates admitted in Post Graduate (PG) Degree programmes in the Faculty of Arts, Science, Commerce and Management, Karpagam Academy of Higher Education (KAHE).

1. PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

1.1. P.G. PROGRAMMES OFFERED

The various P.G. Programmes offered by the KAHE are listed in the table below.

S. No.	Programmes Offered
1	M.Sc. Biochemistry
2	M.Sc. Microbiology
3	M.Sc. Biotechnology
4	M.Sc. Physics
5	M.Sc. Chemistry
6	M.Sc. Mathematics
7	M.Sc. Computer Science
8	M.Com.
9	M.A. English

1.2. MODE OF STUDY

All programmes are offered under Full-Time Regular mode. Candidates admitted under 'Full-Time' should be present in the KAHE during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

1.3. ADMISSION REQUIREMENTS (ELIGIBILITY)

A candidate for admission to the first semester Master's Degree Programme shall be required to have passed an appropriate Degree Examination of this Karpagam Academy of Higher Education or any other University accepted by the KAHE as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course as given in the table below.

QUALIFICATIONS FOR ADMISSION

S. No.	Programme	Eligibility
1	M.Sc. Biochemistry	B.Sc. Degree with Biology / Biochemistry / Chemistry / Biotechnology / B.F.Sc. / Polymer Chemistry / Microbiology/ Zoology / Botany / Plant Science / Plant Biotechnology / Animal Science / Animal Biotechnology / B.Pharm / Industrial Chemistry / Applied Microbiology / Medical Microbiology / Human Genetics / Medical Genetics / Molecular Biology / Genetics Technology / Environmental Science / Environment Biotechnology / Genetics Engineering / Bioinformatics / Plant Biology & Biotechnology / Animal Cell & Biotechnology / Agriculture / Medical Lab Technology / Nutrition & Dietetics
2	M.Sc. Microbiology	B.Sc. Microbiology / Applied Microbiology / Industrial Microbiology / Medical Microbiology / Botany / Zoology / Biology / Biotechnology /Industrial Biotechnology/ Molecular Biology / Genetic Engineering / Biochemistry / Agriculture / Forestry / Medical Lab Technology / Life Sciences

3	M.Sc. Biotechnology	B.Sc. Degree with Biotechnology/ Industrial Biotechnology/ Biology / Biochemistry / B.Sc Biology with Chemistry Ancillary / B.F.Sc. / Microbiology / Zoology / Botany / Plant Science /Plant Biotechnology / Animal Science /Animal Biotechnology / B.Pharm / Applied Microbiology / Medical Microbiology / Human Genetics / Medical Genetics / Molecular Biology / Genetics / Environmental Science / Environment Biotechnology / Genetics Engineering / Bioinformatics / Plant Biology & Biotechnology / Animal Cell & Biotechnology / Agriculture / B.Tech (Biotech)
4	M.Sc. Physics	B.Sc. Physics, B.Sc. Physics (CA) / B.Sc. Applied Sciences
5	M.Sc. Chemistry	B.Sc. Chemistry, Industrial Chemistry, Polymer Chemistry, B.Sc. Applied Sciences
6	M.Sc. Mathematics	B.Sc. Mathematics / B.Sc. Mathematics with Computer Applications, B.Sc. Applied Sciences
7	M.Sc. Computer Science	B.Sc. Computer Science / B.Sc Computer Science (Cognitive Systems)/ B.Sc Computer Science (AI&DS)/ B.Sc Computer Science (Cyber Security)/ Computer Technology / Information Technology / Electronics / Software Systems / BCA/ B.Sc. Applied Sciences
8	M.Com	B.Com. / B.Com.(CA) /B.Com (PA) / B.Com (Finance & Insurance) / B.Com. (e-Commerce) / B.Com.(IT) / B.B.M. /B.B.M. (CA) / B.B.A./ B.B.A (CA) / B.Com (CS), B.A. Co-operation / Bachelor's Degree in Bank Management/ B.A. Economics / B. Com Financial Analytics/ B. Com International Accounting and Finance
9	MA English	BA (English)/Any UG degree with Part II – English for four semesters.

2. DURATION OF THE PROGRAMMES

2.1. The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Sc., M.Com., MA	4	8

2.2. Each semester normally consists of 90 working days or 450 Instructional hours for full-time mode of study. End Semester Examination shall be conducted at the end of every semester for the respective courses.

3. CHOICE BASED CREDIT SYSTEM

Credits means the weightage given to each course of study by the experts of the Board of Studies concerned. All PG programmes are offered under Choice Based Credit System and students can earn a total of 92 credits.

4. STRUCTURE OF THE PROGRAMME

Every Programme will have a curriculum and syllabus consisting of core courses, elective courses, open elective, Internship and project work.

a. Major courses

Major courses consist of theory and practical and the examinations shall be conducted at the end of each semester.

b. Elective courses

Elective courses are to be chosen with the approval of the Head of Department concerned from the list of elective courses mentioned in the curriculum.

c. Project Work

The candidates shall undertake the project work in the Fourth Semester either in the Department concerned or in Industries, Research Institute or any other Organizations (National / International) and the project report has to be submitted at the end of the fourth semester.

If the candidate undertakes the Research Project work outside the Department, the faculty concerned within the Department shall be the Supervisor and the teacher/scientist of the host institute will be the Co-supervisor. The candidate shall bring the attendance certificate from the host institute.

The Head of the Department shall assign a project supervisor who shall monitor the student's project work(s). A Project Assessing Committee (PAC) shall be constituted with HoD and two senior faculty members of the Department. The PAC shall announce the dates for the reviews and

demonstration. The student shall make a presentation on the progress and demonstration of their project before the PAC in the presence of their supervisor on the scheduled dates.

d. Internship

The student shall undergo 15 days internship at the end of second semester. Internship report will be evaluated and marks will be awarded in the third semester. Students have to earn 2 credits for the Internship. The Internship will be assessed internally and marks will be awarded out of 100.

e. Open Elective

He / She may select one of the open elective courses from the list given below offered by other departments in the third semester. Students have to earn 2 credits for this course (The student cannot select a course offered by the parent department).

S.No.	Name of the offering Department	Course Code	Name of the Course
1	English	24EGPOE301	English for Competitive Examinations
2	Commerce	24CMPOE301	Personal Finance and Planning
3	Management	24MBAPOE301	Organizational Behavior
4	Computer Applications	24CAPOE301	Robotics Process Automation
5	Computer Science	24CSPOE301	Cyber Forensics
6	Mathematics	24MMPOE301	Coding theory
7	Physics	24PHPOE301	Electrical Appliances and Servicing
8	Chemistry	24CHPOE301	Industrial Chemistry
9	Microbiology	24MBPOE301	Fermentation Technology
10	Biotechnology	24BTPOE301	Nutrition and Dietetics

5. CREDIT TRANSFER THROUGH ONLINE PLATFORM / INTERNATIONAL STUDIES

Students are encouraged to enroll in courses offered by MOOC platforms and international institutions of higher learning, either virtually or in person. The equivalent credits for these courses will be determined by a committee named Subject Equivalency Committee comprising the Dean, Head of Department (HoD), and one faculty member nominated by the Vice Chancellor. The committee's decision will be submitted for ratification/approval by the Board of Studies (BoS) and the Academic Council. Additionally, the equivalent grade points for marks/grades/grade

points awarded by various MOOC platforms and international institutions of higher learning will be determined by a committee named Grade Equivalency Committee duly constituted by the Vice-Chancellor. The decisions of this committee will also be submitted for ratification/approval by the Academic Council. This shall be approved to be implemented from the even semester of the academic year 2024-25.

6. MEDIUM OF INSTRUCTION

The medium of instruction for all courses, examinations, seminar presentations, Internship and project/thesis/dissertation reports should be English.

7. MAXIMUM MARKS

The maximum marks assigned to different courses shall be as follows:

(i) Each of the theory and practical courses shall carry maximum of 100 marks. Out of which 40 marks are for Continuous Internal Assessment (CIA) and 60 marks are for End Semester Examinations (ESE).

(ii) Maximum Marks for Project work

S. No	Programme	Maximum Marks	CIA	ESE
1	M.Sc., M.Com., M.A	200	80	120

8. a. FACULTY MENTOR

To help students in planning their courses of study and for general advice on the academic programme, the HoD shall allot a certain number of students to a faculty who will function as mentor throughout their period of study. Faculty mentors shall advise the students and monitor their behavior and academic performance. Problems if any shall be counseled by them periodically. The faculty mentor is also responsible to inform the parents of their wards' progress. Faculty mentor shall display the cumulative attendance particulars of his / her students' periodically (once in 2 weeks) on the Notice Board to enable the students to know their attendance status and satisfy the **clause 8** of this regulation.

9. CLASS COMMITTEE

Every class shall have a Class Committee consisting of teachers of the class concerned, student representatives (Minimum two boys and 2 girls of various capabilities and Maximum of 6 students) and the HoD / senior faculty concerned as a Chairperson. The objective of the class committee Meeting is all about the teaching – learning process. The Class Committee shall be convened at least once in a month. The constitution and functions of the Class Committee shall include

1. The class committee shall be constituted during the first week of each semester.
2. The Class Committee of a particular class of any department is normally constituted by the HoD/Chairperson of the Class Committee. However, if the students of different departments are mixed in a class, the Class Committee shall be constituted by the respective Dean of the Faculty.
3. The HoD/Chairperson of the Class committee is authorized to convene the meeting.
4. The respective Dean of the Faculty has the right to participate in any Class committee meeting.
5. The Chairperson is required to prepare the minutes of every meeting, and submit the same to the Dean concerned within two days after having convened the meeting. Serious issues if any shall be brought to the notice of the Registrar by the HoD/Chairperson immediately.
6. Analyzing and solving problems experienced by students in the class room and in the laboratories.
7. Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.

10. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. Every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate should be satisfactory during the course.

b. A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident /

Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Startup Activity / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed minimum attendance requirements and shall be permitted to appear for the examination on the recommendation of the Head of Department concerned and Dean to condone the shortage of attendance. The Head of Department has to verify and certify the genuineness of the case before recommending to the Dean concerned.

c. However, a student who has secured less than 65% in any of the semesters due to any reasons, shall not be permitted to appear for the End Semester Examinations. But he/she will be permitted to appear for his/her arrear examinations. In order to redo the semester with lack of attendance he/she has to attend the corresponding semester of the subsequent year(s) with approval of the Dean of the Faculty, Dean - Students Affairs and the Registrar.

11. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

11.1. Every Faculty is required to maintain an **Attendance and Assessment Record (Log book)** which consists of attendance of students marked for each lecture/practical/ project work, the CIA and Seminar marks and the record of class work completed (topic covered), separately for each course. This should be submitted to the HoD once in a week for checking the syllabus coverage, records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted every fortnight to respective Dean. After the completion of the semester the HoD should keep this record in safe custody for five years as records of attendance and assessment shall be submitted for inspection as and when required by the KAHE/any other approved body.

11.2. Continuous Internal Assessment (CIA): The performance of students in each course will be continuously assessed by the respective faculty. Retest will be conducted and considered based on the requirements and recommendations by the Head of the Department. The guidelines for the Continuous Internal Assessment (CIA) are given below:

Theory Courses

S. No.	Category	Maximum Marks
1	Attendance	5
2	Test – I (2 ½ units)	10
3	Test – II (2 ½ units)	10
4	Journal Paper Analysis & Presentation*	15
	Total	40

*****Evaluated by two faculty members of the department concerned. Distribution of marks for one Journal paper analysis: Subject matter 5 marks, Communication/PPT Presentation 4 marks, Visual aid 2 marks and Question and Discussion 4 marks.

Practical Courses

S. No.	Category	Maximum Marks
1	Attendance	5
2	Observation work	5
3	Record work	5
4	Model practical examination	15
5	*Viva – voce* [Comprehensive]*	10
	Total	**40**

* *Viva - voce* conducted during model practical examination.

Every practical Exercise / Experiment shall be evaluated based on the conduct of Exercise/ Experiment and records maintained.

11.3 Portions for Test Question Paper

Portions for Internal Test – I : 2 ½ Units

Portions for Internal Test – II : 2 ½ Units

11.4 Pattern of Test Question Paper

Theory Courses:

Maximum Marks : 100 **Duration: 3 Hours**

Section	Marks
Part – A	Short Answer Answer ALL the Questions (10 x 2 = 20 Marks)
Part - B	Long Answer – 5 six mark questions 'either – or' type Answer ALL the Questions (5 x 6 = 30 Marks)
Part - C	Essay type Answer– 5 ten mark questions 'either – or 'type Answer ALL the Questions (5 x 10 = 50 Marks)

11.5 Attendance

Marks Distribution for Attendance

S. No.	Attendance (%)	Maximum Marks
1	91 and above	5.0
2	81 - 90	4.0
3	76 - 80	3.0
4	Less than or equal to 75	0

12. ESE EXAMINATIONS

12.1 End Semester Examination (ESE): ESE will be held at the end of each semester for each course. The question paper is for a maximum of 100 marks.

Pattern of ESE Question Paper

Theory Courses:

Maximum Marks: 100 **Duration: 3 Hours**

Section	Marks
Part – A	Short Answer Answer ALL the Questions (10 x 2 = 20 Marks)
Part - B	Long Answer – 5 six mark questions 'either – or' type Answer ALL the Questions (5 x 6 = 30 Marks)
Part - C	Essay type Answer– 5 ten mark questions 'either – or 'type Answer ALL the Questions (5 x 10 = 50 Marks)

The 100 Marks is converted to 60 Marks.

12.2 Practical Courses: There shall be combined valuation by the Internal and External examiners. The pattern of distribution of marks shall be as given below.

S. No.	Category	Maximum Marks
1.	Experiments	40
2.	Record work	10
3.	*Viva – voce* [Comprehensive]	10
	Total	**60**

Record Notebooks for Practical Examination

Candidate taking the Practical Examination should submit Bonafide Record Notebook prescribed for the practical examination, failing which the candidate will not be permitted to take the practical examination.

In case of failures in Practical Examination, the marks awarded for the Record at the time of first appearance of the Practical Examination shall remain the same at the subsequent appearance also by the candidate.

12.3. Evaluation of Project Work

12.3.1 The project shall carry a maximum marks as per (vide clause 6 (ii)). ESE will be a combined evaluation of Internal and External Examiners.

12.3.2 The project report prepared according to the approved guidelines and duly signed by the supervisor(s) shall be submitted to HoD.

Guidelines to prepare the project report

a. Cover page
b. Bonafide certificate
c. Declaration
d. Acknowledgement
e. Table of contents
f. Chapters
    - Introduction
    - Aim and Objectives
    - Materials and Methods (Methodology)
    - Results (Analysis of Data) and Discussion (Interpretation)
    - Summary
    - References

12.3.3 The evaluation of the project will be based on the project report submitted and *Viva-Voce* Examination by a team consisting of the supervisor, who will be the Internal Examiner and an External Examiner who shall be appointed by the COE. In case the supervisor is not available, the HoD shall act as an Internal Examiner.

12.3.4 If a candidate fails to submit the project report on or before the specified date given by Examination Section, the candidate is deemed to be failed in the project work and shall re-enroll for the same in a subsequent semester.

If a candidate fails in the *viva-voce* examinations he/she has to resubmit the project report within 30 days from the date of declaration of the results. For this purpose the same Internal and External examiner shall evaluate the resubmitted report.

12.3.5 Copy of the approved project report after the successful completion of *viva voce* examinations shall be kept in the KAHE library.

13. PASSING REQUIREMENTS

13.1 Passing minimum: A candidate needs to secure a minimum of 20 marks out of 40 marks in CIA and 30 marks out of 60 marks in ESE. The overall passing minimum in each course is 50 marks out of 100 marks (Sum of the marks in CIA and ESE examination).

13.2 If a candidate fails to secure a pass in a particular course (either CIA or ESE or Both) as per clause 17.1, it is mandatory that the candidate has to register and reappear for the examination in that course during the subsequent semester when examination is conducted for the same till, he / she receives pass both in CIA and ESE (vide Clause 2.1).

13.3 Candidate failed in CIA will be permitted to improve CIA marks in the subsequent semesters by writing tests and by re-submitting Assignments.

13.4 The CIA marks secured by the candidate in the first passed attempt shall be retained by the Office of the Controller of Examinations and considered valid for all subsequent attempts till the candidate secures a pass in ESE.

13.5 A Candidate who is absent in ESE in a Course / Practical / Project Work after having enrolled for the same shall be considered to have Absent (AAA) in that examination

14. IMPROVEMENT OF MARKS IN THE COURSE ALREADY PASSED

The Candidates desirous to improve the marks secured in a passed course in their first attempt shall reappear once (**only in ESE**) in the subsequent semester. **The improved marks shall be considered for classification but not for ranking.** If there is no improvement there shall be no change in the marks awarded earlier.

15. AWARD OF LETTER GRADES

All assessments of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each course as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81 - 90	9	EXCELLENT
A	71 - 80	8	VERY GOOD
B+	66 - 70	7	GOOD
B	61 - 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	< 50	-	REAPPEARANCE
AAA	-	-	ABSENT

16. GRADE SHEET

After the declaration of the results, Grade Sheets will be issued to each student which will contain the following details:

i. The list of courses enrolled during the semester and the corresponding grade obtained.

ii. The Grade Point Average (**GPA**) for the semester and

iii. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA of a Semester and CGPA of a programme will be calculated as follows.

GPA of a Semester = (Sum of the product of the GP by the corresponding credits of the courses offered in that Semester) / (Sum of the credits of the courses of that Semester)

i.e. **GPA** of a Semester = $\frac{\sum_i CiGPi}{\sum_i Ci}$

Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme

CGPA of the entire programme = ----------

Sum of the credits of the courses of the entire programme

i.e. **CGPA** of the entire programme = $$\frac{\sum_{n}\sum_{i} CniGPni}{\sum_{n}\sum_{i} Cni}$$

where,

Ci is the credit fixed for the course 'i' in any semester
GPi is the grade point obtained for the course 'i' in any semester
'n' refers to the Semester in which such courses are credited

Note: RA grade will be excluded for calculating **GPA** and **CGPA**.

17. REVALUATION

Candidate can apply for revaluation or retotaling of his / her semester examination answer script (**theory courses only**), within 2 weeks from the date of declaration of results, on payment of a prescribed fee. For the same, the prescribed application has to be sent to the Controller of Examinations through the HoD. **A candidate can apply for revaluation of answer scripts not exceeding 5 courses at a time.** The Controller of Examinations will arrange for the revaluation and results will be intimated to the candidate through the HODs concerned**.** Revaluation is not permitted for supplementary theory courses.

18.TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Re-totaling are allowed on representation (clause 18). Student may get the Xerox copy of the answer script on payment of prescribed fee, if he / she wish. The student may represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the KAHE), the HoD of Department concerned, the faculty of the course and Dean from other discipline nominated by the KAHE and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

19. ELIGIBILITY FOR THE AWARD OF THE DEGREE

A student shall be declared to be eligible for the conferment of the Degree if he / she has

- Successfully completed all the components in clause 3 and gained the required number of total credits as specified in the curriculum corresponding to his / her Programme within the stipulated period.
- No pending disciplinary enquiry/ action against him/her.

- The award of the degree must be approved by the Board of Management.

20.CLASSIFICATION OF THE DEGREE AWARDED

20.1. Candidate who qualifies for the award of the Degree (vide clause 14) having passed the examination in all the courses in his / her first appearance, within the specified minimum number of semesters and securing a **CGPA not less than 8.0** shall be declared to have passed the examination in **First Class with Distinction.**

20.2 Candidate who qualifies for the award of the Degree (vide clause 14) having passed the examination in all the courses within the specified maximum number of semesters (vide clause 2.1), securing a **CGPA not less than 6.5** shall be declared to have passed the examination in **First Class**.

20.3 All other candidates (not covered in clauses 21.1 and 21.2) who qualify for the award of the degree (vide Clause 20) shall be declared to have passed the examination in **Second Class**.

21. RANKING

A candidate who qualifies for the PG Degree programme passing all the Examinations in the first attempt, within the minimum period prescribed for the programme of study from Semester I through Semester IV to the programme shall be eligible for ranking. Such ranking will be confined to 10% of the total number of candidates qualified in that particular programme of Study subject to a maximum of 10 ranks.
The improved marks will not be taken into consideration for ranking.

22. SUPPLEMENTARY EXAMINATION

Supplementary Examination will be conducted only for the final semester students within ten days from the date of publication of results for students who have failed in one theory course only. Such students shall apply with prescribed fee to the Controller of Examinations within the stipulated time.

23.DISCIPLINE

23.1. If a student indulges in malpractice in any of the Internal/External Examinations he/she shall be liable for punitive action as prescribed by the KAHE from time to time.

23.2. Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the KAHE. The erring students will be referred to the disciplinary committee constituted by the KAHE, to enquire into acts of indiscipline and recommend the disciplinary action to be taken.

24. KAHE ENTRANCE EXAMINATION

At the end of Fourth Semester, the KAHE Entrance Examinations will be conducted who are aspiring for Higher Education (Ph.D).

25. REVISION OF REGULATION AND CURRICULUM

Karpagam Academy of Higher Education may from time-to-time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary.

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Annexure I

S.No.	Programme	Subject	Eligibility
1.	B. Sc.	Biotechnology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany or Zoology or chemistry as subjects at the Higher Secondary level.
2.	B. Sc.	Computer Science	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern. preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
3.	B. Sc.	Microbiology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany Zoology or chemistry as subjects at the Higher Secondary level.
4.	B. Sc.	Information Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
5.	B. Sc.	Computer Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
6.	B.Sc.	Computer Science(Cognitive Systems)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.

7.	B.Sc.	Computer Science (Artificial Intelligence and Data Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
8.	BCA	Computer Application	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
9.	B. Com.	Commerce	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
10.	B.Com (CA)	Commerce with Computer Applications	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
11.	B. Com. (PA)	Commerce with Professional Accounting	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
12.	B. Com. (BPS)	Commerce with Business Process Services	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
13.	B.B.A.	Business Administration	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
14.	B. Com	Financial Analytics	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level

15.	B. Com	International Accounting and Finance	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
16.	B.Com	Information Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
17.	B. Sc.	Computer Science (Cyber Security)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
18.	B. Com	FinTech.	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level

Karpagam Innovation and Incubation Council (KIIC)

(A Section 8 Company)

Based on the 2019 National Innovation and Startup Policy and the 2019–2023 Tamil Nadu Startup Policy, KIIC has recommended to the KAHE students who are affiliated with the KIIC that it be incorporated in the university Program Regulations 2023-24 and implement from this academic year.

Norms to Student Start-Ups

a) Any (UG/PG /(Ph.D.) Research scholars, student, right from the first year of their program is allowed to set a startup (or) work part time/ full time in a startup or work as intern in a startup

b) Any (UG/PG / (Ph.D.) Research scholars) student right from the first year of their program is allowed to earn credit for working on Innovative prototypes/business Models/ Pre incubation (case to case basis).

c) Start Up activities will be evaluated based on the guidelines being given by the expert committee of the KIIC

d) Student Entrepreneurs may use the address of incubation center (KIIC) to register their venture while studying in KAHE.

e) Students engaged in startups affiliated with the KIIC or those who work for them may be exempted from KAHE's attendance requirements for academic courses under current regulations, up to a maximum of 30% attendance per semester, including claims for ODs and medical emergencies Potential Students who have been incubated at KIIC may be permitted to take their University semester exams even if their attendance is below the minimum acceptable percentage, with the proper authorization from the head of the institution.
(On case-to-case basis depends upon the applicability strength, societal benefits and quality of the Innovation and Subsequent engagement of the students with the/ her business)

f) Any Students Innovators/entrepreneurs are allowed to opt their startup in place mini project /major project, /seminar and summer training etc. (In plant training, Internship, value added Course.). The area in which the student wishes to launch a Startup may be interdisciplinary or multidisciplinary.

g) Student's startups are to be evaluated by Expert committee, formed by KIIC and KAHE

Guide lines to award Credits/ Marks to a Student startup

Student's startup stages are divided into five phases and these startup phases can be considered equally in place of the course title as mentioned below with the same credits allotted to the course title in a University curriculum.

Sl. No.	Description/Startup phases	In place of the Subject / Course title	Grades/Credits /Marks
1	**Idea stage/Problem Identification**	**Seminar**	**Same Marks/Credits can be awarded that are listed in the course title's curriculum for the respective startup phases.**
2	**Proof of Concept (POC) /Solution development**	**In-plant training /Internship**	
3	**Product Development (Lab scale) /Prototype Model/ Company Registered**	**Mini Project/ Value added Course**	
4	**Validation/Testing**	**Main Project phase I**	
5	**Business Model/Ready for Commercialization/Implementation**	**Main Project phase II,**	

DEPARTMENT OF PHYSICS
FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
PG PROGRAMME (CBCS) – M.Sc., Physics
(2024–2026 Batch and Onwards)

Course code	Name of the course	Category	Outcomes		Instruction hours/Week			Credit (s)	Maximum Marks			Page. No.
			POs	PSOs	L	T	P		CIA	ESE	Total	
SEMESTER- I												
24PHP101	Classical Mechanics and Special Relativity	CC	1,2,3,4,5,7,11,13,14	1,2	4	0	0	4	40	60	100	31
24PHP102	Electronics and Automation	CC	1,2,4,5,6,7,8,12	1,2	4	0	0	4	40	60	100	34
24PHP103	Condensed Matter Physics	CC	1,2,4,5,12,14	1,2	4	0	0	4	40	60	100	37
24PHP104	Nanoscience and Nanotechnology	CC	1,2,3,4,6,7,14,15	1,2	4	0	0	4	40	60	100	41
24PHP105A	Elective-I: Industrial Physics	EC	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2	4	0	0	4	40	60	100	44
24PHP105B	Elective-I: Instrumentation and Measurement Techniques	EC	1,2,3,4,5,6,7,8,10,11,12,13,14,15	1,2		0	0					48
24PHP105C	Elective-I: Numerical Methods in Physics	EC	1,2,3,4,5,7,8,11,12,13,14	1,2		0	0					51
24PHP111	General Physics Practical – I	CC	1,2,3,4,5,8,12,13,14	1,2	0	0	4	3	40	60	100	54

24PHP112	Electronics Practical – I		CC	1,2,3,4,5,7,8,9	1,2	0	0	4	3	40	60	100	57
Journal Paper Analysis & Presentation						2	0	0	0	-	-	-	
Semester Total						**22**	**0**	**8**	**26**	**280**	**420**	**700**	
SEMESTER-II													
24PHP201	Electromagnetic Theory and Electrodynamics		CC	1,2,3,4	1	4	0	0	4	40	60	100	63
24PHP202	Mathematical Physics		CC	1,2,3,4,5,14	1,2	4	0	0	4	40	60	100	67
24PHP203	Thermodynamics and Statistical Mechanics		CC	1,2,3,4,5,6	1,2	4	0	0	4	40	60	100	71
24PHP204	Laser and Optics		CC	1,2,3,4,5,7,8,9	1,2	4	0	0	4	40	60	100	75
24PHP205A	Elective-II	Renewable Energy Sources and Applications	EC	1,3,4,5,6,7,8,9,13,14	1,2	4	0	0	4	40	60	100	79
24PHP205B		Thin Film Physics		1,2,3,4,5,6,7,8,13,14	1,2								83
24PHP205C		Industrial and Power Electronics		1,2,3,4,5,6,7,8,10,12,13,14	1,2								87
24PHP206	Community Engagement and Social Responsibility		CC	1,2,3,4,5,6,7,8,10,15	2	2	0	0	2	40	60	100	90
24PHP211	General Physics Practical – II		CC	1,2,3,4,5,6,7,8,10,12,13,14	1,2	0	0	3	2	40	60	100	94
24PHP212	Electronics Practical – II		CC	1,2,3,4,5,7,8,9	1,2	0	0	3	2	40	60	100	97
Journal Paper Analysis & Presentation				-		2	0	0	0	-	-	-	
Semester total						**24**		**6**	**26**	**320**	**480**	**800**	

SEMESTER-II													
24PHP301	Quantum Mechanics		CC	1,2,3,4,5,7,8,11,13,14,15	1,2	4	0	0	4	40	60	100	103
24PHP302	Spectroscopy		CC	1,2,3,4,5,6,7,8,11,13,14,15	1,2	4	0	0	4	40	60	100	107
24PHP303	Nuclear and Particle Physics		CC	1,2,3,4,5,7,9,10,11,12,13,14	1,2	4	0	0	4	40	60	100	111
24PHP304	Physics of Material and Characterization		CC	1,3,4,5,7,12,14	1,2	4	0	0	4	40	60	100	115
24PHP305A	Elective-III	Medical Instrumentation	EC	1,2,3,4,7,9,12	1,2	4	0	0	4	40	60	100	118
24PHP305B		Numerical Methods and Programming		1,2,3,4,5,7,8,11,12,13,14	1,2		0	0					121
24PHP305C		Plasma Physics Fundamentals and Applications		1,2,3,4,5,14	1,2		0	0					124
24PHP311	Advanced Physics Practical		CC	1,2,3,4,5,12,13,14	1,2	0	0	3	2	40	60	100	127
24PHP312	Advanced Electronics Practical		CC	1,2,3,4,5,7,8,9,12	1,2	0	0	3	2	40	60	100	130
24PHPOE301	Open Elective	Electrical Appliances and Servicing	OE	1,2,3,4,5,7,8,9,12	1,2	3	0	0	2	40	60	100	133
24PHPP391	Internship Program		CC			-			1	100	-	100	
Journal Paper Analysis & Presentation				-		1	0	0	0	-	-	-	
Semester Total						24	-	6	27	420	480	900	

SEMESTER – IV												
24PHP491	Project	CC	1,2,3,4,5,6,7,8,9,10,11,12,13,14	1,2	-	-	30	15	80	120	200	139
Semester Total					-	-	30	15	80	120	200	
*End of II Semester – Internship for 15 days												
Total								94	1100	1500	2600	

ELECTIVE COURSES

Elective –1 (24PHP105)		Elective –2 (24PHP205)		Elective –3 (24PHP305)	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
24PHP105A	Industrial Physics	24PHP205A	Renewable Energy Sources and Applications	24PHP305A	Medical Instrumentation
24PHP105B	Instrumentation and Measurement Techniques	24BTP205B	Stem Cell Biology	24PHP305B	Numerical Methods and Programming
24PHP105C	Numerical Methods in Physics	24PHP205B	Thin Film Physics	24PHP305C	Plasma Physics Fundamentals and Applications

Open Elective Course		
Semester	**Subject code**	**Subject**
III	24PHPOE301	Electrical Appliances and Servicing

*Electives are Transborder/cross disciplinary / Discipline centric elective nature.

Blue – Employability, Green– Entrepreneurship, Red- Skill Development

List of Value-Added Course

Semester- I	Semester- II	Semester- III
Basic Domestic Electrical Appliances and Servicing	Physics of Electronics Communication	Embedded Systems

PROGRAMME OUTCOMES (POs)

PO1: Disciplinary knowledge: Post-graduates will be able to gain In-depth knowledge of advanced biotechnological concepts applicable to various diversified fields such as medical, industrial, environment, agriculture.

PO2: Communication Skills: The Post-graduates will be able to strengthen the communication skills by sharing the concepts of biotechnology through oral presentation and writing research manuscripts.

PO3: Critical thinking: The Post-graduates will understand and demonstrate key practical skills/ competencies in adapting suitable biotechnological techniques, resources and modern instrumentation.

PO4: Problem solving: The Post-graduates will gain knowledge on broader perspective of the discipline biotechnology enabling him/ her to identify challenging societal problems and plan his/her professional career to develop innovative solutions.

PO5: Analytical reasoning: The Post-graduates will be able to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence

and examples, and addressing opposing viewpoints.

PO6: Research-related skills: The Post-graduates will be able design, solve the application-oriented problem in biotechnological field through project-based learning.

PO7: Cooperation/Team work: The Post-graduates will be able to work independently as well as in teams and apply basic ethical principles in all their pursuits.

PO8: Scientific reasoning: The Post-graduates will be able to conduct investigations, analyze, interpret and draw solutions to mitigate the environmental problem using the biotechnological tools.

PO9: Reflective thinking: The Post-graduates will be able to understand the basis of molecular pathogenesis and its diagnosis; the graduate will be equipped to design custom medicine for the infectious/non infectious diseases

PO10: Information/digital literacy: The Post-graduates will be effectively able to manage resources and time using ICT and Computer enabled tools and accomplish ability to understand and communicate the ideas effectively.
PO 11 Self-directed learning: The Post-graduates will have the ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

PO 12 Multicultural competence: The Post-graduates will possess knowledge of the values and beliefs of multiple cultures with a global perspective to effectively engage and interact respectfully with diverse groups.

PO 13: Moral and ethical awareness/reasoning: The Post-graduates will be capable of demonstrating their ability to identify ethical issues, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights.

PO 14: Leadership readiness/qualities: The Post-graduates will be capable for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO 15: Lifelong learning: Post-graduates will carry on to learn and adapt in a world of constantly evolving technology.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO I: The post-graduates of Biotechnology will be able to acquire the in-depth knowledge of the basic and applied subjects of Biotechnology.

PEO II: The post-graduates of Biotechnology will be able to acquire the knowledge and ability to use the concept of theories, practical skills and recent technological tools involving any technological and professional issues independently in a global and societal context.

PEO III: The graduates of Biotechnology will continue to learn to update and to become an entrepreneur in a competitive world and also contribute to all forms of life.

PROGRAMME SPECIFIC OUTCOMEs (PSOs)

To enable the student to

PSO1: Quench the knowledge on fundamental of biotechnological and its related fields.
PSO2: Skilled to work on biotechnological concepts with modern tools and techniques towards product and process development for academic, industrial and research applications.

PROGRAMME OUTCOMES

At the end of the programme, the students will

PO1	**Scientific and Disciplinary Knowledge** Demonstrate advanced and specialized knowledge of the core areas of physics, such as Classical Physics, electromagnetism, quantum mechanics, electronics, mechanics and Industrial Physics.
PO2	**Critical Thinking and Problem Solving** Demonstrate the ability to think critically, reason logically, and make well-informed decisions and apply this deep knowledge to solve complex, real-world problems in the field of physics-related and well-defined research questions and hypotheses.
PO3	**Scientific Reasoning and Design Thinking** Design and conduct experimental, theoretical, or computational research projects to investigate physical phenomena.
PO4	**Research Related Skills** The individual possesses a strong sense of inquiry, problem-solving, hypotheses formulation, data analysis, and the ability to plan, execute, and report experiments.
PO5	**The Physics and society:**

	Understand the role and responsibility of the Professional and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge.
PO6	**Environment and sustainability.** Be aware of the impact of professional scientific solutions in societal and environmental contexts and exhibit the knowledge and the need for Sustainable Development.
PO7	**Ethical Conduct and Social Responsibility:** Adhere to the ethical standards and best practices of the scientific community.
PO8	**Individual and teamwork:** Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
PO9	**Communication Skills:** Effective writing and speaking skills; Share opinions and express oneself confidently using appropriate media; exhibit the ability to listen, read, and write analytically; and communicate complicated information to different groups.
PO10	**Leadership Readiness Skills** Demonstrate leadership skills and the ability to contribute to the advancement of interdisciplinary. Additionally, engage in collaborative teamwork to plan, execute, and present research projects.
PO11	**Self-Directed and Life-long Learning** Engage in continuous learning and professional development to stay updated with the latest developments in the field.
PO12	**Modern Tools,** select, and apply appropriate techniques, resources, modern technology and IT tools including prediction and modelling to complex Scientific activities with an Understand of the limitations Tools.
PO13	**Project Management** Demonstrate knowledge and scientific Understand to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data, and provide solutions. Demonstrate our organizational skills and ability to manage time and resources.
PO14	**Domain Knowledge** Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.
PO15	**Interdisciplinary Skills** Integrate knowledge from different subfields of physics to tackle multidisciplinary challenges.

PROGRAMME SPECIFIC OUTCOMES

- PSO1: Enhance the basic concepts of core areas of Physics especially in mathematical Physics, electromagnetism, classical mechanics, statistical mechanics, Electronics and quantum mechanics for unravelling the diverse phenomena observed in nature.

- PSO2: Perform the general Physics and research-oriented experiments with appropriate analysis for proper interpretation of results; to compete with the latest development in the thrust area of research.

Semester I

24PHP101 CLASSICAL MECHANICS AND SPECIAL RELATIVITY 4H – 4C

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 T**otal**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Moments and product of inertia, Special theory of relativity, Lorentz transformation.

COURSE OBJECTIVES (CO):

- To Understand basics of variational principle, Lagrangian and Hamiltonian formalism
- To Know about central force problem, phase space, canonical transformation and Hamilton Jacobi technique
- To Apply normal mode analysis to physical systems
- To Learn concepts of special relativity and familiarize basics of non-linear dynamics.

COURSE OUTCOMES (COs):

Upon the completion of this course, the students will be able to

Cos	**Course Outcomes**	**Blooms Level**
CO1	Understand basic mathematical tools like variational calculus to mechanical systems and able to compute Lagrangian and Hamiltonian equation of motion	Understand
CO2	Understand central force problem and also system in non-inertial reference frame	Understand
CO3	Analyze mechanics problems through canonical transformation technique and HamiltonJacobi technique	Analyze
CO4	Learn the mechanism of oscillators and rigid body dynamics	Apply
CO5	Study basic concept of special theory of relativity and relativistic mechanics	Understand

UNIT I: DYNAMICS OF SYSTEMS **10 HOURS**

Newton's laws, Dynamical systems, Phase space dynamics, Stability analysis- Central force motions- Two body collisions- Scattering in laboratory and center of mass frames- Constraints and their classification – Variational principle- Generalized coordinates – D'Alembert's Principle- Louville's theorem- Scaling laws- Conservation laws and cyclic coordinates

UNIT- II LAGRANGIAN AND HAMILTONIAN FORMULATION 10 HOURS

Lagrangian Equations of Motion- Hamiltonian formalism and equations of motion- Hamiltonian canonical equation of motion-Physical significance of Hamiltonoian-Advantages of Hamiltonian approach- Relativistic Lagrangian and Hamiltonian for a free particle -Applications of Hamiltonian equation soft motion- simple pendulum, compound pendulum, linear harmonic oscillator- Advantages of canonical equation- condition for ta transformation to the canonical.

UNIT III RIGID BODIES 9 HOURS

Rigid body dynamics: Symmetrical top and fast and sleeping top-moment of inertia tensor- Non inertial frames and pseudoforces- The Euler's Angles-Euler's Theorem- Angular momentum and angular velocity of a rigid body- Moments and product of inertia-Principle axis transformation – rotational kinetic energy of a rigid body – moment of inertia of a rigid body – Equation of motion of a rigid body (Euler's equation)

UNIT IV PHENOMENON OF OSCILLATIONS 10 HOURS

Periodic Motion: Small oscillations, normal modes-Invariance of Maxwell's equations- canonical transformations- Hamilton Jacobi equation for Hamilton characteristics function- Noether's theorem- Stable and unstable equilibrium – two coupled oscillator- Poisson's brackets and Lagrange's bracket

UNIT- V RELATIVITY 9 HOURS

Basic postulates of Special theory of relativity - Lorentz transformation- Relativistic kinematics and mass-energy equivalence- Generalization of Newton's law - Lagrangian formulation of relativistic mechanics — Hamiltonian formulation of relativistic mechanics — Covariant Lagrangian formulation -Covariant Hamiltonian Formulation

TOTAL: 48 HOURS

TEXT BOOKS:

1. AGRAWAL, H. M. (2019). Classical mechanics. NEW AGE INTERNATIONAL PUB..
2. Herbert Goldstein, Charles Poole, John Safko (2002) 'Classical Mechanics' III Edition, Pearson Education, Dorling Kindersley Publication, New Delhi.
3. J. C. Upadyaya (2014) 'Classical Mechanics', Himalaya Publishing House, Mumbai.

REFERENCE BOOKS:

1. B.D.Gupta and SathyaPrakash (2015) Classical Mechanics, Kethernath, Ramnath publications.
2. Tom W.B. Kibble, Frank H. Berkshire (2004) 'Classical Mechanics',Imperial College Press, London.

WEBSITES:

1. https://nptel.ac.in/courses/115105098/
2. https://nptel.ac.in/courses/115106059/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	2	-	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	2	-	2	-	-	-	-	-	-	-	-	-	2	3	2
CO3	3	3	3	3	3	-	-	2	-	-	1	-	1	-	2	3	3
CO4	3	2	2	3	3	-	2	-	-	-	2	-	1	1	2	2	3
CO5	3	3	2	3	3	-	-	-	-	-	1	-	-	-	-	3	3
Average	**3**	**2.8**	**1.8**	**2.4**	**2.8**	**-**	**0.4**	**0.4**	**-**	**-**	**0.8**	**-**	**0.4**	**0.2**	**1.2**	**2.8**	**2.8**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP102	**ELECTRONICS AND AUTOMATION**	**4H – 4C**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Integrated circuit**,** semiconductor, diode, BJT, FET

COURSE OBJECTIVES (CO):

- To improve semiconductor device structures for various applications.
- To give an idea about the basics of electronics and electronic devices, this is very important for knowing the basics of any modern instrument.
- To understand the static and dynamic characteristics of power semiconductor devices
- To enable the students for the selection of devices for different power electronics applications.

COURSE OUTCOMES (COs):

Upon the completion of this course, the students will be able to

COs	**Course Outcomes**	**Blooms Level**
CO1	Understand the basics about discrete components and integrated components including analog and digital circuits.	Understand
CO2	Gain the skill to apply appropriate sensors and measurement instruments for industrial applications.	Apply
CO3	Understand the role of sensors, actuators, programmable logic controllers (PLCs), and industrial networks in automating industrial processes	Understand
CO4	Understand the principles and working of various Sensors and Actuators	Understand
CO5	Design and Analysation of various embedded systems with IoT , AI to environment sustainability.	Analyze

UNIT I - INTRODUCTION OF ELECTRONICS **10 HOURS**

Electronics components: circuits: divider, voltage, current, power, resistor, capacitor, diode, inductor; classification of semiconductor devices. Integrated circuit (IC): op-amp 741, analogue-to-digital converter (ADC), digital-to-analogueue converter (DAC).

UNIT II- SWITCHING DEVICES **10 HOURS**

Transistors: classification; operation, configuration, characteristics of BJT, FET, and MOSFET. Thyristors: classification: working,operation, characteristics, silicon-controlled rectifiers - (SCR);gate turn-off thyristors.

Relay: classification; working; operation; electromechanical relays: SPST-SPDT.

UNIT III - SENSORS AND ACTUATORS **10 HOURS**

Sensors:Types; Classification; Temperature Sensors, Proximity Sensors, Inductive Proximity Sensors, and Hall Effect Proximity Sensors.

Actuators: Types, Classification, Working, Operation, Electric, Hydraulic, and Pneumatic.

UNIT IV - EMBEDDED SYSTEM CONNECTIVITY FOR IOT AND AI **9 HOURS**

Introduction to the Basics of Microprocessors; Function Blocks of Microprocessors; Basics of Microcontrollers - Function Block Diagram; Basic Architecture of Arduino - Pin Description; Basics of IoT, Cloud Computing, and Artificial Intelligence.

UNIT V – AUTOMATION **9 HOURS**

Case study: Illustration block diagram for Automation: Home – Industry - Agricultural- Institution - Health Care - Applications.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Salivahanan, S., & Kumar, N. S. (2012). Electronic Devices and circuits. Tata McGraw-Hill.

2. Balbir Kumar, & Shail B. Jain. (2007). Electronic Devices and circuits. Prentice-Hall of India.
3. Kishore, K. L. (2008). Electronic Devices and circuits. BS Publications.

REFERENCE BOOKS:

1. Senthil Kumar, N., Saravanan, M., & Jeevananthan, S. (2010). Microprocessors and microcontrollers. Oxford University Press.
2. Choudhuri, K. B. R. (2017). Learn Arduino prototyping in 10 days: Your crash course to build innovative devices. Packt Publishing.
3. Internet of Things (2020) , Shriram K Vasudevan , Abhishek S Nagarajan , RMD Sundaram , 2ed Paperback – 9 September.
4. Robotic Process Automation: Lessons Learned from Case Studies.December (2019), 23(4/2019):66-71

WEBSITES:

1. https://www.ipcsglobal.com

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	1	2	1	-	-	-	-	-	-	-	-	2	2	3	3
CO2	3	3	3	3	1	-	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	3	2	-	-	-	-	-	-	2	-	-	-	2	2
CO4	3	2	1	3	1	1	-		-	-	-	-	-	-	-	2	3
CO5	3	2	-	2	2	3	2	3	-	-	-	3	-	-	-	3	3
Average	**3**	**2.2**	**2.4**	**1.8**	**0.4**	**1**	**1**	**0.6**	**0**	**0**	**0**	**1**	**0**	**0.4**	**0.4**	**2.4**	**2.6**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP103 **CONDENSED MATTER PHYSICS** **4H – 4C**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 T**otal**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Bragg's law, Crystal systems, Thermoelectricity, Magnetism, Superconductors

COURSE OBJECTIVES (CO):

- To Study the properties of materials and to choose the correct material for the correct use.
- To interpret an idea about the preparation methods and characterization of different materials.
- To elaborate idea about importance of crystals and their properties.
- To Demonstrate the link between microscopic structure and bulk properties in a variety of systems in hard and soft condensed matter

COURSE OUTCOMES (COs):

Upon the completion of this course, the students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand Macroscopic and microscopic theory of crystalline strcutures and it's properties	Understand
CO2	Analyze the electronic, magnetic and thermal properties of materials	Analyze
CO3	Understand the importance and significance of semiconductors for various applications	Understand
CO4	Explain various types of magnetic phenomenon and applications.	Analyze
CO5	Explicate superconductivity, its properties, important parameters related to possible applications	Apply

UNIT I- CRYSTAL STRUCTURES **10 HOURS**

Introduction to Types of solids. Basics of crystals and crystallographic parameters. The Lattice - Basis - unit cell - Seven types of crystal systems. Bravais lattices- Diffraction and Structure factor- Bonding of solids- The reciprocal lattice and their properties. Symmetry in crystals - point groups and space groups- X- ray Diffraction: Bragg's law – Free electron Theory and Concept of specific heat- Electron-Electron Interactions: Born-Oppenheimer approximation –Structure factor. Crystal defects: Classification of defects - Points defect - line defect – Surface defect – volume defect

UNIT II– THERMAL THEORY OF SOLIDS **10 HOURS**

Response and Relaxation Phenomena – classical theory and Einstein's theory of specific heat – Debye's theory - Intrinsic and extrinsic semiconductors - Free carrier concentration in semiconductors– Mobility of charge carriers – Effect of temperature on mobility – electrical conductivity of semiconductors – Hall Effect and Thermoelectric Power- Electron Motion in a periodic potential – Drude Model of electrical and thermal conductivity-Thermal conductivity of metals

UNIT III – DIELECTRICS **10 HOURS**

Band Theory of solids: Metals, insulators and semiconductors- Dielectrics: Dielectric properties of insulators, Types of polarizations and their polarizability equations- Debye's equations- Dielectric constant and dielectric loss. Applications of dielectric materials. Ferroelectrics: General properties of ferroelectrics, classification and properties of ferroelectric crystals, dipole theory of ferroelectricity, Applications of ferroelectric materials.

Piezoelectricity: General properties of piezoelectric materials and their applications.

UNIT IV – MAGNETISM OF SOLIDS **9 HOURS**

Origin of magnetism; Langevin theory of diamagnetism and Paramagnetism; Quantum theory of paramagnetism; Weiss theory - Hund's rules - Quenching of orbital angular momentum. Cooling by adiabatic demagnetization; Pauli paramagnetism; Ferromagnetism : Curie-Weiss law, Temperature dependence of saturation magnetization – Heisenberg's exchange interaction – Magnons - Ferromagnetic domains – Origin of domains – Coercive force and hysteresis; Ferrimagnetism and anti- ferromagnetism.

UNIT V- SUPERCONDUCTIVITY **9 HOURS**

Introduction to superconductors-Sources of superconductivity – The Meissner effect – Type I and Type II Superconductors - Thermodynamics of superconducting transitions – Origin of energy gap – London equations –London Penetration depth –Coherence length – Josephson junctions – Flux quantization – Theory of DC and AC Josephson effect – Recent high temperature superconductor – Recent applications of superconductivity.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Pillai S.O., 2005, Solid State Physics, 4 th Edition, New Age International Publishers Ltd.
2. Saxena. B.S., R.C.Gupta and P.N.Saxena, 2012, Fundamentals of Solid State Physics, 15thedition, Pragati Prakashan, Meerut.

REFERENCE BOOKS:

1. Kittel. C. 2012, Introduction to Solid State Physics, 8 th Edition, Willey Eastern Ltd., NewDelhi.
2. Neil W Ashcroft, N. DaviMermin, 2021, Solid state physics, Cengage Learning India,New Delhi.
3. Dekkar. A.J., revised edition, 2000, Solid State Physics, Macmillan India Ltd., New Delhi.
4. Keer. H.V. 1 stedition , 2002, Principles of Solid State, New age international., New Delhi.

WEBSITES:

1. https://nptel.ac.in/courses/115106061/

2. https://nptel.ac.in/courses/115101009/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	2	-	2	1	-	-	-	-	-	-	-	-	3	-	2	-
CO3	3	-	-	3	3	-	-	-	-	-	-	2	-	2	-	-	2
CO4	3	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	2	2	-	-	-	-	-	-	-	-	2	-	-	2
Average	**3**	**0.4**	**-**	**2.2**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**0.4**	**-**	**2**	**-**	**1**	**0.8**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP104 **NANOSCIENCE AND NANOTECHNOLOGY** **4H- 4C**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** **T**otal**:100** **End Semester Exam:** 3 Hours

PREREQUISITE:

Nanoscale, Bragg's law, diffraction, Spectroscopy, Energy storation

COURSE OBJECTIVES (CO):

- To introduce the fundamentals of nano-scale engineering and manufacturing.
- To gain knowledge about Current and future applications of nanostructured materials will be reviewed with respect to their impact in commercial products and technologies.
- To Understand key design factors at the nano-scale. Well-established and novel synthesis/fabrication methods
- To nanostructures will be critically discussed giving a broad overview of the state-of-the-artnanomanufacturing processes.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Distinguish different classes of nanostructured materials and nanostructures based on dimension.	Understand
CO2	Explain the fundamental principles of nanotechnology and their application.	Apply
CO3	Apply engineering and physics concepts to the nano-scale and non-continuum domain.	Analyze
CO4	Gain broad Understand of advanced physical techniques employed for the preparation of 1D and 0D nanostructures.	Understand

CO5	Identify and compare state-of-the-art nanofabrication methods and perform a criticalanalysis of the research literature.	Apply

UNIT – I FUNDAMENTALS **10 HOURS**

Historical development of nanomaterials- Introduction Classification of nanomaterials – Nanostructures Nanoscale- Length scales in physics- Carbon Nanotubes (CNT)- Graphenes- Fullerenes- Quantum Dots -Semiconductor Nanoparticles- Metal-based Nanostructures - Nanowires - Nanodendrimers

UNIT-II NOVEL PROPERTIES OF NANOMATERIALS **10 HOURS**

Size and shape dependent properties- Physical & chemical properties, optical, emission, vibrational, thermal, electrical, magnetic, mechanical(Pizeoelectrics), bio-sensing properties- carbon clusters- Excitons, Optical properties and semiconductor nano particles- Nanocomposites

UNIT – III SYNTHESIS METHODS OF NANO MATERIALS **10 HOURS**

Top down and Bottom up approach -Physical Method- Chemical routes: Sol-gel Process, Microemulsion method - Electrochemical methods - hydrothermal. Vapor growth: Thin Film chemical vapor deposition - physical vapor deposition – sputtering - laser ablation - chemical vapor deposition. Mechanical methods: High energy ball milling, mechanical attrition- Preparation of Gold nano particles- Nanolithography

UNIT – IV CHARACTERIZATION **9 HOURS**

X-Ray Diffraction - Fourier Transform Infrared spectroscopy - Raman spectroscopy - UV-visible spectroscopy - Optical Microscopy - Scanning Electron Microscopy- Transmission Electron Microscopy- Atomic Force Microscopy- Electrochemical Impedance Spectroscopy

UNIT – V APPLICATIONS **9 HOURS**

Applications of nanoparticles: quantum dots, nanowires, thin films for photovoltaic devices (LED, solar cells)- Fuel cells- Solar Panels- Wearable flexible electronics- CNT based transistors. Nanoelectronic Devices: Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS) - bio-sensing - Biological/bio-medical applications- High strength nanocomposites.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Poole, C. P., & Owens, F. J. (2003). Introduction to nanotechnology. John Wiley.
2. Kulkarni, S. K. (2015). Nanotechnology: Principles and practices. Springer International Publishing AG.
3. Introduction to nanoscience and nanotechnology. (2021). . PHI Learning.
4. Introduction to Nanoelectronics (2011), V.V. Mitin, V.A. Kochelap and M.A. Stroscio, Cambridge University Press.

REFERENCE BOOKS:

1. Richard Booker, Earl Boysen (2011) Nanotechnology (John Wiley and Sons).
2. Mark C. Hersam (2006), "MSE 376 Nanomaterials," https://nanohub.org/resources/1914.
3. Cambridge University Press.
4. Richard Booker, Earl Boysen, Nanotechnology, John Wiley and Sons.

WEBSITES:

1. https://nptel.ac.in/courses/118102003/
2. https://nptel.ac.in/courses/118104008/
3. https://nanohub.org/resources/7313
4. https://ocw.mit.edu/courses/mechanical-engineering/2-674-micro-nano-engineering-laboratory-spring-2016/lecture-notes/MIT2_674S16_Lec7Nano.pdf

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	2	3	3	-	2	2	-	-	-	-	-	-	2	2	2	2
CO2	3	1	3	3	-		-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	1	-		-	-	-	-	-	2	-	-	-	2	2
CO4	3	3	2		-		-	-	-	-	-	-	-	-	-	2	3
CO5	3	2	1	2	2	3	3	3	-	-	-	3	-	-	-	3	3
Average	**3**	**2.2**	**2.4**	**1.8**	**0.4**	**1**	**1**	**0.6**	**0**	**0**	**0**	**1**	**0**	**0.4**	**0.4**	**2.4**	**2.4**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP105A **INDUSTRIAL PHYSICS** **4H – 4C**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60**
Total**:100** **End Semester Exam:** 3 Hours

PREREQUISITE:

Nondestructive Testing, Sound waves, X-rays, Sound waves

COURSE OBJECTIVES (CO):

- To provide a basic Understand with case studies on different surface NDE techniques.
- To study about Nondestructive Testing (NDT) role in quality control, flaw detection and structural health monitoring covering a wide range of industries
- To apply them for inspecting materials in accordance with industry specifications and standards.
- To imparts the modern trends in measurement techniques.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Enable A basic knowledge of surface NDT techniques	Understand
CO2	Solve various problems encountered like leakage, cracks, blowholes etc with the manufacturing process by Analyze the data.	Analysis
CO3	Equip the students to utilize modern tools and softwares for Analyze and solving real life problems.	Apply
CO4	Differentiate various defect types and select the appropriate NDT methods for better evaluation	Understand
CO5	Document the testing and evaluation of the results and Apply for further analysis.	Apply

UNIT I- INTRODUCTION TO NDT **10 HOURS**

Introduction to Destructive testing - Non-Destructive testing – Relative Merits and Limitations – NDT vs Mechanical testing. Dry technique and Wet technique – Principle – Applications – Advantages and Limitations. Dyes – Developers – Cleaners. Fluorescent penetrant test. Liquid penetrant inspection.

UNIT II- ULTRASONIC TESTING **10 HOURS**

Basic properties of Sound Beam - Sound waves - Velocity of ultrasonic waves - Acoustic pressure - Behaviour of ultrasonic waves - Ultrasonic Transducers - Characteristics of ultrasonic beam - Inspection methods - Normal incident pulse-echo inspection - Normal incident through transmission testing - Angle beam pulse-echo testing -Criteria for probe selection - Flaw sensitivity - Beam divergence - Penetration and resolution - corrosion detection - Ultrasonic flaw detection equipment - Modes of display - A-scan - B-scan - C-scan - Immersion testing - Applications of ultrasonic testing -Advantages - Limitations - Standards.

UNIT III– RADIOGRAPHIC IMAGE TESTING **10 HOURS**

Basic principle - Electromagnetic Radiation Sources -X-ray source - Production of X-rays - High energy X-ray source - Gamma ray sources - Properties of X- and gamma rays - Radiation Attenuation in the specimen - Effect of Radiation in film - Film ionization -Inherent unsharpness- Radiographic Imaging - Geometric factors - Radiographic film - Intensifying screens -Film density - Radiographic sensitivity - Penetrometer - Determining radiographic exposure -Inspection Techniques -Single wall single image technique - Double wall penetration technique.

UNIT IV-EDDY CURRENT TESTING **9 HOURS**

Generation of eddy currents – effect of change of impedance on instrumentation – properties of eddy currents – eddy current sensing elements, probes, type of coil arrangement –applications, advantages, limitations –Factors affecting sensing elements and coil impedance - test part and test system – Signal to noise ratio – equipment's, reference samples, calibration, inspection of tubes, cylinders, Remote Field Sensing - Interpretation/Evaluation.

UNIT V -MAGNETIC PARTICLE TESTING 9 HOURS

Theory of magnetism – ferromagnetic, paramagnetic materials – characteristics of magnetic fields – magnetic hysteresis–magnetization by means of direct and alternating current – surface strength characteristics –Depth of penetration factors– Circular and longitudinal magnetization techniques, current calculation — field produced by a current in a coil, shape and size of coils, field strength.

TOTAL: 48 HOURS

TEXT BOOKS:

1. J. Prasad and C. G. K. Nair (2011) Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition.
2. Non-Destructive Examination and Quality Control (1989), ASM International, Vol.17, 9th edition
3. B.Raj, T. Jayakumar and M. Thavasimuthu (2007) Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition.

REFERENCE BOOKS:

1. Ed. Peter.J. Shull (2002) Nondestructive Evaluation : Theory, Techniques, and Applications, Marcel Dekker.
2. C. Hellier, (2001) Handbook of Non-Destructive Evaluation, McGraw-Hill Professional, 1st edition.
3. B.P.C. Rao, (2006) Practical Eddy Current Testing, Alpha Science International Limited.
4. Practical Nondestructive Testing (2011), Baldev Raj, T. Jayakumar, M. Thavasimuthu,Narosa Publishing House New Delhi.
5. Paul E. Mix, AJohn, (2005) Introduction to Non-Destructive Testing, A Training Guide, 2nd Edition, Wiley & Sons.

WEBSITES:

1. https://nptel.ac.in/courses/113/106/113106070/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	3	1	2	1	2	-	-	-	-	-	-	2	2	3	3
CO2	3	3	2	2	1	1	-	-	-	-	-	-	-	1	-	3	2
CO3	3	3	3	3	2		-		3	2	1	3	-	2	-	2	2
CO4	3	2	1	3	-	-	3		-	1	-	-	2	3	2	2	3
CO5	3	2		2	2	3	2	3	-	-	-	3	-	-	-	3	3
Average	**3**	**2.6**	**1.8**	**2.2**	**1.4**	**1**	**1.4**	**0.6**	**0.6**	**0.6**	**0.2**	**1.2**	**0.4**	**1.6**	**0.8**	**2.6**	**2.6**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP105B INSTRUMENTATION AND MEASUREMENT TECHNIQUES 4H – 4C

Instruction Hours/week: L:4 T:0 P:0 **Marks: Internal:**40 **External:**60 **Total:**100
End Semester Exam: 3 Hours

PREREQUISITE:

Sensors, Amlifiers, Optical fibers, Capacitors

COURSE OBJECTIVES (CO):

- To provide basic concepts of electrical and electronic noises
- To Give a basic idea about different methods of mathematics, used in Physics.
- To introduce students about the methods of mathematical physics
- To develop required experimental skills to solve problems in instrumentation.

COURSE OUTCOMES (COs):

Upon the completion of this course, the students will be able to

Cos	Course Outcomes	Blooms Level
CO1	Design and analyze electronic instrumentation system to interface with standard industrial sensors/ transducers.	Apply
CO2	Understand the instrumentation systems	Understand
CO3	Analyze and specify component and system requirements for installation of instrumentation systems	Analyze
CO4	Implement techniques to reduce electrical noises in measurement circuits	Apply
CO5	Explain the precision and accuracy of a measure as it pertains to international standards	Understand

UNIT I- MEASUREMENTS **10 HOURS**

Accuracy and precision. Significant figures. Error and uncertainty analysis. Types of errors: Gross error, systematic error, random error. Statistical analysis of data (Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square) and curve fitting. Gaussian distribution.

UNIT II - SIGNALS AND SYSTEMS 10 HOURS

Periodic and aperiodic signals. Impulse response, transfer function and Frequency response of first and second order systems. Fluctuations and Noise in measurement system. S/N ratio and Noise figure. Noise in frequency domain. Sources of Noise: Inherent fluctuations, Thermal noise, shot noise, 1/f noise

UNIT III- SENSORS AND TRANSDUCERS 10 HOURS

Input mechanism- Categories of sensors – resistive, voltage generating, variable magnetic coupling, variable capacitance, fiber optic, photomultiplier tubes, ionizing radiation sensors, electronic noses, electrochemical, mechano- electrochemical, velocity sensors, mass flow meters, industrial sensors; Application of sensors to physical measurements

UNIT IV- ANALOGUE AND DIGITAL SIGNAL CONDITIONING 9 HOURS

Differential amplifiers; operational amplifiers; instrumentation amplifiers; active analogue filters, signal processing, charge amplifiers; digital filters; DSP techniques

UNIT V- VACUUM SYSTEMS 9 HOURS

Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system- Chamber, Mechanical pumps, Diffusion pump & Turbo Modular pump, Pumping speed, Pressure gauges (Pirani, Penning, ionization).

TOTAL: 48 HOURS

TEXT BOOKS:

1. Singh, S. K. (2011) Industrial Instrumentation and Control. Tata-McGraw-HillPublishing Company. ISBN-13 :978-0-07-026222-5

2. Northrop, R. B. (2012) Introduction to Instrumentation and Measurement-2nd

Edition.CRC Press, Taylor and Francis Group. ISBN 978-0849-33773-4

3. Placko, D. (2007) Fundamentals of Instrumentation and Measurements. Iste Ltd. ISBN-13: 978-1-905209-39-2

4. Measurement, Instrumentation and Experiment Design in Physics and Engineering (2015), M.Sayer and A. Mansingh, PHI Learning Pvt. Ltd.

Reference Books:

1. Experimental Methods for Engineers, J.P. Holman, McGraw Hill (2009) Introduction toMeasurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt. Ltd

2. Transducers and Instrumentation (2010), D.V.S. Murty, 2nd Edition, PHI Learning Pvt. Ltd.

WEBSITES:

1. https://nptel.ac.in/courses/108105064
2. https://nptel.ac.in/courses/103105130

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	3	1	1	2	-	1	3	3	3	3	2	2	2
CO2	3	-	2	2	3	1	-	2	-	1	2	3	2	3	1	3	2
CO3	-	2	-	2	-	-	-	-	-	-	-	2	-	2	-	-	1
CO4	-	-	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**1.2**	**0.4**	**1**	**1.4**	**1.2**	**0.4**	**0.2**	**0.8**	**-**	**0.2**	**1**	**1.8**	**1**	**1.6**	**0.6**	**1**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester I

24PHP105C **NUMERICAL METHODS IN PHYSICS** **4H – 4C**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Differentiation, Integration,

COURSE OBJECTIVES (CO):

- To equip the students with knowledge of programming in C.
- To introduce simulation techniques to optimize the various parameters in various fields
- To give an idea about different types of computations involved in Physics,
- To improve branch of physics like large scale quantum mechanical calculations.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Implement numerical methods for scientific problems	Understand
CO2	Create, solve and interpret basic mathematical tools	Analyze
CO3	Analyze different techniques for errors in systems	Analyze
CO4	Use the tools, methodologies, language and conventions of physics to test and Communicate ideas and explanations.	Apply
CO5	Identify and describe the characteristics of various numerical methods	Understand

UNIT I - CURVE FITTING **9 HOURS**

The least squares method for fitting a straight line, parabola, power and exponential curves with the help of principle of least square fit.

UNIT II– INTERPOLATION **10 HOURS**

Introduction to finite difference operators - Newton's forward and backward difference interpolation formulae - Lagrange's interpolation formula - Newton's divided difference formula with error term - interpolation in two dimensions - Cubic spline interpolation end conditions. Statistical tests - Ψ^2- test and T-test.

UNIT III- NUMERICAL DIFFERENTIATION AND INTEGRATION **10 HOURS**

Numerical differentiation - errors in numerical differentiation - cubic spline method - finding maxima and minima of a tabulated function - Integration of a function with Trapezoidal Rule - Simpson's 1/3 and 3/8 Rule and error 55 associated with each - Romberg's integration - Gaussian integration method - Monte Carlo evaluation of integrals - numerical double integration

UNIT IV- DIFFERENTIAL EQUATIONS **10 HOURS**

Numerical Solution of Ordinary Differential Equations:Euler method - modified Euler method and Runge - Kutta 4^{th} order methods - adaptive step size R-K method - predictor - corrector methods - Milne's method - Adam-Mouton method.

Numerical Solution of System of Equations**:**Gauss-Jordan elimination Method - Gauss-Seidel iteration method – Gauss elimination method and Gauss-Jordan method to find inverse of a matrix

UNIT V- NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS
9 HOURS

Elementary ideas and basic concepts in finite difference method – Schmidt Method - Crank - Nicholson method - Weighted average implicit method - Concept of stability.

TOTAL: 48 HOURS

TEXT BOOKS:

1. G. Shanker Rao, K. Keshava Reddy (2009) Mathematical Methods, I.K. , 1^{st} edition, International Publishing House, Pvt. Ltd.

2. S.S. Sastry,5^{th} edition (2013), Introductory Methods of Numerical Analysis, PHI Pvt. Ltd.

3. Singaravelu.A,Numerical Methods, (2020) Meenakshi Agencies Pvt.Ltd, Chennai.

REFERENCE BOOKS:

1. Tao Pang, 1st edition (2006) An Introduction to Computational Physics, Cambridge University Press

2. James B Scarborough (2008) Numerical Mathematical Analysis,6th Edition Oxford &Ibh Publishing Co. Pvt Ltd.

WEBSITES:

1. https://nptel.ac.in/courses/115106118/
2. https://nptel.ac.in/courses/115104095/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	-	2
CO2	-	3	3	-	-	-	3	2	-	-	-	3	3	3	-	-	-
CO3	-	3	3	3	-	-	-	-	-	-	-	3	-	3	-	2	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	-	3	-	2	-
CO5	-	2	3	-	-	-	-	2	-	-	2	2	-	2	-	2	2
Average	**1.2**	**2.8**	**3**	**1.8**	**0.6**	**-**	**0.6**	**0.8**	**-**	**-**	**0.4**	**2**	**0.6**	**2.8**	**-**	**1.2**	**0.8**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester I

24PHP111 GENERAL PHYSICS PRACTICAL - I 4H – 2C

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Viscocity, Young's modulus, Specific heat capacity, Photoelectric effect

COURSE OBJECTIVE (CO):

- To gain practical knowledge by Apply the experimental methods to correlate with the Physics theory.
- To learn the usage of optical systems for various measurements.
- To apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

COURSE OUTCOMES (COs):

Upon the completion of this course, the students will be able to

Cos	Course Outcomes	Blooms Level
CO1	Apply the analytical techniques and graphical analysis to the experimental data.	Apply
CO2	Verify laws studied in the different theory course.	Analyze
CO3	Measure different properties of materials	Analyze
CO4	Built own equipments for measuring the properties of materials	Apply
CO5	Classify the materials with the properties	Understand

ANY TEN EXPERIMENTS

1. Young's Modulus – Elliptical Fringes (Cornu's method).
2. Viscosity of liquid – Mayer's oscillating disc method.
3. Michelson Interferometer – Determination of λ and dλ.
4. 'e/m' by Thomson's method and Magnetron method.
5. Young's Modulus – Hyperbolic Fringes (Cornu's method).
6. Determination of Plank's constant using Photo cell.
7. Forbe's method – Thermal conductivity.
8. 'e' by Millikan's method.
9. Ferguson's method - Specific heat of a liquid.
10. Faraday effect – Determination of Verdet constant using He-Ne laser.
11. Cornu's Method – Determination of Elastic Constants of Transparent Materials
12. Kerr effect –determination of Kerr constant of a Liquid.
13. To determine reduction factor K using Helmholtz Galvanometer.
14. To determination of wavelength of monochromatic source by Acoustic Diffraction method.
15. To determine theenergy of electron in-elastic scattering: Frank-Hertz experiment.

TEXT BOOKS:

1. Ouseph C.C., U.J. Rao and V. Vijayendran (2009), Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai
2. Singh S.P., (2003), Advanced Practical Physics – 1, 13th Edition, PragathiPrakashan, Meerut

REFERENCE BOOKS:

1. Gupta S.L. and V.Kumar (2002), Practical Physics, 25th Edition, PragathiPrakashan, Meerut

2. B.L Worsnop& H T Flint (1951), Advanced Practical Physics For Students, 9th revised Edition,Littlehampton Book Services Ltd.

WEBSITES:

1. https://nptel.ac.in/courses/115105110/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	2	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-	3
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	2	-
CO3	3	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	3
CO4	3	-	-	2	3	-	-	2	-	-	-	2	1	2	-	-	2
CO5	3	-	-	-	2	-	-	-	-	-	-	-	-	3	-	-	3
Average	**2.8**	**1**	**0.4**	**1.2**	**1**	**-**	**-**	**0.4**	**-**	**-**	**-**	**0.4**	**0.6**	**2**	**-**	**0.4**	**2.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP112 **ELECTRONICS PRACTICAL – I** **4H – 2**

Instruction Hours/week: L:0 T:0 P: 4 **Marks:** Internal**:40** External**:60 T**otal**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Integrated circuits, Operational amplifiers, FET, UJT

Course Objectives:

- To gain practical knowledge by Apply the experimental methods to correlate with the Physics theory.
- To learn the usage of optical systems for various measurements.
- To apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientificconcepts in a group.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Gain the knowledge in quantization of electromagnetic fields.	Understand
CO2	Measure different properties of materials	Apply
CO3	Analyze the characteristics of oscillators and wave shaping circuits	Analyze
CO4	Understand the basic concepts of amplifiers and operational amplifier.	Understand
CO5	Design and handle various instruments.	Apply

ANY TEN EXPERIMENTS

1. Construct and verify the output of the IC regulated power supply.

2. Find the Hysterisis of IC 555 - Schmitt Trigger and plot the response.
3. Construct and verify the output of Instrumentation Amplifier using four IC 741
4. Design and construct high pass and low pass , filter using IC 741 and plot the frequency response curve.
5. Design and construct RC coupled amplifier and plot the frequency response curve.
6. Wave form generators (Square wave and Triangular wave) – Op amp.
7. Wein's bridge oscillator – Op amp.
8. Astable and monostable using discrete components.
9. Analog computer setup – Solving simultaneous equations.
10. Design and construct Differential amplifiers and plot the frequency response curve
11. FET characteristics and Source follower.
12. UJT Characteristics

TEXT BOOKS:

1. Ouseph C.C., U.J. Rao and V. Vijayendran (2007), Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai
2. Singh S.P., (2003), Advanced Practical Physics – 1, 13th Edition, PragathiPrakashan, Meerut

REFERENCE BOOKS:

1. Singh S.P., (2000), Advanced Practical Physics – 2, 12th Edition, PragathiPrakashan, Meerut
2. Ramakant A. Gayakwad, (2002), Op-amp and Linear Integrated Circuits,4th Edition, Prentice Hall

WEBSITES:

1. https://nptel.ac.in/courses/122106025/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	2	2	1	-	1	1	1	-	-	-	-	-	-	3	2
CO2	3	3	3	3	1	-	1	1	1	-	-	-	-	-	-	3	2
CO3	3	2	1	-	1	-	1	1	1	-	-	-	-	-	-	3	2
CO4	2	2	1	1	1	-	1	1	1	-	-	-	-	-	-	3	2
CO5	3	3	2	1	1	-	1	1	1	-	-	-	-	-	-	3	2
Average	**2.8**	**2.6**	**1.8**	**1.4**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Value Added Course

BASIC DOMESTIC ELECTRICAL APPLIANCES AND SERVICING

Instruction Hours/week: L:0 T:0 P: 0 **Marks:** Internal**: 100** External**:- T**otal**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Electrical circuits, Electrical components, Network theorems

Course Objectives:

- To create awareness about types and handling of domestic appliances
- To acquire knowledge about principle of operation, working and application of various domestic appliances.
- To acquire skills in assembly, repair, installation, testing and maintenance of domestic appliances.
- To acquire skills in entrepreneurship

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Repair maintenance of the basic electrical and electronics appliances	Apply
CO2	Identification to protective devices	Understand
CO3	Do domestic wring and maintenance	Analyze
CO4	Repair and maintenance of the split Vacuum Cleaner and washing machine	Understand
CO5	Acquire knowledge about tools, equipment and Instruments	Apply

UNIT – I Instruments and Testing

Introduction – Voltage tester screwdriver – Continuing Test – Insulation test – Measurement of Power for DC & AC Circuits.

Electrical Cooking Appliances Introduction – Types – Construction – Electric Toaster – Types – Automatic and Non-Automatic.

Electric Iron Box Types – Non-Automatic – Automatic – Construction and Working – Comparision – Trouble Shooting – Steam Iron Box.

UNIT - II Water Heaters & Coffee makers

Water Heater – Function – Types – Electric Kettle – Immersion water heater – Construction and working – storage water heaters – Non pressure type – pressure type – construction and working – repairs & remedies – Coffee maker – types – construction and working of percolator type.

UNIT - III Electric Mixer & Egg beaters

Electric Maker – Function – Construction – General Operating Instruction – Caution – Cleaning – Repairs and Remedies – Egg beaters – Hand operated crank type – Electric type – Construction.

UNIT - IV Vacuum Cleaner and washing machine

Vacuum Cleaner – Function – Principle – Main components – features – types - working – accessories - Filters – Repairing. Washing Machine – Function – Types – Semi and Fully Automatic – Top and Front loading – washing technique – working cycle – construction and working of washing machine – comparison of Top ` – Types – Construction and working – safety features – repairs & remedies.

TEXT BOOKS:

1. Electrical Practical , Directorate General of employment & training (DGET), Arihant Publisher, Edition: 2018

REFERENCE BOOKS:

1. Handbook of Repair and Maintenance of Domestic Electronics Appliances handbook By Shashi Bhushan Sinha, BPB Publications

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	2	-	2	2	-	-	2	3	-	2	2	-	2	-	-	-	-
CO2	2	-	2	2	-	-	3	2	-	-	2	2	2	2	-	-	-
CO3	2	-	2	-	-	-	2	3	-	-	2	-	1	2	-	-	-
CO4	2	-	2	2	-	-	2	3	-	-	2	-	2	2	2	-	-
CO5	2	-	2	2	-	-	2	3	-	-	1	-	2	2	2	-	-
Average	**2**	-	**2**	**1.6**	**-**	**-**	**2.2**	**2.8**	**-**	**0.4**	**1.8**	**0.4**	**2.8**	**1.6**	**0.8**	-	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP201 ELECTROMAGNETIC THEORY AND ELECTRODYNAMICS 4H- 4C

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** **Total:100** **End Semester Exam:** 3 Hours

PREREQUISITE:

Dielectrics, Polarization, Gauss law, Electromagnetic waves, Total internal reflection

COURSE OBJECTIVES (CO):

- The aim of this course is to provide the students with the fundamental principles of electrical energy (electro- magnetism).
- To expose the students to the ideas of electromagnetic waves and structure of transmission line
- To apply the Maxwell's equations and to solving practical electromagnetic fields
- To understand the propagation of EM wave in free space, conductors & dielectrics.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Define and derive expressions for the energy both for the electrostatic and magnetostatic fields, and derive Poyntings theorem from Maxwells equations and interpret the terms in the theorem physically	Understand
CO2	Understand the basic concepts of electrodynamics	Understand
CO3	Formulate potential problems within electrostatics and magnetostatics	Apply
CO4	Analyze the theories and properties of electrostatics	Analyze
CO5	Analyze the interaction of electrostatic properties with matter.	Analyze

UNIT- I ELECTROSTATICS& MAGNETOSTATICS 10 HOURS

Electrostatics: Electric intensity – Electric potential – Gauss Law - Dielectric and its polarization - Electric displacement D – Dielectric constant ε_r – Polarisibiltiyα - Clausius-Mossotti relation (Non-polar molecules) – The Langevin equation (Polar molecules) – Electrostatic energy

Magnetostatics: Current density J – Ampere's law of force – Biot-Savart law – Ampere's circuital law – Magnetic scalar potential ϕ_m (no applications) – Magnetic vector potential A – Magnetisation and magnetization current – Magnetic intensity – Magnetic susceptibility and Permeability.

UNIT- II FIELD EQUATIONS AND CONSERVATION LAWS 9 HOURS

Equation of continuity - Displacement currents - The Maxwell's equations derivations - physical significance - Poynting vector - Electro magnetic potentials A and ϕ - Maxwell's equations in terms of Electro magnetic potentials - Concept of gauge -Lorentz gauge - Coulomb gauge

UNIT- III ELECTROMAGNEITC WAVE PROPAGATION 9 HOURS

Propagation of Electromagnetic Waves: Electromagnetic waves in Free space - Isotropic dielectric - Anisotropic dielectric – Conducting media - Ionized gases.

Radiating systems: Oscillating electric dipole – Radiation from an oscillating dipole – Radiation from small current element.

UNIT- IV INTERACTION OF E.M.WAVES WITH MATTER 10 HOURS

Interaction of E.M.Waves with matter (Macroscopic): Boundary conditions at interfaces - Reflection and refraction – Frenel's laws-Brewster's law and degree of polarization - Total internal reflection and critical angle.

Interaction of E.M.Waves with matter (Microscopic): Scattering and Scattering parameters - Scattering by a free electron (Thomson Scattering) - Scattering by a Bound electron (Rayleigh scattering) – Dispersion Normal and Anomalous – Dispersion in gases (Lorentz theory) – Dispersion in liquids and solids.

UNIT – V RELATIVISTIC ELECTRODYNAMICS 10 HOURS

Purview of special theory of relativity – 4-vectors and Tensors - Transformation equations for charge and current densities J and ρ – For electromagnetic potentials A and ϕ - Electromagnetic field tensor $F_{\mu\nu}$ - Transformation equations for the field vectors E and B - Covariance of field equations in terms of 4-vectors - Covariance of Maxwell equations in 4-tensor forms – Covariance and transformation law of Lorentz force.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Gupta, Kumar and Singh, (2007), Electro dynamics, 19th Edition, Pragati Prakasan, Meerut, New Delhi.

2. Satya Prakash 10th revised (2003), Electromagnetic theory and Electro dynamics, Kedar Nath Ram Nath & Co, Meerut.

REFERENCE BOOKS:

1. Chopra & Agarwal (2004), Electromagnetic theory, 6th Edition, Nath & Co, Meerut.

2. Griffiths D., (2013), Introduction to Electrodynamics, 4th Edition, Printice Hall of India, New Delhi.

3. Paul Lorrain and Dale R Corson (2015), Electromagnetic fields and waves, 3rd Edition, W. H. Freeman and Company New York.

4. Jacson. J.D., (2009), Classical Electro dynamics, 3rd Edition, Willey Eastern, New Delhi.

WEBSITES:

1. https://nptel.ac.in/courses/115101008/

2. https://nptel.ac.in/content/syllabus_pdf/104104085.pdf

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
Average	**2.4**	**1.8**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP202 **MATHEMATICAL PHYSICS** **4H – 4**

Instruction Hours/week: L:4 T:0 P:0 Marks**:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Vector, Matrix, Fourier transform, Integration, differentiation, Laplace Transform

COURSE OBJECTIVES (CO)

- To Understand basics of vector analysis, curvilinear coordinate system, linear vector space and tensors
- To Familiarize infinite series and error analysis
- To Learn complex variables and residue theorem technique to solve real integrals appearing inphysics problems.
- To Understand differential equations and self adjoint operators

Course Outcomes

At the end of this course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand vector calculus and also able to write operators in different coordinate system	Understand
CO2	Apply linear vector space concepts in mathematical physics	Apply
CO3	Understand convergence of infinite series, error analysis and curve fitting	Understand
CO4	Analyze the real integrals appearing in science and engineering problems	Analyze
CO5	Solve differential equations and understand self adjoint operators used in mathematical physics	Apply

UNIT I VECTOR SPACE, MATRICES AND GROUP THEORY 10 HOURS

Definition of vector space – Linear dependence – Linear independence – Basis – Dimension of a vector space – Schmidt orthogonalization process – Inner product.

The Algebra of matrix- special matrices (orthogonal, unitary and Hermition), properties and applications-solution of linear equation- linear transformation - Eigen values and Eigen Functions-Caley-Hamilton's theorem and applications –Diagonalisation.- Introductory group theory

UNIT II TENSORS AND COMPLEX VARIABLE 10 HOURS

Definition of tensors - Contravariant, Covariant ,Mixed Tensor -Rank of a Tensor –Kronecker delta symbol – symmetric and antisymmetric tensors – Invariant tensors. Quotient law- Metric tensor - Conjugate tensor.

Functions of a complex variable – single and multivalued functions – Cauchy-Riemann differential equation – analytical – Cauchy's integral theorem and integral formula – Liouville's theorem - Taylor's series – Laurent's series - Residues and their evaluation - Cauchy's residue theorem – application to the evaluation of definite integrals.

UNIT III FOURIER TRANSFORM AND LAPLACE TRANSFORM 10 HOURS

Introduction to Fourier Series – Dirichlet's Theorem and Dirichlet's Conditions– change of interval – complex form – Fourier series in the interval (0, T) –Fourier transform- Properties– Fourier transform of derivatives – Fourier sine and cosine transforms of derivatives – Fourier transform of functions of two or three variables. Applications

Laplace Transform

Properties of Laplace transforms – Laplace Transform of derivative of a function – Laplace transform of integral – Laplace transform of periodic functions - Inverse Laplace Transform – Fourier Mellin Theorem -– Convolution theorem – Applications

UNIT IV Ordinary and Partial Differential Equations 9 HOURS

First and Second Order Ordinary Differential Equations with Constant Coefficients – Initial Value Problem – Method of Finding Solutions –Definition of Ordinary and Singular Points – Power Series Solution – Solutions About Ordinary Point and Singular Point. Characteristics and boundary condition for PDEs - Solution of heat flow equation (Method of separation of variables) – Linear flow in semi infinite solid – Variable linear flow in an infinite bar – two and three dimensional

heat flow – Heat flow in circular plate (use of cylindrical co ordinates) – Equation of motion for the vibrating string – Vibrations of a rectangular membrane

UNIT V SPECIAL FUNCTIONS AND ELEMENTS OF COMPUTATIONAL TECHNIQUES 9 HOURS

Basic properties of gamma and beta functions-Legendre's polynomials and functions – Hermite differential equation and Hermite polynomials - Bessel function – Second order Bessel function Rodrigues formula – recurrence relations –Lagurae Polynomials –Differential equation and solution - recurrence relations – generating functions- -Laguerre function - recurrence relations – generating functions - root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using RungeKutta method. Finite difference methods

TOTAL: 48 HOURS

TEXT BOOKS:

1. Satya Prakash., (2002). Mathematical Physics , 4th edition, S.Chand& Co, New Delhi.
2. Gupta.B.D., (2002), .Mathematical Physics, 2nd edition, Vikas publishing company, New Delhi.
3. Singaravelu.V., (2008). Numerical methods, 2nd edition, Meenakshi publications, Sirkali.
4. Rajput.B.S., (2003). Mathematical Physics, 16th edition, PragatiPrakashan, Meerut.

Reference Books:

1. Venkataraman.M.K., (2003). Numerical methods in Science & Engineering, 5th edition, The National Publishing Company, Chennai.
2. Butkov, (2007), Mathematical Physics, Addison Wesley, New York
3. A.W. Joshi, (2008), Tensors and Matrices, reprint, Wiley Interscience, New York.
4. George B. Arfken, Hans J. Weber, Frank E. Harris, 7 edition, (2012) Academic Press

WEBSITES:

1. https://nptel.ac.in/courses/115103036/
2. https://nptel.ac.in/courses/115105097/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	3	2	1	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	-	2	-	2	2
CO3	2	3	3	3	2	-	-	-	-	-	-	-	-	-	-	3	1
CO4	3	3	3	2	-	-	-	-	-	-	-	-	-	2	-	3	-
CO5	-	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2	-
Average	**2.2**	**3**	**2.8**	**2.2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**2.6**	**0.6**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP203 THERMODYNAMICS AND STATISTICAL MECHANICS 4H – 4

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Thermodynamics, Blackbody radiation

COURSE OBJECTIVES (CO):

- To introduce the concepts of statistical Thermodynamics.
- To Consolidate the Understand of the laws of thermodynamics and a systematic definition of thermodynamic potentials as the general formalism of thermodynamics.
- To know the foundations of equilibrium statistical physics as the microscopic theory of matter and fields.
- To apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	**Course Outcomes**	**Blooms Level**
CO1	Describe the laws of thermodynamics from both a macroscopic and microscopic point of view.	Understand
CO2	Apply the laws of thermodynamics to real physical systems and processes	Apply
CO3	Use the statistical physics methods, such as Boltzmann distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in physical systems.	Analyze
CO4	Describe the differences between systems of bosons and fermions and how these arise from microscopic consideration	Understand

CO5	Apply the concepts and laws of thermodynamics to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.	Apply

UNIT- I LAWS OF THERMODYNAMICS 10 HOURS

Laws of thermodynamics and basic defenitions−Adiabatic equation of a perfect gas- Thermodynamic potentials- Examples from classical and quantum physics- – Thermodynamic probability –Boltzman entropy relation.

Maxwell relations-Calculation of entropy changes in reversible processes. The principle of increase of entropy − The Clausius-Clayperon equation − Van der Waals equation of state- virial theorem- Limitations of Van der Waals equation of state.

UNIT- I KINETIC THEORY 9 HOURS

Assumptions of kinetic theory-Distribution function and its evolution − Boltzmann transport equation and its validity − Boltzmann's H-theorem − Transport phenomena: Diffusion-conductivity-Viscosity- Brownian motion and its sailent features-Mean free path–Expression for mean free path-Experimental determination-Zero order approximation - First order approximation

UNIT- III CLASSICAL STATISTICAL MECHANICS 10 HOURS

Maxwell Boltzmann distribution law: Evaluation of constants - Maxwell's law of distribution of velocities - Most probable speed, Average speed, Root mean square speed - Principle of equipartition of energy - Partition function - Condition for applicability of M.B statistics - Non degenerate and degenerate systems - Maxwell velocity distribution in a given direction - Total internal energy of an ideal gas - Molar heat capacity of a gas at constant volume – Entropy - Helmholtz free energy - Pressure and equation of state of an ideal gas - Limitation of M.B method

UNIT- IV QUANTUM STATISTICAL MECHANICS 10 HOURS

Necessisty of quantum statistical mechanics – Difference between classical and quantum statistics -Derivation of Bose-Einstein and Fermi-Dirac distributions through microcanonical and grand canonical ensembles B.E energy distribution for energies in the range E to E + dE – Condition for B.E distribution to approach classical M.B distribution –Ensembles and its types. FD law for the energies in the range E to E+dE –Energy distribution curve - Free electron in a metal - Fermi

temperature - Calculating the partition function for Bosons and Fermions-Comparison of MB,BE and FD statistics.

UNIT -V APPLICATIONS OF QUANTUM STATISTICAL MECHANICS 9 HOURS

Weakly degenerate Bose and Fermi gas – Strongly degenerate Bose gas – Bose-Einstein Condensation – Strongly degenerate Fermi gas at low temperature and high temperatures – Fermi energy and Fermi momentum –Black body radiation – Planck's distribution law – Thermionic emission – Liquid Helium and its properties –Ising Model.

TOTAL: 48 HOURS

TEXT BOOKS:

1. S.C.Garg, R.M. Bansal, C.F. Ghosh (2012)Thermal Physics, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.

2. Sathya Prakash and Agarwal J.P., (2021) Statistical MechanicsKedar Nath Ram.

3. Agarwal B.K. and M. Eisner, 3rd edition, (2013), Statistical Mechanics, New age international Limited, New Delhi.

4. Reif F., (2008), Fundamentals of Statistical and Thermal Physics, (Reprint), McGraw Hill International Edition, Singapore.

5. Gupta and Kumar, reprint, (2014), Elements of Statistical Mechanics, Pragati Prakashan, Meerut.

REFERENCE BOOKS:

1. Sears N. and L. Salinger (2013), Thermodynamics, 3rd Ed., Narosa Publishing House, New Delhi.

2. Greiner W., L. Neise and H. Stocker, 1st edition, (2007), Thermodynamics and Statistical Mechanics, Springer Verlag, New York.

3. Singh. K. and S.P. Singh reprint (2016), Elements of Statistical Mechanics, S. Chand & Company Ltd., New Delhi.

4. A B Gupta and H.P.Roy, (2019) Thermal Physics, Books and Sllied (P) Ltd, Kolkata.

WEBSITES:

1. https://nptel.ac.in/courses/115103113/
2. https://nptel.ac.in/courses/115/103/115103028/
3. https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/lecture-notes/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	2	2	2	1	1	-	-	-	-	1	-	-	2	2	3	2
CO2	3	1	3	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	1	-	-	-	-	-	-	1	2	-	-	-	2	2
CO4	3	3	2	3	-	1	-	-	-	-	-	-	-	-	-	2	3
CO5	3	2	2	2	2	1	-	-	2	2	-	3	-	-	-	3	3
Average	**3**	**2.2**	**2.4**	**2.2**	**0.6**	**0.6**	**0**	**0**	**0.4**	**0.4**	**0.4**	**1**	**0**	**0.4**	**0.4**	**2.6**	**2.6**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP204 **LASER AND OPTICS** **4H – 4**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Reflection, Refraction, Coherence, Fiber optics

COURSE OBJECTIVES (CO):

- To give exposure to students about the characteristics of different lasers, their fabrication techniques, applications etc.
- To make the student understand the principles of Lasers
- To enable the student to explore the field of Nonlinear optics
- To be able to apply the fundamental concepts of optics in *lasers*, optical fiber communications and optoelectronics

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Acquire fundamentals , Principles of Laser action and Understand the basic conceptsof different types of lasers	Understand
CO2	Describe modes in multimode fibers and mode field parameter in single-mode fibers	Understand
CO3	Differntiate the absorption and spontaneous and stimulated emission in two level system	Analyze
CO4	Operate and analyze the properties of laser ,Types of laser and its application..	Apply
CO5	Explain and Classify fibers as single-mode, multimode step index and multi-mode graded index.	Apply

UNIT – I INTRODUCTION **8 HOURS**

Stimulated absorption, Spontaeous and stimulated emission- Einstein A & B coefficients- Optical Pumpting- Population Inversion- Polarization – Scattering and polarization – Circular and elliptical polarization – Matrix representation – Orthogonal polarization – Reflection and refraction of a plane boundary – Amplitudes of reflected and refracted waves – Brewster's angle.

UNIT - II COHERENCE **8 HOURS**

Theory of partial coherence – Coherence time and coherence length – Spectral resolution of a finite wave train – Coherence and line width – Spatial coherence – Ruby laser and it's applications– Extended sources – The Van Cittert Jernike theorem – Measurement of Stellar diameter – Hanbury Brown Twiss intensity interferometry – Fabry Perot interferometer – Theory of multi layer films.

UNIT - III FIBER OPTICS **8 HOURS**

Propagation of light in an optical fiber – Acceptance angle – Numerical aperture – step and graded index fibers – Fiber fabrication techniques – Optical fiber as cylindrical wave guide – wave guide equations – Wave equations in step index fibers. Fiber optic switches – integrated optical fiber and its applications – long haul communication.

UNIT -IV ENERGY LEVELS **8 HOURS**

Thermal equilibrium – Einstein's relations – Condition for large simulated emissions – Condition for light amplification – line shape function – Population Inversion – Pumping methods – Threshold condition – Critical population inversion – Line broadening – Cavity configurations – Modes – Laser rate equations (two. three, four level systems)

UNIT - V Q SWITCHING **8 HOURS**

Methods of Q switching – Peak power – Laser amplifiers – Mode locking – Distributed feedback laser – Material working – Isotope separation– Measurement of distance – Laser in medicine- Holography: Principle of holography – Theory - Some distinguishing characteristics of holographs -practical applications of holography - Advances in holography Masers – the two-level maser system - Ammonia maser-Hydrogen maser-Three level maser system.Applications of Lasers.

TOTAL: 40 HOURS

TEXT BOOKS:

1. Fowles. G.R. and Holt (1975), Introduction to modern optics, Rincharf and Winstron Inc. New York. (Units I and II)

2. Stewart D. Personick, (1989), Fibre optics technology and its applications – Khanna publishers, Delhi. (Unit III)

3. Laud. B.B., (2004), Lasers and Non-linear optics, New Age International, New Delhi. (Units IV and V)

4. Max Born and Emil Wolf (1999), Principles of optics, Cambridge University Press, Cambridge.

REFERENCE BOOKS:

1. Nussbaum. A. and R.A. Philips (1976), Contemporary optics – Prentice Hall, Englewood

2. Cliffs, NJ.Wood. R.W, (2010), Physical Optics, Dover Publications, Inc, New York

3. Ghatak. A.K. and K.Thyagarajan, (2000), Contemporary Optics, Macmillan India Limited, Chennai.

4. Albert K. Levine, (1971-1972), Lasers Vol. I, II, III & IV, Marcel Dekker Inc. New York

5. Jenkins and White, (2001), Fundamentals of Optics, 4th Edition, Mc-Graw Hill, New York.

6. Ghatak. A.K. and K Thyagarajan, (2003), Lasers: Theory and Applications, Macmillan India Limited, Chennai.

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc22_ph19/preview

2. https://ocw.mit.edu/courses/res-6-005-Understand-lasers-and-fiberoptics-spring-2008/resources/laser-fundamentals-i/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	2	2	1	-	2	1	1	-	-	-	-	-	-	3	2
CO2	3	3	3	3	1	-	1	1	1	-	-	-	-	-	-	3	2
CO3	3	2	1	-	1	-	1	1	1	-	-	-	-	-	-	3	2
CO4	2	2	1	1	1	-	1	1	1	-	-	-	-	-	-	3	2
CO5	3	3	2	1	1	-	2	3	1	-	-	-	-	-	-	3	2
Average	**2.8**	**2.6**	**1.8**	**1.4**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP205A RENEWABLE ENERGY SOURCES AND APPLICATIONS 4H – 4

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Renewable energy, Photosynthesis, Wind power, Tidal power

COURSE OBJECTIVES (CO):

- To understand energy scenario, energy sources and theirutilization.
- To explore society's present needs and future energy demands.
- To Study the principles of renewable energy conversionsystems.
- To exposed to energy conservation methods.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Describe the environmental aspects of renewable energy resources. In Comparison with various conventional energy systems, their prospects and limitations.	Understand
CO2	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation	Analyze
CO3	Understand the concept of biomass energy resources and green energy	Analyze
CO4	Understand the conversion principles of wind and tidal energy	Understand
CO5	Acquire the basic knowledge of ocean thermal energy conversion and hydrogen energy	Apply

UNIT- I PRINCIPLES OF RENEWABLE ENERGY **8 HOURS**

Introduction: Energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).

UNIT- II SOLAR ENERGY **8 HOURS**

Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder.Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.

UNIT- III WIND ENERGY **8 HOURS**

Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and muliblade system. Vertical axis- Savonius and darrieus types. Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft) .

UNIT- IV TIDAL POWER **8 HOURS**

Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations. Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems associated with OTEC.

UNIT- V GREEN ENERGY **8 HOURS**

Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, ZeroenergyConcepts.Benefits of hydrogen energy, hydrogen production technologies (electrolysis

method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.

TOTAL: 40 HOURS

TEXT BOOKS:

1. G.D.Rai, (2011) , Non conventional energy sources, Khanna Publishers
2. H P Garg & Prakash, (2000), Solar Energy -Fundementals and Applications ,First Revised Edition Tata McGraw-Hill Education, New Delhi.
3. S.P.Sukhatme. (2008) , Solar Energy, Tata McGraw-Hill Publishing Co. Ltd.
4. D. Mukherjee and S. Chakrabarti, (2005), Fundamentals of Renewable Energy Systems, New Age International Publishers.

REFERENCE BOOKS:

1. Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, (2020) Fundamentals and Applications of Renewable Energy | Indian Edition McGraw Hill Education (India) Private Limited.
2. D.S. Chauhan and S.K.Srivastava. (2004), Non Conventional Energy Resources, New Age International Publishers.

WEBSITES:

1. https://nptel.ac.in/courses/112105050/
2. https://nptel.ac.in/courses/115107116/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	-	-	3	3	3	3	3	2	-	-	-	-	-	2	-	2	-
CO2	2	-	2	3	2	2	2	2	-	-	-	-	2	2	-	-	2
CO3	3	-	-	-	2	3	3	3	-	-	-	-	-	2	-	-	-
CO4	3	-	-	2	2	3	3	-	-	-	-	-	-	2	-	-	-
CO5	3	-	-	-	2	3	2	-	-	-	-	-	-	-	-	-	-
Average	**2.2**	**-**	**1**	**1.6**	**2.2**	**2.8**	**2.6**	**1.4**	**-**	**-**	**-**	**-**	**0.4**	**1.6**	**-**	**0.4**	**0.4**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP205B **THIN FILM PHYSICS** **4H – 4**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Thin fim, vaccum, Dielectrics, Capacitors

COURSE OBJECTIVES (CO):

- To develop an intuition for surface and thin film physical principles through plotting of functions using Maple
- To relate the mathematical results to practical applications and experiments in thin film techniques.
- To Develop an appreciation of the mathematical basis for experimental techniques for deposition and analysis of thin films
- To demonstrate knowledge of different thin film deposition strategies

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Discuss the differences and similarities between different vacuum based deposition techniques	Understand
CO2	The importance of use of thin films in application and research.	Apply
CO3	Select proper deposition techniques for various applications.	Analyze
CO4	Amalyze and use models for nucleating and growth of thin films	Understand
CO5	Apply the relation between deposition technique, film structure, and film properties, discuss typical thin film applications,	Apply

UNIT I -GROWTH AND STRUCTURE OF FILMS 8 HOURS

General features - Nucleation theories - Four stages of film growth incorporation of defects during growth - Thin film structures - Structural defects.

Thickness Measurement Methods: Electrical methods Mass methods – Optical interference method – Photometric – Ellipsometry – multiple beam Interferometry – FECO -Fizeau's technique.

UNIT II - PREPARATION OF THIN FILMS 8 HOURS

Creation of vaccum-rotary and diffusion pumps – measurement of vacuum-penny and piranigauage- Physical methods: thermal evaporation - Sputtering mechanism and methods – RF sputtering - DC planar magnetron sputtering- Epitaxy methods – Molecular beam epitaxy (MBE). Chemical methods: chemical vapour deposition and chemical solution deposition techniques - spray pyrolysis - laser ablation.

UNIT III - ELECTRICAL PROPERTIES OF THIN FILMS 8 HOURS

Electrical conduction in metallic film-conduction mechanism in Discontineous and contineous film - Semiconducting film- Theoretical considerations-Size effects – Thin film transistor – Insulator film - Dielectric properties - Effect of film thickness on dielectric properties - Dielectric losses- Different mechanism involved in insulator film-Piezoelectric film.

UNIT IV - MAGNETIC, OPTICAL AND MECHANICAL PROPERTIES OF THIN FILMS 8 HOURS

Ferromagntic property of thin film - Anisotropy in magnetic films – Hall effect- Thin film optics-Reflection and transmission-Optical absorption-Optical constant-Size effects- Photo emission-Mechanical properties – Stress – Adhesion – Hardness-Stiffness. Experimental methods for measurement of mechanical properties of thin films.

UNIT V - EMERGING THIN FILM MATERIALS AND APPLICATIONS 8 HOURS

Applications in electronics – electric contacts, connections and resistors, capacitors and inductances - Optical - reflection and anti-reflection coatings - Interference filters – Electrophotography- High Tc Superconducting thin film-FeSe film - Films for magnetic recording-

cobalt alloy –Ni-Fe, Pt-Fe- Thin film solar cell - Dye-sensitized solar cells (DSSC) - Quantum dot solar cells (QDSCs)- Copper Zinc Tin Sulfide (CIGS) solar cell.

TOTAL: 40 HOURS

TEXT BOOKS:

1. Chopra, K.L. (2004) Thin film Phenomena, Mc Graw hill.
2. Chopra, K.L. and Das, S.R (2013) Thin films solar cells. Springer.
3. Thin Film Fundamentals- A. Goswami, (1996) New Age International Pvt Ltd.
4. Anderson, J.C. (2011) The use of thin films in physical investigation, Academic press

REFERENCE BOOKS:

1. Berry,Hall and Harris (2003) Thin films technology,Van Nostrand Reinhold publishing.
2. George Hass (2001)Physics of thin films, Academic press.
3. Holland. L, (2004), Vacuum deposition of thin films, Weily Publication
4. Milton Ohring (2001) The Materials Science of Thin Films, Academic Press.
5. Meissel. L.T and R. Glang (2000) Handbook of thin film technology, Tata McGraw Hill, New Delhi.

WEBSITES:

1. https://nptel.ac.in/content/storage2/courses/112108092/module2/lec08.pdf
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113104075/lec41.pdf

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	2	3	3	3	3	3	2	-	-	-	-	-	2	-	3	2
CO2	2	2	2	3	2	2	2	2	-	-	-	-	2	2	-	2	2
CO3	2	2	-	-	2	3	3	3	-	-	-	-	-	2	-	2	1
CO4	3	2	-	2	2	3	3	-	-	-	-	-	-	2	-	2	1
CO5	3	2	-	-	2	3	2	-	-	-	-	-	-	-	-	-	-
Average	**2.6**	**2**	**1**	**1.6**	**2.2**	**2.8**	**2.6**	**1.4**	**0**	**0**	**0**	**0**	**0.4**	**1.6**	**0**	**1.8**	**1.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP205C **INDUSTRIAL AND POWER ELECTRONICS** **4H – 4**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

FET, UJT, Diode

COURSE OBJECTIVES (CO):

- To enable the students to learn and design industrial and power electronic circuits
- To present the principles and applications of industrial and power electronics
- To develop the circuits designing skills related to the power electronics and Understand the concept of industrial electronics
- To have a core understanding of MOSFET, BJT, UJT

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Acquire knowledge about fundamental concepts and techniques used in power electronics.	Understand
CO2	Ability to analyze various single phase and three phase power converter circuits and understand their applications	Analyze
CO3	Foster ability to identify basic requirements for power electronics based design application	Analyze
CO4	To develop skills to build, and troubleshoot power electronics circuits	Apply
CO5	To fabricate Device by using concepts of industrial electronics	Apply

UNIT – I POWER TRANSISTORS AND THYRISTOR **8 HOURS**

Power Transistors: Introduction, Power MOSFETs – Steady State Characteristics, Switching Characteristics Bipolar Junction Transistors – Steady State Characteristics, Switching

Characteristics, Switching Limits, IGBTs, MOSFET Gate Drive, BJT Base Drive, Pulse transformers and Opto-couplers. Thyristors :Introduction – Principles, Construction, Operation and Characteristics of SCR – Two Transistor Model –TRIAC – DIAC – GTO – SCS – SUS – SBS — UJT– Relaxation Oscillator – PUT.

UNIT -II TURN ON/OFF MECHANISMS **8 HOURS**

Introduction– Types of Turn on Methods: AC Gate Triggering: Forward Voltage Triggering– Thermal Triggering– Radiation Triggering– DC Gate Triggering: Pulse Triggering – Types of Turn Off Methods: Natural Commutation – Forced Commutation: Self Commutation Complimentary Commutation – Auxiliary Commutation – External Pulse Commutation—Line Commutation – Thyristor Rating.

UNIT -III CONTROLLED RECTIFIERS INVERTERS **8 HOURS**

Introduction– Single phase Half Wave Controlled Rectifiers with Resistive Load – HWCR with Inductive Load – HWCR with Free Wheeling Diode – Single phase Full Wave Controlled Rectifiers with Resistive, Inductive Loads – FWCR with Freewheeling Diode - AC Voltage Controllers - DC-DC Converters - DC-AC Converters. Inverters: Single Phase Half & Full Bridge Voltage Inverters

UNIT -IV CYCLO CONVERTERS AND CHOPPERS **8 HOURS**

Introduction – Single Phase Centre Tapped Step-Up Cyclo Converter – Single Phase Centre Tapped Step- Down Cyclo Converter – Three Phase to Single Phase Cyclo converter—Three Phase To Three Phase Cyclo Converters— Step-up and Step-down Choppers

UNIT - V APPLICATIONS **8 HOURS**

Industrial heating: Arc furnace, high frequency heating, High frequency source for induction heating, dielectric heating and microwave heating, Ultrasonic- Generation and applications.– SMPS – UPS – Static Circuit Breaker – Battery Charger –Emergency Lighting System – Time Delay Control – Static Switches.

TOTAL: 40 HOURS

TEXT BOOKS:

1. Power Electronics: Circuits Devices and Applications (2014) Mohammad H Rashid, Pearson 4th Edition
2. MDSingh, —PowerElectronics‖ (2007) 2ndEdition, Tata-McGrawHill
3. Power Electronics (2012) P.S. Bimbhra Khanna Publishers 5th Edition

REFERENCE BOOKS:

1. Power Electronics: Converters, Applications and Design (2014) Ned Mohan et al Wiley 3rd Edition
2. Power Electronics (2011) Daniel W Hart McGraw Hill 1st Edition
3. Elements of Power Electronics (2008) Philip T Krein Oxford Indian Edition
4. Harish C Rai, "Industrial and Power Electronics" (2002) 10th edition, Umesh publications
5. Timothy J Maloni, "Industrial Solid State Electronic Devices and Circuits" (1999) 2nd edition

WEBSITES:

1. https://www.scribd.com/document/384072127/Power-Electronics-Circuits-Devices-and-Applications-by-Muhammad-H-Rashid

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	2	3	3	3	3	3	2	-	-	-	-	-	2	-	3	2
CO2	2	2	2	3	2	2	2	2	-	-	-	-	2	2	-	2	2
CO3	2	2	-	-	2	3	3	3	-	-	-	-	-	2	-	2	1
CO4	3	2	-	2	2	3	3	-	-	-	-	-	-	2	-	2	1
CO5	3	2	-	-	2	3	2	-	-	-	-	-	-	-	-	-	-
Average	**2.6**	**2**	**1**	**1.6**	**2.2**	**2.8**	**2.6**	**1.4**	**0**	**0**	**0**	**0**	**0.4**	**1.6**	**0**	**1.8**	**1.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP206 **COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY** **2H-2C**

Instruction Hours/week: L:2 T:0 P:0 **Marks:** Internal**:100** External**: -T**otal**:100**

End Semester Exam: 3 Hours

PRE-REQUISITE:

Reneable energy sources, Photovoltaic cells

COURSE OBJECTIVES (CO):

- To gain insights into the structures, challenges, and opportunities within communities
- To explore ethical frameworks and dilemmas related to community engagement and social responsibility
- To develop skills in monitoring, evaluating, and reporting on the outcomes of community engagement efforts to ensure effectiveness and accountability.

COURSE OUTCOMES (COs):

At the end of this course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the concept, ethics, and spectrum of community engagement	Understand
CO2	Recognize the significance in local community development and rural culture.	Understand
CO3	Know the rural development programs, institutions	Understand
CO4	Analyze the role of local administration in fostering community involvement and social networking.	Analyze
CO5	Develop skills in conducting community engaged research with a focus on ethics, rural distress, poverty alleviation, and disaster mitigation.	Apply

UNIT I INTRODUCTION AND PRINCIPLES **6 HOURS**

Concept, Ethics and Spectrum of Community engagement, Local community, Rural culture and Practice of community engagement - Stages, Components and Principles of community development, Utility of public resources. Contributions of self-help groups

UNIT II RURAL DEVELOPMENT **6 HOURS**

Rural Development Programs and Rural institutions Local Administration and Community Involvement- Social contribution of community networking, Various government schemes. Programmes of community engagement and their evaluation.

UNIT III COMMUNITY AND RESEARCH **6 HOURS**

Community Engaged Research and Ethics in Community Engaged Research Rural Distress, Rural Poverty, Impact of COVID-19 on Migrant Laborers, Mitigation of Disaster.

UNIT IV ENERGY CONSUMPTION AND SAVING **6 HOURS**

Extension activity for- Village community- Alternate energy sources for replacing conventional energy sources.

UNIT V PHOTOVOLTAIC APPLICATIONS **6 HOURS**

Extension activity for Erection of photovoltaic panels and utilization- Exposure and hands-on training

TOTAL: 30 HOURS

TEXT BOOK:

1. Principles of Community Engagement, (2011).2nd Edition, NIH Publication No. 11-7782.

WEBSITES:

1. https://youtu.be/-SQK9RGBt7o
2. https://www.uvm.edu/sites/default/files/community_engagement_handout.pdf (Community Engagement)

3. https://www.atsdr.cdc.gov/communityengagement/pce_concepts.html (Perspectives of Community)
4. https://egyankosh.ac.in/bitstream/123456789/59002/1/Unit1.pdf (community concepts)
5. https://sustainingcommunity.wordpress.com/2013/07/09/ethics-and-community-engagement/(Ethics of community engagement)
6. https://www.preservearticles.com/sociology/what-are-the-essential-elements-of-community/4558 (Elements of Community)
7. https://www.yourarticlelibrary.com/sociology/rural-sociology/rural-community-top-10-characteristics-of-the-rural-community-explained/34968 (features of rural community)
8. https://www.mapsofindia.com/my-india/government/schemes-for-rural-development-launched-by-government-of-india (Government programmes for rural development)
9. https://www.yourarticlelibrary.com/sociology/rural-sociology/rural-community-top-10-characteristics-of-the-rural-community-explained/34968 (rural lifestyle)
10. https://www.insightsonindia.com/social-justice/issues-related-to-rural-development/government-schemes-for-rural-development-in-india/ (schemes for rural development)
11. https://www.mpgkpdf.com/2021/09/community-development-plan-in-hindi.html?m=1
12. https://images.app.goo.gl/sNF2HMWCuCfkqYz56
13. https://images.app.goo.gl/VaMNNMEs77XyPMrP7

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	-	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	3	-	2	1	-	2	-	-	-	-	-	-	1
CO3	3	-	2	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	2	-	-	2	-	1	-	3	-	-	-	-	2	-	1
CO5	3	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**3**	**2.5**	**2**	**2**	**3**	**2**	**2**	**1**	**-**	**2.5**	**-**	**-**	**-**	**-**	**2**	**-**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP211 **GENERAL PHYSICS PRACTICAL – II** **3H – 4**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 Total:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Semiconductors, Solar cells, Ferromagnetism, Laser, LCR circuit

COURSE OBJECTIVES (CO):

- To gain practical knowledge by Apply the experimental methods to correlate with the Physics theory.
- To learn the usage of optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Determine characteristics of a solar cell	Understand
CO2	Classify the materials and its properties	Analyze
CO3	Analyse the magnetic Properties of Materials	Analyze
CO4	Analyze the optical properties of materials	Analyze
CO5	Apply the principles of electronics to design and analyze electronic circuits	Apply

ANY TEN EXPERIMENTS

1. Arc spectra – Copper and Iron

2. Arc spectra – carbon and brass
3. Determination of V-I characteristics of a solar cell.
4. Find the magnetic Susceptibility of ferromagnetic substances – Quinke's method
5. Find the magnetic Susceptibility of ferromagnetic substances – Gouy method
6. Determination Hall mobility, Hall coeffieient and charge carrier concentration of semiconductor.
7. Measurement of resistivity and conductivity of dielectric using Four-probe apparatus.
8. Compressibility of a liquid – Ultrasonic Interferometer, and verify with Ultrasonic Diffractometer
9. Determination of Stefan's constant.
10. Laser Diffraction at sharp edge – Determination of wavelength.
11. Series LCR circuit: (i) Determination of the resonance frequency using variable frequency source, (ii) To study the resonance of LCR using AC mains.
12. To determine the energy and area of cross section: Compton scattering.
13. To find the magnetic splitting energy of sodium atom by Zeeman Effect.

TEXT BOOKS:

1. Ouseph C.C., U.J. Rao and V. Vijayendran (2007), Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai

REFERENCE BOOKS:

1. Singh S.P., (2003), Advanced Practical Physics – 1, 13th Edition, PragathiPrakashan, Meerut

2. Singh S.P., (2000), Advanced Practical Physics – 2, 12th Edition, PragathiPrakashan, Meerut

3. Gupta S.L. and V.Kumar, (2002), Practical Physics, 25th Edition, PragathiPrakashan, Meerut

4. B.L Worsnop& H T Flint, (1951) Advanced Practical Physics For Students, 9th revised Edition, Littlehampton Book Services Ltd

WEBSITES:

1. https://nptel.ac.in/courses/115/105/115105110/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	3	3	3	3	2	-	-	-	-	-	-	-	3	-	-	2
CO2	3	-	-	3	-	3	-	-	-	-	-	-	2	2	-	2	-
CO3	3	-	-	3	3	-	-	-	-	-	-	-	-	3	-	3	-
CO4	3	-	2	3	3	2	-	-	-	-	-	-	-	2	-	2	-
CO5	3	-	3	3	3	3	2	3	-	2	-	2	2	2	-	2	-
Average	**3**	**0.6**	**1.6**	**3**	**2.4**	**2**	**0.4**	**0.6**	**-**	**0.4**	**-**	**0.4**	**0.8**	**2.4**	**-**	**1.8**	**0.4**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP212 **ELECTRONICS PRACTICAL – II** **4H – 2C**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 T**otal**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

BJT, FET, Oscillator, OP-Amp

COURSE OBJECTIVES (CO):

- To understand the Biasing network for BJT and FET, transient analysis and frequency response of BJT and FET in single stage and multistage amplifier
- To understand the frequency response feedback amplifier using BJT and FET and Tuned amplifier
- To understand the operation of Oscillators and waveform generators
- To learn the usage of digital electronics measurements.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Implement the OP 741 to design electronic circuiut for solving arithmetical problems	Understand
CO2	Apply the analytical techniques and graphical analysis to the experimental data.	Apply
CO3	Analyze the characteristics of oscillators and wave shaping circuits	Analyze
CO4	Understand the basic concepts of amplifiers and operational amplifiers	Understand
CO5	Impart the results of the GATES using ICs to design flip flops	Apply

ANY TEN EXPERIMENTS

1. Op-amp – Simultaneous Addition and Subtraction and binary to BCD conversion
2. Op-amp – V to I, I to V converter.
3. Op-amp Adder Subtractor by using OP 741.
4. V-I characteristics of a schotkky and photoconductive diode: comparision
5. V-I characteristics of Photo Transistor, LDR, LED.
6. Ultrasonic distance measurement by using Arduino.
7. PIR Based Alarm System Using embedded method.
8. Traffic Light Simulation by using Embedded.
9. Op-amp Log and Antilog amplifier.
10. Op-amp comparator – Zero crossing detector, Window detector, time marker
11. 555 Timer application –bi-stable multivibrators.
12. Characteristics and an application of SCR
13. Study of various types of flip-flops (R-S, J-K, Master Slave J-K)
14. PLL characteristics.
15. Pulse width modulation and de-modulation.

TEXT BOOKS:

1. Ouseph C.C., U.J. Rao and V. Vijayendran (2007), Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai
2. Singh S.P., (2003), Advanced Practical Physics – 1, 13th Edition, PragathiPrakashan, Meerut

REFERENCE BOOKS:

1. Singh S.P., (2000), Advanced Practical Physics – 2, 12th Edition, PragathiPrakashan, Meerut

2. Gupta S.L. and V.Kumar, (2002), Practical Physics, 25th Edition, PragathiPrakashan, Meerut

3. Ramakant A. Gayakwad, (2002), Op-amp and Linear Integrated Circuits ,4th Edition, Prentice Hall

WEBSITES:

1. https://nptel.ac.in/courses/122/106/122106025/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	2	2	1	-	1	1	1	-	-	-	-	-	-	3	2
CO2	3	3	3	3	1	-	1	1	1	-	-	-	-	-	-	3	2
CO3	3	2	1	-	1	-	1	1	1	-	-	-	-	-	-	3	2
CO4	2	2	1	1	1	-	1	1	1	-	-	-	-	-	-	3	2
CO5	3	3	2	1	1	-	1	1	1	-	-	-	-	-	-	3	2
Average	**2.8**	**2.6**	**1.8**	**1.4**	**1**	-	**1**	**1**	**1**	-	-	-	-	-	-	**3**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Value Added Course

PRINCIPLES OF ELECTRONIC COMMUNICATION

Instruction Hours/week: L:30 T:- P:0 **Marks:** Internal**:100** External**:-** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Bandwidth, Antenna, Electromagnetic wave spectrum

COURSE OBJECTIVES (CO):

- To know the fundamental concepts of Communication.
- To learn the designing procedure and operations of the circuits used for communications.
- To provide a strong foundation in the design and construction of Analog Communication systems like AM, FM

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Explain the need for modulation in communication systems, analyze amplitude and frequency modulation techniques.	Understand
CO2	Demonstrate knowledge of analog and digital modulation methods PWM, PCM, PSK, and QPSK.	Apply
CO3	Describe the functioning of superheterodyne receivers, explain the significance of IF and oscillator frequencies.	Understand
CO4	Analyze the working principles of various antennas, including resonant and non-resonant antennas.	Analyze
CO5	Understand different modes of electromagnetic wave propagation.	Understand

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UNIT I -MODULATION TECHNIQUES

Introduction to Communication Systems – Information – Transmitter – Channel –Need for Modulation– Amplitude Modulation: AM Theory – AM Transmitter block diagram – Frequency modulation: System description – Frequency Spectrum – Generation of FM – Direct and Indirectmethods.

UNIT II - WAVE PROPAGATION

EM Waves – Free Space Propagation – Surface Wave Propagation – Sky WavePropagation – Space Wave Propagation – Trophospheric Scatter Propagation – Structure ofAtmosphere – Virtual height – MUF – LUF – Skip Distance – Ionospheric abnormalities- DuctPropagation

UNIT III -ANTENNA THEORY

Electro Magnetic radiations –Resonant antennas- Non resonant antennas –Bandwidth, Beam width and Polarization – Grounded and Ungrounded antennas – Impedance matching – Dipole Arrays - Yagi Uda antenna – Parabolic antenna – Horn and Lens antenna .

UNIT IV- RECEIVER

Introduction – Super heterodyne Receiver – Choice of IF and Oscillator Frequencies –Image Rejection – Adjacent Channel Selectivity – Spurious Response - Tracking – AGC –Double conversion receiver

UNIT V - MODULATION TYPES ANALOG; DIGITAL MODULATION

Introduction to PAM, PPM, PWM and PCM- Binary Phase Shift Keying – differential phase shift keying – deferentially encoded PSK - Quadrature Phase Shift Keying – Quadrature amplitude shift keying – Binary frequency shift keying.

TEXT BOOKS:

1. Electronic Communication Systems, Kennedy and Davis,Tata McGraw Hill, Fifth Edition, 2012.
2. Electronic Communications, Dennis Roddy and John Coolen, Pearson Education, Fourth Edition, 2008.

REFERENCE BOOKS:

1. Antenna Wave Propagation, K.D. Prasad and Satyaprakahan, Pearson Education, Indian Reprint, Fourth Edition, 2012.
2. Principles of Communication Engineering, Anok Singh & A K Chhabra, S.Chand Publications, Seventeenth Edition, 2010.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	-	-	-	2	-	-	-	-	-	-	2	2	2
CO2	-	-	-	2	-	-	-	-	-	-	2	2	-	-	-	-	3
CO3	2	-	-	2	-	-	-	-	-	-	2	2	-	-	-	-	2
CO4	3	-	-	2	-	-	-	2	-	-	-	2	-	-	-	-	3
CO5	3	-	-	3	3	-	-	2	-	-	-	2	-	-	-	2	2
Average	**2.2**	**-**	**-**	**2.2**	**0.6**	**-**	**-**	**1.2**	**-**	**-**	**-**	**1.6**	**-**	**-**	**0.4**	**0.8**	**2.4**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP301 **QUANTUM MECHANICS** **4H – 4C**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Wave theory, Angular momentum

COURSE OBJECTIVES (CO):

- This course is aimed to introduce basic concepts and ideas on Quantum Mechanics
- To acquire working knowledge of the Quantum Mechanics postulate on the physical systems.
- To impart knowledge of advanced quantum mechanics for solving relevant physical problems
- It has revolutionized the whole science, important for any physics student to know the basics of quantum mechanics

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Solve the Schroedinger equation to obtain wave functions	Understand
CO2	Interpret the wave function and apply operators and its commutation relations.	Apply
CO3	Apply special functions for the solution of differential equation	Apply
CO4	Understand the role of uncertainty in quantum physics for the determination of simultaneity of physically measured variables.	Understand
CO5	Implement the principle of separation of variables in solving Schrodinger wave equation	Analyze

UNIT -I ORIGIN OF QUANTUM THEORY 10 HOURS

Introduction Wave -Particle Duality-Dual nature of light matter-De-Broglie Concept of Stationary orbits-Linear Vector Space- Linear Operator- Eigen functions and Eigenvalues - Hermitian Operator- Postulates of Quantum Mechanics- Simultaneous Measurability of Observables- General Uncertainty Relation- Dirac's Notation- Equations of Motion; Schrodinger, Heisenberg and Dirac representation- momentum representation.

UNIT-II ANGULAR MOMENTUMA AND THEIR PROPERTIES 10 HOURS

Angular momentum operators – Angular momentum commutation relations – Eigen values and Eigen functions of L^2 and Lz – General angular momentum – Eigen values of J^2 and Jz – Ladder operators (J^+ and J^-) – Angular momentum matrices – Matrices for J^2, Jz, J+, J-, Jx and Jy – Spin angular momentum – Spin ½ systems – Spin vectors for spin ½ systems – Addition of angular momentum - Clebsh-Gordan coefficients.

UNIT- III RELATIVISTIC QUANTUM MECHANICS AND PHYSICAL APPLICATION OF SCHRODINGER'S EQUATIONS 10 HOURS

Einstein's theory of relativity -The Free particle, Particle in a box- Schrodinger's Equations-Time dependent and Time -Independent- - Heiseberg's uncertainty Principle. Pauli principle – Inclusion of spin – Spin functions for two electrons – Spin functions for three electrons – The Helium atom – Central field approximation – Thomas-Fermi model of the atom– Molecular orbital theory: Hydrogen molecule ion H2+- Valence bond theory – Heitler-London theory of hydrogen molecule.

UNIT- IV SCATTERING THEORY MANY ELECTRON PROBLEM 9 HOURS

Elementary theory of scattering- Partial waves – Scattering by a central potential: partial wave analysis – Significant number of partial waves – Scattering by an attractive square-well potential – Briet-Wigner formula – Scattering length – Expression for phase shift – Integral equation – The Born approximation ─Application of Born Approximations

UNIT- V FIELD THEORY **9 HOURS**

Introduction – Classical approach to field theory – Relativistic Lagrangian and Hamiltonian of a charged particle in an electromagnetic field – Field: Lagrangian and Hamiltonian formulations – Quantum equation for the field – Second quantisation – Klein Gordon Equation and associated problems- Lorentz covariance of the Dirac equation – Creation, annihilation and number operators. WKB Approximation

TOTAL: 48 HOURS

TEXT BOOKS:

1. Aruldhas. G, (2009), Quantum Mechanics, 2nd Edition, Prentice-Hall of India, New Delhi.
2. Leonard I. Schiff, (2017), Quantum Mechanics, 3rd Edition, McGraw Hill International, Auckland
3. Satya Prakash, New Edition, (2019) Edition, Quantum Mechanics, Kedar Nath & Ram Nath & Co, Meerut.
4. Gupta, Kumar and Sharma, (2002 – 2003), Quantum Mechanics, 22nd Edition, Jai Prakash Nath & Co, Meerut.

REFERENCE BOOKS:

1. Eugen Merzbacher, (2013), Quantum Mechanics, 3rd Edition, Wiley, Weinheim
2. Mathews. P.M. and K. Venkatesan, 2nd Edition, (2013), Textbooks of Quantum Mechanics, McGraw Hill International, Weinheim.
3. Chatwal R.G. and Sk. Anand, 4th edition, (2004), Quantum Mechanics, Himalaya Publishing House, New Delhi
4. Thangappan. V. K., 2nd Edition, (2013), Quantum Mechanics, Tata McGraw Hill, New Delhi

WEBSITES:

1. https://nptel.ac.in/courses/115101107/
2. https://nptel.ac.in/courses/122106034/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	2	-	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	1	1	-	2	-	-	1	-	-	-	-	-	-	2	3	2
CO3	3	3	2	3	3	-	-	2	-	-	2	-	1	-	2	2	3
CO4	3	2	2	3	3	-	2	-	-	-	2	-	1	1	2	2	3
CO5	3	3	2	3	3	-	-	-	-	-	1	-	-	-	-	3	3
Average	**3**	**2.2**	**1.4**	**2.2**	**2.8**	**0**	**0.4**	**0.6**	**0**	**0**	**1**	**0**	**0.4**	**0.2**	**1.2**	**2.4**	**2.6**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP302 **SPECTROSCOPY** **4H – 4(**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 T**otal**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Electromagneticspectrum, energy levels, vibration levels

COURSE OBJECTIVES (CO):

- The course will provide a valuable theoretical introduction and an overview of modern topics in spectroscopy, which are of current interest and importance in Semiconductor Industry and Biomedicine.
- To give an Understand of wide range of techniques including optical Nearfield spectroscopy, X-ray, Raman, and FTIR spectroscopy.
- To introduce optical spectroscopy methods that are widely used in physics, chemistry and biological sciences
- To teach the basic aspects of nuclear magnetic resonance (NMR) spectroscopy.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Understand the basic prnciples of ESR, NMR, NQR, Raman spectroscopy	Understand
CO2	Know about the molecular structure and functional groups governing the molecule	Understand
CO3	Identify the scientific knowledge about the various molecules through spectroscopic characterizations	Creating
CO4	Analyze the spectrum obtained from various spectroscopic characterizations	Analyze
CO5	Apply spectroscopic methods for specific applications in scientific industry	Apply

UNIT I ATOMIC AND MICROWAVE SPECTROSCOPY 10 HOURS

Introduction to Spectroscopy :Electromagnetic spectrum – Absorption or Emission of radiation – Line width- Natural line broadening-Doppler broadening –Pressure broadening Interaction of light with matter - Spectra of Alkali Metal Vapours - Normal Zeeman Effect - Anomalous Zeeman Effect - Magnetic Moment of Atom and the G Factor - Lande's 'g' Formula - Paschen Back Effect - Hyperfine Structure of Spectral Lines - Characteristic X-ray spectra.

Microwave Spectroscopy: The Rotation of molecules - Rotational spectra - Diatomic molecules- poly atomic molecules - Techniques and Instrumentation- Chemical analysis by Microwave Spectroscopy.

UNIT- II INFRA-RED AND RAMAN SPECTROSCOPY 10 HOURS

The Vibrating Diatomic molecule- the diatomic vibrating rotator- the vibration-rotation spectrum of Carbon Monoxide- breakdown of the Born-Oppenheimer Approximation: the interaction of rotation and vibrations-The vibrations of Polyatomic molecule- Techniques and Instrumentation.

Raman Spectroscopy: Introduction- Pure rotational Raman Spectra(linear and symmetric top molecules)- Vibrational Raman Spectra- Polarization of Light and the Raman Effect- Structure Determination from Raman and Infra-red spectroscopy- Techniques and instrumentation of Infrared and Raman spectrometers.

UNIT-III ELECTRONIC SPECTRA: FLUORESCENCE & PHOSPHORESCENCE SPECTROSCOPY 10 HOURS

Electronic Excitation of Diatomic Species-Vibrational Analysis of Band Systems of Diatomic Molecules- Intensity Distribution- Rotational Structure of Electronic Bands-Resonance and Normal Fluorescence-Intensities of Transitions- Phosphorescence Population of Triplet State and Intensity-Experimental Methods-Applications of Fluorescence and Phosphorescence

UNIT-IV NMR SPECTROSCOPY AND NQR SPECTROSCOPY 9 HOURS

Quantum mechanical and Classical description - The Bloch equation - Basic principles – Interaction between spin and a Magnetic field – pulsed (Fourier Transform) NMR – wide line NMR spectrometers – Spectra and molecular structure – chemical shifts – spin-spin coupling – integration – applications.

Quadrupole Effects- Nuclear Quadrupole energy level for axial and non-axial symmetry – Experimental techniques and applications.

UNIT-V ELECTRON SPIN RESONANCE AND MOSSBAUER SPECTROSCOPY

9 HOURS

Basic principles – ESR spectrometer – ESR spectra – Hyperfine interaction – g-factor – line widths – applications.Principles of Mossbauer spectroscopy – Chemical Isomer shifts – Quadrupole splitting and Zeeman splitting – applications of Mossbauer Spectroscopy.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Fundamentals of Molecular Spectroscopy (2017) 4th Edition, Colin N. Banwell and Elaine M. McCash, Mcgraw Higher Ed
2. Aruldhas. G., (2013), Molecular Structure and Spectroscopy, 2nd Edition, Prentice Hall of India, New Delhi
3. Straughan.B.P. and S. Walker, (2000), Spectroscopy: Volume 1, Chapman and Hall Ltd, London.

REFERENCE BOOKS:

1. Chatwall and Anand, (2004), Atomic and Molecular Spectroscopy, 5th Edition, Himalaya Publishing House, New Delhi.
2. Gordon M Barrow, (1962), Introduction to Molecular Spectroscopy, McGraw-Hill Inc.,US

WEBSITES:

1. https://nptel.ac.in/courses/104101099/
2. https://nptel.ac.in/courses/104102113/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	1	-	3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	1	-	3	3	2	-	1	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	2	-	-	2	-	1	-	2	2	3
CO4	3	2	2	3	3	-	2	-	-	-	2	-	1	1	2	2	2
CO5	3	3	2	3	3	-	-	-	-	-	1	-	-	-	-	2	2
Average	**3**	**2**	**1.4**	**3**	**3**	**0.4**	**0.4**	**0.6**	**0**	**0**	**1**	**0**	**0.4**	**0.2**	**1.2**	**2**	**2.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP303 **NUCLEAR AND PARTICLE PHYSICS** **4H – 4**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 T**otal**:100**
End Semester Exam: 3 Hours

PREREQUISITE:

Nucleus, Radioactive decay, Alpha particles, Beta particles, Gamma particles, Elementary particles

COURSE OBJECTIVES (CO):

- To impart knowledge about basic nuclear physics properties and nuclear models for Understand of related reaction dynamics
- To introduce students to the fundamental concepts of nuclear and sub-nuclear physics
- To give an insight into the different nuclear processes and the fundamental particles, which are the real building blocks of the universe.
- To introduce the fundamental concepts of nuclear and sub-nuclear physics

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Understand the fundamental principles of nuclear and particle physics, including the structure of the nucleus and nuclear forces	Understand
CO2	Analyze different types of nuclear reactions, such as fusion, fission, and radioactive decay, and understand their applications in energy production, medical imaging, and treatment.	Analyze
CO3	Apply quantum mechanical concepts to describe the behavior of particles at the subatomic level,	Apply
CO4	Ubderstand the interactions between elementary particles and their implications for the Understand of fundamental forces.	Understand

CO5	Gain knowledge of experimental techniques and tools used in nuclear and particle physics research	Apply

UNIT I - NUCLEAR SIZE AND MASS **9 HOURS**

Basics nuclear Properties: size, shape and Distribution of nuclear charge - Nuclear mass and binding energy of a nucleus – semi-empirical mass formula – Nature of nuclear force – form of nucleon-nucleon potential – charge independence and charge symmetry of nuclear forces - Bound states of two nucleons-Ground state of Deuterium - Wave mechanics of ground state of Deuterium-Spin states –Pauli's exclusion principle -Tensor force - Exchange force - Low energy Nucleon - Nucleon scattering

UNIT II - NUCLEAR MODELS **9 HOURS**

Liquid drop model - Bohr Wheeler theory of fission - Condition for spontaneous fission - Shell model: Explanation for magic numbers - Prediction of shell model - Prediction of spin and parity - Nuclear statistics - Magnetic moment of nuclei - Nuclear isomerism – Hydrogen -hydrogen cycle – chain reaction-Collective model: Optical model: Nilsson model - Elementary ideas-Introduction of Astro nuclear Physics

UNIT III- RADIOACTIVITY **10 HOURS**

Alpha decay: Properties of α particles - Velocity and energy of α particles - Gamow's theory of α particles- Geiger - Nuttall law- α ray energies and fine structure of α rays - α disintegration energy-Low range α particles

Beta decay: Properties of β particles - General features of β ray spectrum – Pauli's hypothesis - Fermi's theory of β particles - Forms of interaction and selection rules - Fermi's and Gamow teller transition

Gamma decay: The absorption of γ rays by matter - Interaction of γ rays with matter - Measurement of γ ray energies - Dumont bent crystal spectrometer method-internal conversion – Applications.

UNIT IV - NUCLEAR REACTIONS **10 HOURS**

Nuclear fission and fusion - Kinds of reaction and conservation laws - energetics of nuclear reaction – Applications of Nuclear Energy – Nuclear Reactors - Isospin - Reaction cross section- Continuum theory of nuclear reaction - Resonance - Briet Wigner Dispersion formula - Stages of nuclear reaction - Statistical theory of nuclear reaction - Surface reaction. Nuclear reactors in India and abroad for extracting energy with specifications and its applications.

UNIT V - ELEMENTARY PARTICLES **10 HOURS**

Classification of Elementary Particles- Types of interaction in nature-typical strengths and time-scales, conservation laws, charge-conjugation, Parity and Time reversal, CPT theorem, GellMann-Nishijima formula, intrinsic parity of pions, resonances, symmetry classification of elementary particles and their quantum numbers, quark hypothesis, charm, beauty and truth, gluons, quark confinement, asymptotic freedom- Higgs bosons-particle in LHC experiment- Experiment for the cosmic ray detected in space.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Pandya. M.L. and R. P. S. Yadav, (2004), Elements of Nuclear Physics, 1st edition Kedar Nath Ram Nath, Meerut.
2. D.C Tayal , 4th edition (2011), Nuclear Physics, Himalaya Publishing House, New Delhi.
3. Introduction to Nuclear Physics (2010)- Harald, Enge, The Perseus Books Group.

REFERENCE BOOKS:

1. Nuclear Physics: Theory and Experiment (2011)- R. R. Roy, B.P. Nigam, New Age International Pvt Ltd.
2. Kenneth S.Karne, , 1st edition, (2008), Introducing Nuclear Physics, John Wiley and Sons, New York.
3. Sharma. D.C (20040, Nuclear Physics, - K. Nath & Co, Meerut.

4. Bernard L. Cohen, , 1st edition, (2011), Concept of Nuclear Physics, Tata Mc Graw Hill, New Delhi.

5. Devanathan V.,2nd edition, (2008), Nuclear Physics, Narosa Book Distributers Pvt. Ltd., New Delhi.

6. Kaplan Irving, (2002), Nuclear Physics, 2nd Edition, Narosa Book Distributers Pvt. Ltd., New Delhi.

WEBSITES:

1. https://nptel.ac.in/courses/115103101/
2. https://nptel.ac.in/courses/115104043/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	2	-	2	2	-	-	-	-	-	-	-	-	2	-	3	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	-	3	-	-	3
CO3	3	-	-	-	2	-	-	-	-	-	-	3	-	3	-	-	3
CO4	3	-	-	-	2	-	-	-	-	-	-	-	-	2	-	3	-
CO5	3	-	-	-	3	-	3	-	2	2	3	2	1	2	-	2	
Average	**3**	**1**	**0.6**	**1**	**2.2**	**-**	**0.6**	**-**	**0.4**	**0.4**	**0.6**	**1**	**0.2**	**2.4**	**-**	**1.6**	**1.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP304 PHYSICS OF MATERIALS AND CHARACTERIZATION 4H – 4

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 Total:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Nanoscale, Thin film coating, Electron microscopy, Raman spectrum

COURSE OBJECTIVES (CO):

- To Study materials which is always important for any applications.
- To explore preparation of materials by different techniques
- To introduce various methods available for characterizing the materials.
- To introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques Introduction:

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Understand the physical properties of materials, including mechanical, electrical, thermal, optical, and magnetic properties.	Understand
CO2	Analyze the relationship between the structure of materials at the atomic and molecular level	Analyze
CO3	Understand various material synthesis and fabrication techniques	Understand
CO4	Apply the uncertainty of observations and results from the different methods	Apply
CO5	Handle X-ray, thermal, microscopic, and electrical methods of characterization	Apply

UNIT- I SYNTHESIS OF NANOMATERIALS 10 HOURS

Gold, Silver, different types of Nano oxides, TiO2, ZnO by using sol-gel method, Co-precipitation, Hydrothermal, Microwave, Solvothermaland bio synthesis methods, Nanotubes and Nanowires, Carbon nanotubes, Graphene preparation, powder syntheses, crystal growth techniques, zone refining, properties and applications.

UNIT- II SYNTHESIS TECHNIQUES 10 HOURS

Top down and bottom up synthesis- mechanical alloying, Mechanical ball-milling, Ion implantation, Inert gas condensation, Arc discharge, RF-plasma arc technique, Laser ablation, Template assisted synthesis, Clusters, Colloids, Zeolites, Porous silicon.

UNIT- III DEPOSITION TECHNIQUES 9 HOURS

Chemical vapour deposition (CVD), Metal Organic chemical vapour deposition (MOCVD), Epitaxial growth techniques: Molecular beam epitaxy, Atomic layer deposition, Pulsed laser deposition, Pulsed electrochemical deposition, Magnetron sputtering, Spin coating, Introduction to Lithography techniques

UNIT- IV CHARACTERIZATION TECHNIQUES- I 9 HOURS

Principle, Theory, Working and Application; X-Ray Diffraction, Field Emission Scanning Electron Microscopy, High Resolution-Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunnelling Microscopy.

UNIT- V CHARACTERIZATION TECHNIQUES- II 10 HOURS

Photoluminescence Spectroscopy, Raman Spectroscopy, X-Ray Photoelectron Spectroscopy (XPS), Thermal analysis – Differential Scanning Calorimetry (DSC) – Thermogravimetric Analysis (TGA) – Differential Thermal Analysis (DTA) – Dynamic Mechanical Analysis (DMA), Mechanical Testing- Nano Indentation -Vibrating Sample Magnetometer, Zeta Potential and Particle size measurement.

TOTAL: 48 HOURS

TEXT BOOKS:

1. S.P. Gaponenko (1980) Optical Properties of semiconductor nanocrystals, Cambridge University Press.

2. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds.) (2002) Handbook of NanoScience, Engg. and Technology, CRC Press.

3. K. Barriham, D.D. Vvedensky (2001) Low dimensional semiconductor structures fundamental and device applications, Cambridge University Press.

REFERENCE BOOKS:

1. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties &Applications, Imperial College Press, (2004).

2. J. George, (2005) Preparation of Thin Films, Marcel Dekker, Inc., New York.

3. B. D. Cullity (1978) “Elements of X-ray Diffraction” , 4th Edition, Addison Wiley.

4. M. H. Loretto (1984) “Electron Beam Analysis of Materials”, Chapman and Hall.

WEBSITES:

1. https://archive.nptel.ac.in/courses/115/103/115103030/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	-	-	3	3	-	-	-	-	-	-	3	-	3	-	3	2
CO2	3	-	-	-	3	-	2	-	-	-	-	-	-	3	-	2	3
CO3	3	-	2	3	3	-	-	-	-	-	-	3	-	3	-	-	3
CO4	3	-	-	3	3	-	-	-	-	-	-	2	-	3	-	-	3
CO5	3	-	-	-	3	-	2	-	-	-	-	3	-	3	-	-	3
Average	**3**	**-**	**0.2**	**1.8**	**3**	**-**	**0.8**	**-**	**-**	**-**	**-**	**2.2**	**-**	**3**	**-**	**1**	**2.8**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

24PHP305A **MEDICAL INSTRUMENTATION** **4H – 4**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 Total:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Laws of thermodynamics, Electromagnetic spectrum, Ultrasound

COURSE OBJECTIVES (CO):

- To introduce a fundamental of transducers as applicable to physiology
- To explore the human body parameter measurements setups
- To make the students understand the basic concepts of forensic techniques.
- To give basic ideas about how multimedia evidences are useful in crime investigation

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Understand and explain the basic concepts of heat and temperature, including their measurement methods such as thermometry, thermostats, and thermocouples, especially in clinical settings.	Understand
CO2	Describe and differentiate between direct and indirect methods of measuring blood pressure.	Understand
CO3	Measure and analyze various physiological parameters, including blood pH, respiration rate, lung volume, heart rate, and body and skin temperature.	Analyze
CO4	Analyze different types of ventilators, including their modern block diagrams and clinical uses.	Apply
CO5	Classify and describe different types of cardiac pacemakers, including external and implantable pacemakers, their pacing techniques, and programmable features.	Apply

UNIT I: BASICS INSTRUMENT **10 HOURS**

Basic concept of quantity of heat. Definition and measurement of above concept of temperature thermometry, thermostat, thermocouple relevant to clinical laboratory, thermal capacity specific heat capacity, calorimetric techniques calorific values of food and fuel kinetic theory of gases-assumptions. Applications laws of thermodyanamics water bath- parts, care and usage. Incubator-parts, preventive maintenance and use of refrigerators techniques.

UNIT II: CLINICAL MEASUREMENT **10 HOURS**

Measurement of Blood pressure (direct, indirect) – blood flow meter (Electromagnetic& ultrasonic blood flow meter) – blood pH measurement - Measurement of Respiration rate – measurement of lung volume – heart rate measurement – Measurement of body and skin temperature.

UNIT III: BIO-ELECTRIC SIGNALS AND ELECTRODES **9 HOURS**

Elementary ideas of cell structure, Bio – potential and their generation – Resting and action potential – propagation of action potential. Electrodes – Micro – Skin surface – needle electrodes.

UNIT IV: BIO - MEDICAL RECORDERS **10 HOURS**

Electro cardiograph (ECG) – Lead system – ECG electrodes – ECG amplifiers – ECG recording units – analysis of ECG curves. Nervous system – EEG recorder – 10-20 lead system – recording techniques – EEG wave types – Clinical use of EEG.

X ray apparatus – block diagram – Ultrasonic imaging techniques – Echo cardiography – Angiography – CT scanner - Magnetic resonance imaging techniques.

UNIT V: THERAPEUTIC INSTRUMENTS **9 HOURS**

Cardiac pacemaker – classification – External pace makers – implantable pacemaker – pacing techniques – programmable pacemaker – Cardiac defibrillators – types – AC and DC defibrillators - Heart lung machine with Block diagram. Dialysis – Hemo dialysis – peritoneal dialysis. Ventilators – types – modern ventilator block diagram.

TOTAL: 48 HOURS

TEXT BOOKS:

1. A. Nagamani Prabu, Basics of Biomedical Instrument, (2021), LAP LAMBERT Academic Publishing Republic Moldova Europe: ISBN:978-620-4-73350-0

REFERENCE BOOKS:

1. R.S.Khandpur (2003) 'Hand Book of Bio-Medical instrumentation', Tata McGrawHill PublishingCoLtd..
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer (2002) 'Bio-Medical InstrumentationandMeasurements', II edition, Pearson Education, PHI.
3. J.Webster, (1995) 'Medical Instrumentation', John Wiley & Sons.
4. L.A. Geddes and L.E.Baker (1975) 'Principles of Applied Bio-Medical Instrumentation', JohnWiley&Sons.

WEBSITES:

1. https://kanchiuniv.ac.in/coursematerials/Biomedical%20instrumentation.pdf

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	2	1	1	-		-	-	-	-	-	2	-	-	-	1	1
CO2	2	2	1	3	-		1	-	-	-	-	2	-	-	-	1	1
CO3	2	2	1		-		3	-	-	-	-	1	-	-	-	1	1
CO4	2	3	2		-		1	-	-	-	-	2	-	-	-	1	1
CO5	2	2	1		-		1	-	3	-	-	1	-	-	-	1	1
Average	**2.2**	**2.2**	**1.2**	**0.8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1.6**	**0**	**0**	**0**	**1**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP305B NUMERICAL METHODS AND PROGRAMMING 4H – 4

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

Polynomials, Lagrange's equation

COURSE OBJECTIVES (CO):

- To get the science knowledge of using computers to assist in the solution of physical problems, and to further physics research.
- To equip the students of M.Sc. Physics with knowledge of programming in C, roots of equation, interpolation, curve fitting, numerical differentiation, numerical integration, solution of ordinary differential equations
- To introduce students to computational methods for simulating physical systems and solving problems arising in physics and astronomy, as well as in other related fields
- To develop idea about different types of computations involved in Physics, like curve fitting, interpolation, extrapolation, numerical calculations etc.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Describe the characteristics of various numerical methods	Understand
CO2	Programme numerical methods and their implementation like Apply to problem	Analyze
CO3	Analysis techniques for propagating error, representing data graphically. Create, solve and interpret basic mathematical tool	Analyze
CO4	Formulate and computationally solve a selection of problems in physics	Apply
CO5	Use the tools, methodologies, language and conventions of physics to test and Communicate ideas and explanations.	Apply

UNIT- I **9 HOURS**

Errors, different type of errors. Representation of numbers in computer, computer arithmetic, zero in floating point number.

UNIT- II **9 HOURS**

Operators –finite differences, average, differential, etc., their inter-relations. Difference of polynomials. Difference equation. Interpolation. Lagrange's methods, error terms. Uniqueness of interpolating polynomial.

UNIT- III **10 HOURS**

Newton's fundamental interpolation. Forward, backward and central difference interpolations. Interpolation by iteration. Spline interpolation, comparison with Newton's interpolation. Hermite's interpolation. Bivariate interpolation, Lagrange and Newton's methods. Inverse interpolation.

UNIT- IV **10 HOURS**

Approximation of function. Least square method. Use of orthogonal polynomials. Approximation by Chebyshev polynomials, Max-min principle. Economization of power series.

UNIT- V **10 HOURS**

Python Programming –Loops- Conditional statements- Functions- Object-oriented programming- Array computing- 2 and 3d visualizations

TOTAL: 48 HOURS

TEXT BOOKS:

1. E. Balagurusamy, (1999) "Numerical Methods", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. W.H. Press, B.P. Flannery et al., (2007) "Numerical Recipes: Art of Scientific Computing", 3rd Edition, Cambridge Press.

REFERENCE BOOKS:

1. J. M. Mathews and K. Fink, (2004)“Numerical Methods using MATLAB “, 4rd Edition, Prentice Hall Publication,
2. Dr. B.S. Grewal, (2005) "Numerical Methods in Engineering and Science ", Khanna Publication.
3. Robert J schilling, Sandra l harries (2004) " Applied Numerical Methods for Engineers using MATLAB and C.", Thomson Brooks/cole.
4. Richard L. Burden, J. Douglas Faires, (2003) "Numerical Analysis", Thomson / Brooks/cole
5. John. H. Mathews, Kurtis Fink, (2008) "Numerical Methods Using MATLAB" ,Prentice Hall publication
6. JAAN KIUSALAAS ,(2007) "Numerical Methods in Engineering with MATLAB", Cambridge Publication

WEBSITES:

1. https://archive.nptel.ac.in/content/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	-	2
CO2	-	3	3	-	-	-	3	2	-	-	-	3	3	3	-	-	-
CO3	-	3	3	3	-	-	-	-	-	-	-	3	-	3	-	2	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	-	3	-	2	-
CO5	-	2	3	-	-	-	-	2	-	-	2	2	-	2	-	2	2
Average	**1.2**	**2.8**	**3**	**1.8**	**0.6**	**-**	**0.6**	**0.8**	**-**	**-**	**0.4**	**2**	**0.6**	**2.8**	**-**	**1.2**	**0.8**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

24PHP305C PLASMA PHYSICS FUNDMENTALS AND APPLICATIONS 4H – 4

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

States of matter, Conductivity, Magnetic field

COURSE OBJECTIVES (CO):

- The maExplain the fundamental concepts of plasma physics, including plasma formation, characteristics, and behavior under various conditions.
- Analyze plasma dynamics and interactions using theoretical models and computational methods.
- Evaluate the role of plasma in natural phenomena, laboratory experiments, and industrial applications.
- Apply knowledge of plasma physics to solve problems in fields such as astrophysics, fusion energy, space science, and materials processing.in objectives of this course are

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Define plasma state, give examples of different kinds of plasma and explain the parameters characterizing them	Understand
CO2	Analyze the motion of charged particles in electric and magnetic fields	Analyze
CO3	Explain the concept of quasineutrality and describe plasma interaction with surfaces	Understand
CO4	Formulate kinetic and fluid descriptions of plasma, and understand the applicability of the appropriate approximations	Apply
CO5	Linearize equations describing plasma and derive differential equations for various types of waves in plasma and their dispersion relation	Apply

UNIT- I BASICS OF PLASMAS **10 HOURS**

Plasma as a state of matter, Debye length, plasma frequency, collisions, dc conductivity, ac conductivity.

UNIT- II PLASMA PRODUCTION AND MEASUREMENTS **9 HOURS**

Dc discharge, RF discharge, Photo-ionization, Tunnel ionization, Avalanche breakdown, Laser produced plasmas, Langmuir probe.

UNIT- III WAVES AND INSTABILITIES **9 HOURS**

Electromagnetic waves, Langmuir wave, Ion acoustic wave, Surface plasma wave, Ionosphere propagation, Two stream instability, Weibel instability.

UNIT- IV PLASMA CONFINEMENT **10 HOURS**

Single particle motion in a magnetic field, motion in magnetic and electric fields, motion

in inhomogeneous and curved magnetic fields, magnetic moment invariance, mirror confinement, tokamak confinement.

UNIT- V APPLICATIONS **10 HOURS**

Medium and short-wave communication, plasma processing of materials, laser ablation, laser driven fusion, magnetic fusion.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Interaction of electromagnetic waves with electron beams and plasmas, (1994) C.S. Liu and V.K. Tripathi, World Scientific.

REFERENCE BOOKS:

1. Introduction to plasma physics and controlled fusion, (1084) F.F. Chen, Plenum Press.
2. Principles of Plasma Physics, (1973) N.A. Krall and A.W. Trivelpiece, Mc Graw Hill.

WEBSITES:

1. http://nptel.iitm.ac.in/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	-	-	3	3	-	-	-	-	-	-	-	-	3	-	3	2
CO2	3	-	-	3	3	-	-	-	-	-	-	-	-	3	-	3	2
CO3	3	-	-	-	3	-	-	-	-	-	-	-	-	2	-	3	2
CO4	3	-	-	3	3	-	-	-	-	-	-	-	-	3	-	2	3
CO5	2	3	3	3	2	-	-	-	-	-	-	-	-	3	-	3	2
Average	**2.8**	**0.6**	**0.6**	**2.4**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.8**	**-**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP311 **ADVANCED PHYSICS PRACTICAL** **4H – 4**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60 T**otal**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

X-ray diffraction, Radioactive Decay, Integration, Differentiation

COURSE OBJECTIVES (CO):

- To gain practical knowledge by Apply the experimental methods to correlate with the Physics theory.
- The course is designed to train the students so that they can efficiently handle various Instruments
- To learn the usage of optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.

Course Outcomes

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Students will be able to write basic programming for numerical analysis, matrix manipulation, 2D and 3D plotting using SCILAB	Understand
CO2	Gain the knowledge in quantization of electromagnetic fields.	Understand
CO3	Use Scilab for interactive computations	Apply
CO4	Apply the laws studied in the different theory courses.	Apply
CO5	Theoretical and practical skills along with problem solving ability will be developed	Analyze

ANY TEN EXPERIMENTS

1. X-Ray Diffraction – Determination of lattice parameters of a crystalline solid.
2. Scilab Programming-Radioactive Decay
3. Scilab Programming-Numerical Integration
4. Scilab Programming-Computer Simulation of Equations of Motion for a System of Particles
5. Scilab Programming-Computer Simulation of 1-D and 2-D Lattice Vibrations
6. Scilab Programming-Computer Simulation of Kronig-Penney Model
7. Scilab Programming - To find current in a RC circuit and LCR circuit.
8. Scilab Programming - To find eigen value, determinant and inverse of a matrix.
9. Scilab Programming - To solve the differential equation dy/dx=-x with x(0)=0. y(0)=-2 from x=0 to 10 with interval =1
10. Scilab Programming - To evaluate & plot Bessel function and Legendre Polynomial in scilab
11. Scilab Programming - To solve differential equation using Euler's Method
12. Scilab Programming - Plot the diode/transistor characteristics.
13. Scilab Programming - Plot a full wave rectified waveform using Fourier series
14. Scilab Programming - civil application program (To develop a program that finds out whether a tank is overflowing or not write the shape of the tank, its dimensions and rate of flow)

TEXT BOOKS:

1. Ouseph C.C., U.J. Rao and V. Vijayendran (2019), Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.

REFERENCE BOOKS:

1. Singh S.P., 2003, Advanced Practical Physics – 1, (2017), PragathiPrakashan, Meerut, ISBN: 978-93-86633-90-3

2. B.L Worsnop& H T Flint. (2015) Advanced Practical Physics For Students, 9th Edition, Littlehampton Book Services Ltd.

WEBSITES:

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge05/
2. https://nptel.ac.in/courses/111/102/111102137/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	3	3	3	-	-	-	-	-	-	-	3	-	3	-	3	3
CO2	3	-	-	3	3	-	-	-	-	-	-	-	-	3	-	3	-
CO3	3	2	3	3	2	-	-	-	-	-	-	3	2	3	-	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	2	2	-	-	3
CO5	2	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	2
Average	**2.8**	**2.2**	**2.4**	**3**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**0.8**	**2.8**	**-**	**1.2**	**2.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24PHP312 ADVANCED ELECTRONICS PRACTICAL 3H- 2C

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal**:40** External**:60**
Total**:100** **End Semester Exam:** 3 Hours

PREREQUISITE:

Integrated circuit, Microcontroller, Microprocessor, Waveform generator

COURSE OBJECTIVES (CO):

- To introduce different integrated circuit for students to understand the application to electronics circuits
- To understand the Biasing network for BJT and FET, transient analysis and frequency response of BJT and FET in single stage and multistage amplifier
- To understand the frequency response feedback amplifier using BJT and FET and Tuned amplifier.
- This course introduces the assembly language programming of 8085 Microprocessor. It gives a practical training of interfacing the peripheral devices with the 8086 microprocessor.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Understand and apply the fundamentals of assembly level programming of microprocessors and microcontroller	Understand
CO2	Work with standard microprocessor real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters	Apply
CO3	Analyze abstract problems and apply a combination of hardware and software to address the problem	Analyze
CO4	Practically study the working of different electronic components circuits.	Understand
CO5	Learn to minimize contributing variables and recognize the limitations of the equipment.	Apply

ANY TEN EXPERIMENTS

1. Design and implementation of encoder and decoder using logic gates and study of IC 7445and IC 74147.
2. Design and implementation of odd/even parity checker / generator.
3. Design and implementation of multiplexer and de-multiplexer using logic gates and studyof IC 74150 and IC 74154.
4. Pulse Width Modulation using IC's to control DC motor speed.
5. Frequency modulation/demodulation using IC's
6. Decade counters using IC7490 and 7473
7. Arithmetic program using 8051 Microcontroller
8. Program to transfer a block of data using 8051 Microcontroller
9. To arrange set of numbers in Ascending and Descending order using 8051 Microcontroller
10. Waveform generation using 8051 Microcontroller
11. Traffic light control Interface using 8051 Microcontroller.
12. Micro-controller -interfacing of stepper motor.
13. To interface PWM based voltage regulator using 8051 Microcontroller.

TEXT BOOKS:

1. Ramesh Gaonkar, (2013), Microprocessor Architecture Programming and Applications with 8085, 6th edition, PENRAM International Pvt Ltd.
2. P. Horowitz and W. Hill, (1989) The Art of Electronics, Second edition, Cambridge University Press.

3. Ayala, K. J. (2007). The 8051 microcontroller (3rd ed.). Clifton Park, NY: Thomson Delmar Learning.

REFERENCE BOOKS:

1. Muhammad Ali Mazidi, (2003) Janice GillispieMazidi and Rolin D. McKinlay, "The 8051

2. Microcontroller And Embedded Systems Using Assembly And C " (2006), PHI, 2nd edition .

WEBSITES:

1. https://nptel.ac.in/courses/108/105/108105102/

2. https://nptel.ac.in/courses/115/102/115102014/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	3	2	2	1	-	1	1	1	-	-	1	-	-	-	3	3
CO2	3	3	3	3	1	-	1	1	1	-	-	1	-	-	-	3	3
CO3	3	2	1		1	-	1	1	1	-	-	1	-	-	-	3	2
CO4	2	2	1	1	1	-	1	1	1	-	-	1	-	-	-	3	2
CO5	3	3	2	1	1	-	1	1	1	-	-	1	-	-	-	3	2
Average	**2.8**	**2.6**	**1.8**	**1.4**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**3**	**2.4**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester- III

24PHPOE301 ELECTRICAL APPLIANCES AND SERVICING 3H-2C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal**:40** Externa**l:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE:

AC & DC current

COURSE OBJECTIVES (CO):

- To create awareness about types and handling of domestic appliances
- To acquire knowledge about principle of operation, working and application of various domestic appliances.
- To acquire skills in assembly, repair, installation, testing and maintenance of domestic appliances.
- To acquire skills in entrepreneurship

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Repair maintenance of the basic electrical and electronics appliances	Apply
CO2	Identification to protective devices	Understand
CO3	Repair and maintenance of the split Vacuum Cleaner and washing machine	Analysis
CO4	Able to do domestic wring and maintenance.	Apply
CO5	Acquire knowledge about tools, equipment and Instruments	Understand

UNIT – I INSTRUMENTS AND TESTING **8 HOURS**

Introduction – Voltage tester screwdriver – Continuing Test – Insulation test – Measurement of Power for DC & AC Circuits.

Electrical Cooking Appliances Introduction – Types – Construction – Electric Toaster – Types – Automatic and Non-Automatic.

Electric Iron Box Types – Non-Automatic – Automatic – Construction and Working – Comparision – Trouble Shooting – Steam Iron Box.

UNIT - II WATER HEATERS & COFFEE MAKERS **7 HOURS**

Water Heater – Function – Types – Electric Kettle – Immersion water heater – Construction and working – storage water heaters – Non pressure type – pressure type – construction and working – repairs & remedies – Coffee maker – types – construction and working of percolator type.

UNIT - III ELECTRIC MIXER & EGG BEATERS **7 HOURS**

Electric Maker – Function – Construction – General Operating Instruction – Caution – Cleaning – Repairs and Remedies – Egg beaters – Hand operated crank type – Electric type – Construction.

UNIT - IV VACUUM CLEANER AND WASHING MACHINE **7 HOURS**

Vacuum Cleaner – Function – Principle – Main components – features – types - working – accessories - Filters – Repairing. Washing Machine – Function – Types – Semi and Fully Automatic – Top and Front loading – washing technique – working cycle – construction and working of washing machine – comparison of Top and front loading machines – Problems and Remedies.

UNIT - V ELECTRIC FAN & HAIR DRIER **7 HOURS**

Fan – Function – Terminology – Construction and Working of Ceiling & table fans –Exhaust Fan – General Fault and Remedy. Hair Drier – Function – Types – Construction and working – safety features – repairs & remedies.

TOTAL: 36 HOURS

TEXT BOOKS:

1. Electrical Practical (2018), Directorate General of employment & training (DGET), Arihant Publisher, Edition.

REFERENCE BOOKS:

1. Handbook of Repair and Maintenance of Domestic Electronics Appliances handbook (2011) By Shashi Bhushan Sinha, BPB Publications

WEBSITES:

1. https://nptel.ac.in/courses/108/105/108105102/
2. https://nptel.ac.in/courses/115/102/115102014/

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	-	-	-	-	2	-	-	3	-	-	2	2	-	-	-	-	-
CO2	-	-	-	-	2	-	-	2	-	-	2	2	-	-	-	-	2
CO3	-	-	-	-	2	-	-	3	-	-	3	3	-	-	-	-	3
CO4	-	-	-	-	2	-	-	3	-	-	3	2	-	-	-	-	-
CO5	-	-	-	-	3	-	-	3	-	-	2	2	-	-	-	-	-
Average	-	-	-	-	**2.2**	-	-	**2.8**	-	-	**2.4**	**2.2**	-	-	-	-	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Value Added Course

WATER RESOURCE MANAGEMENT

Instruction Hours/week: L:0 T:0 P:0 **Marks: Internal:**100 **External:-**

Total:100

End Semester Exam: 3 Hours

PREREQUISITE:

Groundwater, Irrigation, Water Pollution

COURSE OBJECTIVES (CO):

- To prepare the students for a successful career as water professionals.
- To develop the ability among students to synthesis data and technical concepts for application in Integrated Water Resources Management.
- To provide students an opportunity to work as a part of an interdisciplinary team.
- To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for their career

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Choose and use integrated water resources management and gender relations and roles	Apply
CO2	Design and construct hardware and software water resource system	Understand
CO3	Understanding of professional, institutional arrangements, legal and ethical issues	Understand
CO4	Use the techniques, skills, and modern modeling software tools	Apply
CO5	Understand the impact of water and water related issues in a global, economic, environmental, and societal context	Understand

Unit I

Introduction – Scope and advantages of Groundwater- Aquifer- Infiltration - Water table –forms of water

Unit II

Hydrologic cycle- sources of Groundwater- Origin and occurrence ofgroundwater. Water conservation

Unit III

Water harvesting - Rainwater harvesting - Groundwater harvesting-methods of harvesting-Rural and Urban. Drip irrigation. Water-wise habits

Unit IV

Water Quality – standards of water for different uses- Drinking purposes- Irrigation purposes- Industrial purposes

Unit V

Water Pollution- Introduction- Types of pollution- controlling methods

TEXT BOOKS:

1. Arul.P (2000) A text book of Ground water, Dhanam Agency, Virudhachalam 2nd Ed

REFERENCE BOOKS:

1. Raghunath H.M (2015) Hydrology 3rd ed. New Age International publisher. Todd, D.K. (1980).Groundwater Hydrology, John Wiley and Sons, 2nd Ed

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	-	-	-	2	-	3	3	2	-	2	-	-	-	-	-	-	-
CO2	-	-	-	2	-	3	2	3	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	3	3	2	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	3	3	3	-	-	-	-	3	-	-	-	-
CO5	-	-	-	-	3	3	3	2	-	-	-	-	2	-	-	-	-
Average	**-**	**-**	**-**	**-**	**0.6**	**3**	**2.8**	**2.4**	**-**	**0.4**	**-**	**0.4**	**1**	**-**	**-**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester IV

24PHP491	**PROJECT**	**30H- 15C**

Instruction Hours/week: L:0 T:0 P:30 **Marks:** Internal**:40** External**:60 Total:**100

End Semester Exam: 3 Hours

PREREQUISITE:

Syntrhesis of nanomaterials, XRD, SEM, Applications of nanomaterials

COURSE OBJECTIVES (CO):

- To provides the students to get opportunity and participate in some ongoing research activity and development of a laboratory experiment.
- To provide the student with a broad spectrum of physics projects courses
- To emphasize the role of physics in life and other discipline (chemistry ,mathematics and biology)
- To develop the ability of the students to conduct, observe, analyzes and report an experiment and deal with physical models and formulas mathematically.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Demonstrate knowledge of contemporary issues in their chosen field of research.	Understand
CO2	Apply their knowledge to develop the instruments	Apply
CO3	Present and defend their research work	Analyze
CO4	Secure career in a government or scientific industry, in a teaching career, or in a related career	Understand
CO5	Succeed in problem solving in electronics	Apply

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	3	3	3	3	3	3	2	-	2	2	3	3	3	-	3	3
CO2	3	-	-	3	3	-	3	-	-	-	3	3	3	3	-	2	3
CO3	3	3	3	3	3	2	3	2	2	2	2	3	3	3	-	2	3
CO4	3	-	-	3	3	-	3	2	3	3	-	3	3	3	-	2	3
CO5	3	-	-	3	3	3	3	3	-	3	3	3	3	3	-	2	3
Average	**3**	**1.2**	**1.2**	**3**	**3**	**1.6**	**3**	**1.8**	**1**	**2**	**2**	**3**	**3**	**3**	**-**	**2.2**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation