M.Sc. PHYSICS

CHOICE BASED CREDIT SYSTEM (CBCS)

Syllabus

2023-2024

DEPARTMENT OF PHYSICS

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
(Accredited with A+ Grade by NAAC in the Second Cycle)
Pollachi Main Road, Eachanari (Post), Coimbatore- 641 021,
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FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
POST-GRADUATE PROGRAMMES
(M.Sc., M.Com.)

REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS-2023

The following Regulations are effective from the academic year 2023-2024 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.	Programme 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.Sc. Applied Astrology
9	M.Com.
10	MA English

1.2 MODE OF STUDY

Full-Time

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 ADMSSION REQUIREMENTS (ELIGIBILITY)

Candidates 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.	Name of the Programme Offered	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 / Molecular Biology / Genetic Engineering / Biochemistry / Agriculture / Forestry / Medical Lab Technology / Life Sciences

3	M.Sc. Biotechnology	B.Sc. Degree with 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 Science
5	M.Sc. Chemistry	B. Sc. Chemistry/ B. Sc. Industrial Chemistry/ B. Sc. Polymer Chemistry/ B. Sc. Applied Science
6	M.Sc. Mathematics	B.Sc. Mathematics / B.Sc. Mathematics with Computer Applications
7	M.Sc. Computer Science	B.Sc. Computer Science / Computer Technology / Information Technology / Electronics / Software Systems / BCA/ B.Sc. Applied Sciences
8	M.Com	B.Com./BCom.(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 first class in Part II - English

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. Examination shall be conducted at the end of every semester for the respective courses.

3. CHOICE BASED CREDIT SYSTEM

3.1 All programmes are offered under Choice Based Credit System with a total credit range from 87 to 93 for the PG programmes.

3.2 Credits

Credits means the weightage given to each course of study by the experts of the Board of Studies concerned.

4. STRUCTURE OF THE PROGRAMME

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

a. Core course

Core course consists of theory and practical and the examinations shall be conducted at the end of each semester.

b. Elective course

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, Institute or any other Organizations and the project report has to be submitted at the end of the fourth semester.

In case the candidate undertakes the project work outside the Department, the teacher concerned within the Department shall be the Main guide and the teacher/scientist under whom the work is carried out will be the Co-guide. The candidate shall bring the attendance certificate from the place of project work carried out.

d. Value Added Courses

Courses of varying durations but not less than 30 hours which are optional and

offered outside the curriculum that add value and help the students in for getting placement. Students of all programmes are eligible to enroll for the Value Added Courses. The student shall choose one Value Added Course per semester from the list of Value Added Courses available in KAHE. The examinations shall be conducted at the end of the Value Added Course at the Department level and the student has to secure a minimum of 50% of marks to get a pass. The certificate for the Value Added Course for the passed out students shall be issued duly signed by the HOD and Dean of the Faculty concerned.

e. Internship

The student shall undergo 15 days internship in the end of II semester. Internship report will be evaluated and awarded in the III semester. Students have to earn 2 credits for the Internship.100 marks is awarded for Internship through Continuous Internal Assessment.

f. Open Elective

He / She may select one of the open elective courses from the list given below offered by the other department 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 Department	Course Code	Name of the Course
1	M.A English	23EGPOE301	English for Competitive Examinations
2	M.Com	23CMPOE301	Personal Finance and Planning
3	MBA	23MBAPOE301	Organizational behavior
4	MCA	23CAPOE301	Robotics Process Automation
5	M.Sc Computer Science	22CSPOE301	Cyber forensics
6	M.Sc Mathematics	23MMPOE301	Coding theory
7	M.Sc Physics	23PHPOE301	Material Characterization
		23PHPOE302	Numerical methods and Programming
8	M.Sc Chemistry	22CHPOE301	Chemistry In Everyday Life
9	M.Sc Microbiology	22MBPOE301	Fermentation technology
10	M.Sc Biochemistry	22BCPOE301	Nutrition and Dietetics
11	M.Sc Biotechnology	22BTPOE301	Sericulture

Online Course

Student shall study at least one online course from SWAYAM / NPTEL / MOOC in any one of the first three semesters for which examination shall be conducted at the end of the course by the respective external agencies if any. The student can register to the courses which are approved by the Department. The student shall produce a Pass Certificate from the respective agencies before the end of the third semester. The credit(s) earned by the students will be considered as additional credit(s) over and above the credits minimum required to earn a particular Degree.

5. MEDIUM OF INSTRUCTION

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

6. 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 for End Semester Examinations (ESE).

(ii) Maximum marks for Project work

S. No	Programme	Maximum marks	CIA	ESE
1	M.Sc., M.Com., MA	200	80	120

7. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. Ideally 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 is 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 / 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. However, the candidate has to pay the prescribed condonation fee to the KAHE.

c. However, a candidate who has secured attendance less than 64% in the current semester due to any reason shall not be permitted to appear for the current semester examinations. But he/she will be permitted to appear for his/her supplementary examinations, if any and he/she has to re do the same semester with the approval of the "Students' Affairs Committee" and Registrar.

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 ward students' periodically (once in 2 weeks) on the Notice Board to enable the students to know their attendance status and satisfy the **clause 7** of this regulation.

b. ONLINE COURSE COORDINATOR

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a coordinator for the online courses. The Online course coordinator shall identify the courses which the students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinators shall advice the students regarding the online courses and monitor their course.

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 concerned HoD / senior faculty as a Chairperson. The objective of the class committee Meeting is all about the teaching – learning process. Class Committee shall be convened at least once in a month. The functions of the Class Committee shall include

- Analyzing and Solving problems experienced by students in the class room and in the laboratories.
- Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.

- 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 faculty Dean.
- The Class Committee shall be constituted during the first week of each semester.
- The HoD / Chairperson of the class committee are authorized to convene the meeting of the class committee.
- The respective faculty Dean has the right to participate in any class committee meeting.
- The Chairperson is required to prepare the minutes of every meeting, and submit the same to Dean 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.

10. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Dean depending upon whether all the teachers handling the common course belong to a single department or to various other departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the tests to ensure a uniform evaluation of the tests. If feasible, the course committee shall prepare a common question paper for the Internal Assessment test(s).

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 class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the HoD once in a fortnight for checking the syllabus coverage and records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to Dean once in a month. After the completion of the semester the HoD should keep this record in safe custody for five years. Because 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 as per the guidelines given below:

Theory Courses

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

*****Evaluated by two faculty members of the department concerned. Distribution up 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
Continuous Internal Assessment: 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 **Pattern of Test Question Paper**

Instruction	**Remarks**
Maximum Marks	50 marks
Duration	2 Hours
Part – A	Objective type (20x1=20)
Part - B	Short Answer Type (3 x 2 = 6)
Part - C	3 Eight marks questions 'either – or' choice (3 x 8 = 24 Marks)

11.4 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 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 60 marks.

Pattern of ESE Question Paper

Instruction	**Remarks**
Maximum Marks	60 marks for ESE
Duration	3 hours (½ Hr for Part – A Online & 2 ½ Hours for Part – B and C)
Part – A	20 Questions of 1 mark each (20 x 1 = 20 Marks) Question No. 1 to 20 Online Multiple Choice Questions
Part- B	5 Questions of six marks each (5 x 6 = 30 Marks.) Question No. 21 to 25 will be 'either-or' type, covering all five units of the syllabus; i.e.,

	Question No. 21: Unit - I, either 21 (a) or 21 (b), Question No. 22: Unit - II, either 22 (a) or 22 (b), Question No. 23: Unit - III, either 23 (a) or 23 (b), Question No. 24: Unit - IV, either 24 (a) or 24 (b), Question No. 25: Unit - V, either 25 (a) or 25 (b)
Part - C	Question No.26. One Ten marks Question (1 x 10 = 10 Marks)

12.2 **Practical:** There shall be combined valuation. The pattern of distribution of marks shall be as given below.

Experiments	: 40 Marks
Record	: 10 Marks
Viva-voce	: 10 Marks
Total	**: 60 Marks**

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 clause 6 (ii). ESE will be a combined evaluation of Internal and External Examiners.

12.3.2 The project report is 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 have 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: There is a passing minimum 20 marks out of 40 marks for CIA and the passing minimum is 30 marks out of 60 marks in ESE. The overall passing in each course is 50 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 13.1, 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 secures a 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 CIA marks (if it is pass) obtained by the candidate in the first appearance 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 **failed** in that examination.

14. IMPROVEMENT OF MARKS IN THE COURSE ALREADY PASSED

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 scored.

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.

$$\textbf{GPA} \text{ of a Semester} = \frac{\text{Sum of the product of the GP by the corresponding credits of the courses offered in that Semester}}{\text{Sum of the credits of the courses of that Semester}}$$

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 and retotalling 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 is allowed on representation (clause 17). 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.
- Not any disciplinary action pending 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 13) 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 13) 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 20.1 and 20.2) who qualify for the award of the degree (vide Clause 19) shall be declared to have passed the examination in **Second Class**.

21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

21.1 A candidate due to valid reason on prior application may be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

21.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

21.3 Withdrawal of application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the HoD / Dean concerned and approved by the Registrar.

21.3.1 Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

21.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IV semester.

21.5 Withdrawal from the End semester examination is **NOT** applicable to arrears courses of previous semesters.

21.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

22. PROVISION FOR AUTHORISED BREAK OF STUDY

22.1 **Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme.** However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Registrar, but not later than the last date for registering for the end semester examination of the semester in question, through the HoD stating the reasons therefore and the probable date of rejoining the programme.

22.2 The candidate thus permitted to rejoin the Programme after the break shall be governed by the Curriculum and Regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the Regulations in force at that period of time.

22.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (Vide Clause 20). However, additional break of study granted will be counted for the purpose of classification.

22.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 2.1 irrespective of the period of break of study (vide clause 22.3) in order that he/she may be eligible for the award of the degree.

22.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered

as permitted 'Break of Study' or 'Withdrawal' (Clause 21 and 22) is not applicable for this case.

23. 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.

24. 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.

25. DISCIPLINE

25.1. 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.

25.2. 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.

26. 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.

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 AND HUMANITIES
PG PROGRAM (CBCS) – M.Sc. Physics
(2023-2024 Batch and onwards)

Course code	Name of the course		Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks			P.No.
			PEOs	POs	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER – I												
23PHP101	Mathematical Physics –I		1	a	4	-	-	4	40	60	100	25
23PHP102	Electromagnetic theory and Electrodynamics		3	a	4	-	-	4	40	60	100	28
23PHP103	Classical Mechanics and Special Relativity		3	a	4	-	-	4	40	60	100	31
23PHP104	Semiconductor Devices		7	f	4	-	-	4	40	60	100	34
23PHP105A	Elective-I	Nanoscience and NanoTechnology	1,8	d,c	4	-	-	4	40	60	100	37
23PHP105B		Non-Destrctive Testing										41
23PHP105C		Instrumentation and Measurements Techniques										44
23PHP111	General Physics Practical – I		4	e, f	-	-	4	2	40	60	100	47
23PHP112	Electronics Practical – I		7	e	-	-	4	2	40	60	100	49
Journal Paper Analysis & Presentation			1,8	d	2	-	-	-	-	-	-	
Semester Total					**22**	**-**	**8**	**24**	**280**	**420**	**700**	
SEMESTER – II												
23PHP201	Thermodynamics and Statistical Mechanics		2	a	4	-	-	4	40	60	100	56
23PHP202	Quantum Mechanics – I		3	a,b	4	-	-	4	40	60	100	60
23PHP203	Mathematical Physics-II		1	a	4	-	-	4	40	60	100	63
23PHP204	Spectroscopy		4	c	4	-	-	4	40	60	100	66
23PHP205A	Elective-II	Digital Electronics and Microcontroller	4,5	d,c	4	-	-	4	40	60	100	69

23PHP205B		Solar Energy and Its Utilizaation										72
23PHP205C		Thin Film Physics										75
23PHP211	General Physics Practical – II		4	e,f	-	-	4	2	40	60	100	78
23PHP212	Electronics Practical – II		7	f	-	-	4	2	40	60	100	80
Journal Paper Analysis & Presentation			1,8	d	2	-	-	-	-	-	-	
Semester Total					**22**	**-**	**8**	**24**	**280**	**420**	**700**	
SEMESTER – III												
23PHP301	Quantum Mechanics – II		3	a	4	-		4	40	60	100	86
23PHP302	Laser and Non-Linear Optics		2	c,d	4	-		4	40	60	100	89
23PHP303	Condensed Matter Physics		2	a,b	4	-		4	40	60	100	92
23PHP304	Nuclear and Particle Physics		2	a,e	4	-		4	40	60	100	96
23PHP305A	Elective-III	Advanced Instrumentation Techniques	6	a,e	4	-		3	40	60	100	99
23PHP305B		Numerical methods in Physics										102
23PHP305C		Industrial and Power Electronics										105
23PHP311	Advanced Physics Practical		4	f		-	3	2	40	60	100	108
23PHP312	Advanced Electronics Practical		7	f		-	3	2	40	60	100	111
23XXPOE301	Open Elective	Organizational behavior	4	d	3			2	40	60	100	**114-135**
		Robotics and automation process										
		Nutrition and dietetics										
		Cyber forensics										
		Personal finance and planning										
		Chemistry in everyday life										
		Fermentation technology										
		English for competitive examination										
		Sericulture										
		Coding theory										
Journal Paper Analysis & Presentation			1,8	d	1	-						
23PHP391	*Internship		4	f				2	100	-	100	
Semester total					**24**	**-**	**6**	**27**	**420**	**480**	**900**	

SEMESTER – IV											
23PHP491	Project	1,3,6,8	b,c,d,e		-		15	80	120	200	136
	Semester total			**30**	**-**		**15**	**80**	**120**	**200**	
*End of II Semester- Internship for 15 days											
	Total				**-**		**90**	**1060**	**1440**	**2500**	

Elective Courses*

Elective – I (23PHP105)		**Elective – II (23PHP205)**		**Elective – III (23PHP305)**	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
23PHP105A	Nano-science and Nano Technology	23PHP205A	Digital Electronics and Microcontroller	23PHP305A	Advanced Insrumentation Techniques
23PHP105B	Non-Destrctive Testing	23PHP205B	Solar Energy and Its Utilizaation	23PHP305B	Numerical methods in Physics
23PHP105C	Instrumenttion and Measurement Techniques	23PHP205C	Thin Film Physics	23PHP305C	Industrial and Power Electronics

Open Electives

S.No	**Course Code**	**Title of the Course**
1	**23PHPOE301**	Material Characterizaion
2	**23PHPOE302**	Numerical Methods and Programming

List of Value Added Course

Semester- I	Semester- II	Semester- III
Process of Air Refrigeration	Physics in Electronics Communication	Embedded Systems
Basic Domestic Electrical Appliances and Servicing	Process of Vapour Communication	Water Resource Management

PROGRAMME OUTCOMES

At the end of the programme, the students will

a) The students will obtain good knowledge in the physical sciences. They will be trained to compete in national-level tests like UGC-CSIR NET, JEST, GATE, etc. successfully.
b) Understand the concepts of advanced physics and capable to apply them in real time problems to find appropriate solutions.
c) Develop model and analyse to derive solution using the background of theoretical physics
d) Augment the application feasibility of Physics theoretical formulations in combination with relative concepts belongs to other discipline.
e) Apply learned experimental skill to develop newer materials with unique characteristics employing variety of synthesis techniques.
f) Develop software tools by applying the learned concepts in combination belongs to Mathematical physics, Quantum mechanics and computational physics
g) Perceive novel and contemporary research philosophies globally facilitate to work at par with international standards.
h) Meet any challenge globally for employment in academic, research and industry by exposing the learned skill in diverse zone under Physics discipline.

PROGRAMME SPECIFIC OUTCOMES

i) Recognize how observation, experiment and theory work together.
j) They acquire the knowledge to design and develop a device to meet the social needs or necessity of common people.

k) Be a potential graduate with the stuff of vibrant subject knowledge in every subdivision of Physics especially in Classical Mechanics, Quantum Mechanics, Mathematical Physics, Nuclear Physics, Electronics and Materials Science with application tendency.

l) Have the skill to manage computational tools to explore scientific activity even at subatomic particle level using theoretical concepts without empirical approach.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Understand the advanced trends in Physicswill become experts in various professional zones like industry, research, academic, etc. at par with national and international standards.

PEO 2: Perform procedures as per laboratory standards in the areas like electronics and communications, laser, Nuclear Physics, Solar energy and Thermal Physics.

PEO 3: To prepare students to take up challenges as globally competitive physicists/researchers in diverse areas of theoretical and experimental physics.

PEO 4: To understand modern measurement technology by learning diverse phenomena of physical concepts help them to lead and execute inter- and multidisciplinary academic and research works.

PEO 5: To develop the skill enough to perceive novel and innovative concepts to develop cutting edge technologies as entrepreneur.

PEO 6: To create a sense of ethical responsibilities among students.

PEO 7: They will become a talented pool of source for the semiconductor device fabrication industries / energy material laboratories

PEO 8: They will decorate the positions as leading scientists at R&D institutions.

Pos	a	b	c	d	e	f	g	h	i
PEO1		X		X	X				X
PEO2	X		X					X	X
PEO3				X		X	X	X	
PEO4		X			X				X

PEO5	X	X		X		X			
PEO6	X		X	X		X	X	X	
PEO7		X		X			X		
PEO8			X			X			X

23PHP101 MATHEMATICAL PHYSICS - I 4H – 4C

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

Course Objectives

Themainobjectivesofthiscourseareto:

1. understandbasicsofvectoranalysis, curvilinearcoordinatesystem,linearvectorspaceandtensors
2. familiarizeinfiniteseriesanderroranalysis
3. learncomplexvariablesandresiduetheoremtechniquetosolverealintegralsappea ringinphysicsproblems.
4. understanddifferentialequationsand selfadjointoperators

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO 1	Understandvectorcalculusandalsoabletowriteoperatorsindifferentcoordinates ystem	Understand
CO 2	apply linearvectorspaceconceptsinquantummechanics	Apply
CO 3	understandconvergenceofinfiniteseries, erroranalysisandcurvefitting	Analysis
CO 4	evaluaterealintegralsappearinginscienceandengineeringproblems	Evaluate
CO 5	solvedifferentialequationsand understandselfadjointoperatorsused inquantummechanics	Evaluate

Mapping with Programm Outcomes

Mapping with Programme Outcomes								
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	S	S	S	S	L	S	S	M
CO3	S	S	S	S	L	S	S	M
CO3	S	S	S	M	L	S	M	M
CO4	S	S	S	M	L	S	S	M
CO5	S	S	S	S	L	S	S	M

*S-Strong;M-Medium;L-Low

UNIT I - Vector Space and Matrices [10 hrs]

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.

UNIT II-Tensor Analysis [10 hrs]

Definition of tensors - Transformation of coordinates – Summation convention – Contravariant Tensor – Covariant Tensor – Mixed Tensor – Rank of a Tensor – Tensors of rank higher than two - Kronecker delta symbol – symmetric and antisymmetric tensors – Invariant tensors. Quotient law- Metric tensor - Conjugate tensor.

UNIT III: Complex Variable [10 hrs]

Functions of a complex variable – single and multivalued functions – Cauchy-Riemann differential equation – analytical – line integrals of complex function – Cauchy's integral theorem and integral formula – derivatives of an analytic function – 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 IV:Ordinary Differential Equations [9 hrs]

First and Second Order Ordinary Differential Equations with Constant Coefficients – Initial Value Problem – Method of Finding Solutions – Superposition Principle – Wronskian – Second Order Differential Equations with Variable Coefficients – Definition of Ordinary and Singular Points – Power Series Solution – Solutions About Ordinary Point and Singular Point.

UNITV:Group theory and probability[9 hrs]

Group Theory Definition of groups, subgroups and conjugate classes - Symmetry elements, Transformation, Matrix representation - Point groups - representation of a group - Reducible and irreducible representations - character of a representation - character Table C2v and C3v.Probability Definitions - Simple Properties – Random Variables - Probability distribution - Binomial Distribution – Poisson Distribution – Gauss's Normal Distribution.

SUGGESTED READINGS

1. Mathematical Methods for Physicists (a comprehensive guide) – George B. Arfken and Hans J. Weber and Frank E. Harris, Elsevier Academic Press, 7th Edition, 2013.

2 Mathematical Methods for Physics and Engineering – K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge University Press, 3rd Edition, 2006.

3.Mathematical Physics – P. K. Chattopadhyay, New Age International Publishers, 2nd Edition, 2013.

4.Advanced Engineering Mathematics – Erwin Kreyszig, Herbert Kreyszig and Edward J. Norminton, John Wiley & Sons, 10th Edition, 2011

5.Mathematical Methods in the Physical Sciences – Mary L. Boas, John Wiley & Sons, 3rd Edition, 2006.

6. https://nptel.ac.in/courses/115103036/

7. https://nptel.ac.in/courses/115105097/

SEMESTER-I
4H- - 4C

23PHP102 ELECTROMAGNETIC THEORY AND ELECTRODYNAMICS

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

Course Objectives

- The aim of this course is to provide the students with the fundamental principles of electrical energy (electro- magnetism).
- To understand the propagation of waves in different media, its transmission and reception.
- To understand, develop, and design various engineering applications involving electromagnetic fields.
- To expose the students to the ideas of electromagnetic waves and structure of transmission line
- To obtain an applying the Maxwell's equations and to solving practical electromagnetic fields
- To provide the understanding to the propagation of EM wave in free space, conductors & dielectrics.

Course Outcomes

At the end of this course, students 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, magnetostatics and stationary current distributions in linear, isotropic media, and also solve such problems in simple geometries using separation of variables and the method of images.	Apply
CO4	Analysisthe theories and properties of electrostatics	Analysis
CO5	Analyze the interaction of electrostatic properties with matter.	Analysis
CO6	Acquire the fundamental knowledge in Magnetostatics	Evaluate

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**L**	**S**	**M**	**M**
CO2	**S**	**S**	**M**	**M**	**L**	**S**	**M**	**M**
CO3	**S**	**S**	**M**	**S**	**L**	**S**	**S**	**M**
CO4	**S**	**S**	**M**	**M**	**L**	**S**	**S**	**M**
CO5	**S**	**S**	**M**	**M**	**L**	**M**	**M**	**M**
CO6	**S**	**S**	**M**	**M**	**L**	**M**	**M**	**M**

*S-Strong;M-Medium;L-Low

UNIT- I - ELECTROSTATICS& MAGNETOSTATICS [10 hrs]

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 [10 hrs]

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 [10 hrs]

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[9 hrs]

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 [9 hrs]

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.

SUGGESTED READINGS

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 , 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.
5. Schwaritz. M. 2008, Principles of Electro dynamics, McGraw Hill, Auckland.
6. Jordon and Balmain 2ndedition 2002, EMW radiating systems, Prentice Hall of India Pvt Ltd, New Delhi.
7. Gupta, Kumar and Singh, 2007, Electro dynamics, 19th Edition, Pragati Prakasan, Meerut, New Delhi.
8. Satya Prakash 10th revised 2003, Electromagnetic theory and Electro dynamics, Kedar Nath Ram Nath & Co, Meerut.
9. https://nptel.ac.in/courses/115101008/
10. https://nptel.ac.in/content/syllabus_pdf/104104085.pdf

SEMESTER-I

23PHP103 CLASSICAL MECHANICS AND SPECIAL RELATIVITY 4H – 4C

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

End Semester Exam: 3 Hours

Course objective

Themainobjectivesofthis course areto:

1. Understandbasicsofvariationalprinciple, LagrangianandHamiltonianformalism
2. knowaboutcentralforceproblem, phasespace,canonicaltransformationandHamiltonJacobitechnique
3. applynormalmodeanalysistophysicalsystems
4. learn concepts of special relativity and familarise basics of non-linear dynamics.
5. Appling Newton's law-Lagrangian formulation of relativistic mechanics in daily life.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO 1	Familarisebasicmathematicaltoolslikevariationalcalculustomechanicalsystem sandable tocomputeLagrangianandHamiltonianequation ofmotion	Understand
CO 2	Understandcentralforceproblemandalsosysteminnon-inertialreferenceframe	Apply
CO 3	analyse mechanics problems through canonical transformation technique and HamiltonJacobitechnique	Analysis
CO 4	learnrigidbodydynamicsandnormal modeanalysis	Evaluate
CO 5	Studybasicconceptofspecialtheoryofrelativityandnon-lineardynamics	Evaluate

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**S**	**S**	**L**	**L**	**M**	**M**
CO2	**S**	**S**	**M**	**M**	**L**	**M**	**S**	**M**
CO3	**S**	**S**	**S**	**S**	**L**	**M**	**S**	**M**

CO4	**S**	**S**	**S**	**M**	**L**	**M**	**S**	**M**
CO5	**S**	**S**	**S**	**M**	**L**	**M**	**M**	**M**

*S-Strong;M-Medium;L-Low

Unit I: Lagrangian and Hamiltonian Dynamics [10 hrs]

Constraints - generalized coordinates – D'Alembert's Principle - Hamilton's variational principle-Euler lagnranian differential equation- Lagrange's equation from Hamilton's variational principles-Application of Lagraingan equation of motion- simple pendulum, linear harmonic oscialltor, Atwood machine electric circuit.

Unit II :Hamiltonian formulation of mechanics[10 hrs]

Hamiltionian-Hamiltonian cannical equation of motion-Physical significance of H-Advantages of Hamiltonian approach-Deduction of canonical equations from variational principle-Applications of Hamiltaon equation sof motion- simple pendulum, compound pendulum, isotropic harmonics oscillator- linear harmonic oscillator- particle moving near the surface of earth- principle of least action- Advantages of canonical equation- condition for ta transformation to the canonical.

Unit III: Rigid body Motion [10 hrs]

Generalized co-ordinates for rigid body motion - 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: Small oscillations and Canonical Transformations [9 hrs]

Stable and unstable equilibrium – two coupled oscilaator- Normal coordinates and normal frequencies of vibration- system with few degrees of freedom : parallel pendula, double pendula, triple pendula- linear triatomic molecule -Poisson's brackets and Lagrange's bracket- Hamilton Jacobi method – Hamilton Jacobi equation for Hamilton characteristics function

Unit V: Special relativity in Classical Mechanics[9 hrs]

Basic postulates of Special theory of relativity- Lorentz transformation- Relaivistic generalization of Newton's law-Lagrangian formulation of relativistic mechanics—Hamiltonian formulation of relativistic mechanics—Covariant Lagrangian formulation -Covariant Hamiltonian Formulation

SUGGESTED READINGS

1) Gupta, Kumar and Sharma – Classical Mechanis- Pragati's Prakashan, Meerut.
2) Herbert Goldstein, Charles Poole, John Safko 'Classical Mechanics' III Edition, Pearson Education, Dorling Kindersley Publication, New Delhi (2002**).**
3) M.Lakshmanan and S.Rajesakar, Non-linear Dynamics,Springer(2003)
4) J. C. Upadyaya, 'Classical Mechanics', Himalaya Publishing House, Mumbai (2014).
5) N.C.Rana, P.S.Joag, Classical Mechanics, Tata McGraw Hill, New Delhi (2004).
6) B.D.Gupta and SathyaPrakash, Classical Mechanics, Kethernath, Ramnath publications (2015).
7) Tom W.B. Kibble, Frank H. Berkshire, 'Classical Mechanics',Imperial College Press, London (2004).
8) Wolfgang Kliemann, N. Sri Namachchivaya, 'Nonlinear dynamics and Stochastic Mechanics'CRC Press, USA. (2018).
9) Gerd Baumann, 'Classical Mechanics and Nonlinear dynamics', Second Edition, Springer (2004).
10) https://nptel.ac.in/courses/115105098/
11) https://nptel.ac.in/courses/115106059/

SEMESTER – I

23PHP104 SEMICONDUCTOR DEVICES 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives:

- To improve semiconductor device structures for various applications.
- This paper contains details of basic electronic components, their characteristics and applications in the construction of different electronic instruments.
- Other than ordinary transistors and diodes special devices are also explained.
- 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

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

COs	Course Outcomes	Blooms Level
CO1	Ability to explain the working, design considerations and applications of various semiconducting devices including p-n junctions, BJT's and FET's.	Apply
CO2	Ability describe the working and design considerations for the various photonic devices like photo-detectors, solar-cells and LED's	Understand
CO3	Ability to determine the suitable device for the application	Analysis
CO4	Design and Differentiate of semiconductor power device and its parameters.	Evaluate
CO5	Ability to design of protection circuits and control circuits	Understand

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**M**
CO2	**M**	**S**	**S**	**M**	**S**	**M**	**M**	**M**
CO3	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**
CO4	**S**	**S**	**M**	**S**	**M**	**S**	**S**	**M**
CO5	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**M**

*S-Strong;M-Medium;L-Low

UNIT I [10 hrs]

Physics of Semiconductors: Optical absorption- carrier generation-life time-diffusion length and photo conductivity-Direct and indirect recombination and trapping- Diffusion of carriers, Einstein relation, Continuity equation-carrier injection. **Junctions:** p-n junction and contact potential-Fermi levels-Space charge-Reverse and Forward bias-Zener and Avalanche breakdown-Capacitance of p-n junction- Schottky barriers-Schottky barrier height-C-V characteristics-current flow across Schottky barrier: thermionic emission-Rectifying contact and Ohmic contact.

UNIT II [10 hrs]

Bipolar Junction Transistors (BJT): Fundamentals of BJT operation-Minority carrier distribution-Solution of diffusion equation in base region-Terminal current-current transfer ratio-Ebers-Moll equations-Transistor Biasing- CB, CE & CC Configuration - Method of Biasing-Charge control analysis. BJT switching: Cut off-Saturation-Switching cycle-Active region.

UNIT III [10 hrs]

Field Effect Transistors: Introduction to FET - Construction and Operation of N-Channel JFET - Drain Characteristics - Comparison of JFET & BJT - I-V characteristics-MESFET,MOSFET,Operation,Output and transfer characteristics of MOSFET- MOS capacitor-Debye screening length-Effect of real surfaces; Work function difference-Interface charge-

Threshold voltage and its control-MOS C-V analysis and time dependent capacitance-Unipolar Devices-MODFETs.

UNIT IV [9hrs]

Power Devices: Tunnel devices-Tunnel diode-IMPATT diodes-Static and dynamic characteristics-power and efficiency-noise behavior-BARITT diode-TUNNETT diode-Transferred-electron devices-real-space-transfer devices-SCR, Triac, Diac-construction and working -characteristics- Basics of GTO, MCT, FCT, RCT- Integrated gate commutated thyristor (IGCT).

UNIT V

Opto electronic Devices [9 hrs]

Principles, Operation and Characteristics OfOpto Electronic Devices - LED: Radiative transition-Emission spectra-Luminous efficiency and LED materials- – LED – IR Emitter – LCD – Opto–Couplers - LDR – Photo Diode - Photo Transistor – Photo Voltaic Cell-Solar cell and photo detectors: Ideal conversion efficiency-Fill factor-Equivalent circuit,Voc ,Isc and Load resistance-Spectral response. Reverse saturation current in photo detector.

SUGGESTED READINGS

1. Donald Neamen, Semiconductors Physics and Devices, Tata Mc Graw Hill, 2003.
2. S.M.Sze, Physics of Semiconductor Devices, John Wily & Sons, New Delhi, (2007).
3. Mishra, Umesh K. and Singh, Jaspreet, Semiconductor Device Physics and Design, Springer, (2008).
4. Pierret, R.F., Semiconductor Device Fundamentals, Pearson Education Inc., (2006).
5. Rashid M.H., Power Electronics Circuits, Devices and Applications “, Prentice Hall India, Third Edition, New Delhi, 2004.
6. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGraw-Hill, 2010.
7. Mohan, Undeland and Robins, “Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.
8. Mehta V.K. – Principles of electronics – S. Chand & Co. Ltd., 11th Edition, 2008.
9. Boyle L. stad and Louis Nashelsky, 10th edition, 2013, Electronic devices and circuit theory, Prentice - Hall of India, Delhi.
10. Millman and Halkias, 48th reprint, Integrated electronics, Tata McGraw-Hill, New Delhi, 2008.
11. https://nptel.ac.in/courses/122106025/
12. https://nptel.ac.in/courses/108108112/

SEMESTER-I
4H- - 4C

23PHP105A NANOSCIENCE AND NANOTECHNOLOGY

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

Course Objectives

- This course introduces the fundamentals of nano-scale engineering and manufacturing.
- Current and future applications of nanostructured materials will be reviewed with respect to their impact in commercial products and technologies.
- The main physical forces controlling the nucleation and deposition of nanostructures will be presented allowing a better understanding ofkey design factors at the nano-scale. Well-established and novel synthesis/fabrication methods
- nanostructures will be critically discussed giving a broad overview of the state-of-the-artnanomanufacturing processes.
- To foster the creation of new and relevant technologies and to transfer them to industry for effective utilization of nano materials.
- Different types of nanostructured materials, their general and specific characteristics will be discussed.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Apply engineering and physics concepts to the nano-scale and non-continuum domain.	Apply
CO2	Explain the fundamental principles of nanotechnology and their application	Understand
CO3	Distinguish different classes of nanostructured materials and nanostructures based on dimension	Analysis
CO4	Gain broad understanding of advanced physical techniques employed for the preparation of 1D and 0D nanostructures.	Evaluate
CO5	Identify and compare state-of-the-art nanofabrication methods and perform a criticalanalysis of the research literature	Understand
CO6	Appraise the working principle and issues of energy conversion devices	Evaluate

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**L**	**S**	**M**	**M**
CO2	**S**	**S**	**M**	**M**	**L**	**S**	**M**	**M**
CO3	**S**	**S**	**M**	**S**	**L**	**S**	**S**	**M**
CO4	**S**	**S**	**M**	**M**	**L**	**S**	**S**	**M**
CO5	**S**	**S**	**M**	**M**	**L**	**S**	**M**	**M**
CO6	**S**	**S**	**M**	**M**	**L**	**S**	**M**	**M**

*S-Strong;M-Medium;L-Low

UNIT – I - GENERIC METHODOLOGIES FOR NANOTECHNOLOGY[10 hrs]

Introduction and classification - Classification of nanostructures - Nanoscale architecture; Summary of the electronic properties of atoms and solids - The isolated atom - Bonding between atoms - Giant molecular solids - The free electron model and energy bands - Crystalline solids - Electronic conduction; Effects of the nanometre length scale - How nanoscale dimensions affect properties

UNIT – II–SYNTHESIS OF NANOSTRUCTURE MATERIALS: [10 hrs]

Bottom-up and Top-down approaches (various methods to synthesize nanomaterials) – Sol-gel, C-precipitation, Solid State, Hydrothermal, Solvothermal, synthesis of oxide nanoparticles - synthesis of multicomponant nanostructures - quantum dot- quantum wells.

UNIT – III–CARBON NANOSTRUCTURES [10 hrs]

Carbon Molecules - Nature of the Carbon Bond - New Carbon Structures - Carbon Clusters - Small Carbon Clusters - Carbon Nano tubes - Fabrication - Structure –Applications of Carbon Nano Tubes - Computers - Fuel Cells - Chemical Sensors - Catalysis – Mechanical Reinforcement - Field Emission and Shielding. Solid Disordered Nanostructures - Methods of Synthesis - Failure Mechanisms of Conventional Grain sized Materials –Nano structured Multi layers -Electrical Properties – Porous Silicon - Metal Nano cluster - Composite Glasses.

UNIT – IV–INDUSTRIAL APPLICATIONS OF NANOMATERIALS [9 hrs]

Nanoparticles and Micro –organism, Nanomaterials in bone substitutes & Dentistry, Food and Cosmetic applications, Textiles, Paints, Catalysis, Drug delivery and its applications, Biochips-analytical devices, Biosensors- MEMS, NEMS

UNIT – V–NANOMATERIALS IN ENERGY DEVICES[9 hrs]

Issues and Challenges of functional Nanostructured Materials for electrochemical Energy, Fuel Cells, Principles and nanomaterials design-Primary and Secondary Batteries, Cathode and anode materials, Nanostructured Carbon-based materials- Capacitor, Electrochemical supercapacitors, electrical double layer model, Principles and materials design-Electrochemical Impedance Spectroscopy.

SUGGESTED READINGS

1. Nanotechnology: Principles and Practices by Sulabha K. Kulkarni, Springer Nature; 3rd 2015 edition.
2. Charles P. Poole, Jr. and Frank J. Owens, Istedition 2003, Introduction to Nanotechnology,Wiley,
3. Cornelius T Leondes, MEMS/NEMS: micro electro mechanical systems/nano electromechanical systems Volume 1, Design Methods, Springer, (2006).
4. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005
5. Nano:The Essentials: Understanding Nanoscience and Nanotecnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008
6. D. Linden. Thomas B. Reddy, Handbook of Batteries, 3rd Edition, McGraw-Hill, New York, (2002)
7. Allen J.Bard and Larry R Electrochemical methods: Fundamentals and Applications, Faulkner, 2 ndEdition John Wiley & Sons. Inc, (2004).
8. B.E. Conway, Electrochemical supercapacitors: Scientific Fundamentals and Technological Applications, Kluwer Academic Plenum publisher, New York, (1999).
9. C. Brabec, V. Dyakonov, U. Scherf, Organic Photovoltaics: Materials, Device Physics, and MaufacturingTecchnology, 2nd Edition, WileyVCH, (2014)

10. https://nptel.ac.in/courses/118104008/
11. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ch26/
12. https://nptel.ac.in/courses/112/107/112107283/
13. https://nptel.ac.in/courses/102/107/102107058/

SEMESTER – I

23PHP105B NON-DESTRUCTIVE TESTING 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives

- To provide a basic understandingwith case studies ondifferent surface NDE techniques.
- Nondestructive Testing (NDT) plays an extremely important 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

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

COs	Course Outcomes	Blooms Level
CO1	A basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures	Understand
CO2	The student shall be able to solve various problems encountered like leakage, cracks, blowholes etc with the manufacturing process by analyzing the data.	Analysis
CO3	Competent enough to make use of modern tools and softwares for analyzing and solving real life problems.	Creating
CO4	Differentiate various defect types and select the appropriate NDT methods for better evaluation	Evaluate
CO5	Communicate their conclusions clearly to specialist and non-specialist audiences	Understand
CO6	Document the testing and evaluation of the results for further analysis.	Evaluate

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**S**	**M**	**L**	**S**	**M**
CO2	**S**	**S**	**M**	**S**	**M**	**M**	**L**	**M**
CO3	**S**	**S**	**M**	**M**	**S**	**S**	**M**	**L**
CO4	**S**	**S**	**M**	**M**	**L**	**S**	**M**	**S**
CO5	**M**	**S**	**M**	**S**	**M**	**L**	**M**	**S**

CO6	**S**	**S**	**M**	**S**	**M**	**L**	**S**	**M**

*S-Strong;M-Medium;L-Low

[10 hrs]

UNIT I- INTRODUCTION TO NDT

Introduction to 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 hrs]

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 TESTING [10 hrs]

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 - Penetrameter - Determining radiographic exposure -Inspection Techniques -Single wall single image technique - Double wall penetration technique.

UNIT IV-EDDY CURRENT TESTING [9 hrs]

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, steelbars, welded tubing, plates and pipes, Remote Field Sensing - Interpretation/Evaluation – Applicable codes and standards.

UNIT V -MAGNETIC PARTICLE TESTING [9 hrs]

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, MagneticBarkhausenNoise Analysis (MBN)– advantages and limitation.

SUGGESTED READINGS

1. J.Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).
2. Non-Destructive Examination and Quality Control, ASM International, Vol.17, 9th edition (1989)
3. B.Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition (2007).
4. Ed. Peter.J. Shull, Nondestructive Evaluation : Theory, Techniques, and Applications, Marcel Dekker (2002).
5. C. Hellier, Handbook of Non-Destructive Evaluation, McGraw-Hill Professional, 1st edition (2001).
6. B.P.C. Rao, Practical Eddy Current Testing, Alpha Science International Limited (2006).
7. Practical Nondestructive Testing, Baldev Raj, T. Jayakumar, M. Thavasimuthu,Narosa Publishing House New Delhi.
8. Paul E. Mix, AJohn, Introduction to Non-Destructive Testing, A Training Guide, 2nd Edition, Wiley & Sons, 2005.
9. https://nptel.ac.in/courses/113/106/113106070/

SEMESTER – I

23PHP105C 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

Course Objectives

- It is necessary for a physics student to be familiar with different instrumentation
- techniques.
- Give a basic idea about different methods of mathematics, used in Physics.
- The purpose of the course is to introduce students to methods of mathematical physics
- To develop required experimental skills to solve problems in instrumentation.
- This course provides the basic concepts electrical and electronic noises
- To impart knowledge about various sensor technology and measurements

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Explain the precision and accuracy of a measure as it pertains to international standards	Understand
CO2	Effectively design instrumentation systems that conform to industrial regulations.	Apply
CO3	Analyze and specify component and system requirements for installation of instrumentation systems	Analysis
CO4	Implement techniques to reduce electrical noises in measurement circuits	Apply
CO5	Select sensors for applications to specific measurement tasks	Apply
CO6	Design and analyze electronic instrumentation system to interface with standard industrial sensors/transducers.	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**S**	**S**	**M**	**L**	**S**	**M**
CO2	**S**	**S**	**M**	**S**	**M**	**M**	**L**	**M**
CO3	**S**	**S**	**S**	**M**	**S**	**S**	**M**	**L**
CO4	**S**	**S**	**M**	**M**	**L**	**S**	**M**	**S**
CO5	**S**	**S**	**M**	**S**	**M**	**L**	**M**	**S**

*S-Strong;M-Medium;L-Low

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Unit I -MEASUREMENTS: [10 hrs]

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. Guassian distribution.

Unit II- SIGNALS AND SYSTEMS: [10 hrs]

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 hrs]

Sensors and transducers 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 hrs]

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

Unit V-VACUUM SYSTEM [9 hrs]

Vacuum Systems: 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).

SUGGESTED READINGS

1) Singh, S. K. (2011) Industrial Instrumentation and Control. Tata-McGraw-Hill Publishing 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, M. Sayer and A. Mansingh, PHI Learning Pvt. Ltd. (2015)

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

6) Transducers and Instrumentation, D.V.S. Murty, 2nd Edition, PHI Learning Pvt. Ltd. (2010)
7) Instrumentation Devices and Systems, C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill , (2015)
8) Principles of Electronic Instrumentation, D. Patranabis, PHI Learning Pvt. Ltd (2017)
9) https://nptel.ac.in/courses/108105064
10) https://nptel.ac.in/courses/103105130

SEMESTER – I

23PHP111 GENERAL PHYSICS PRACTICAL - I 4H – 2C

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

End Semester Exam: 3 Hours

Course Objective

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To Understand 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.
- Equip the students in basic communication skills in the course of performing the laboratory experiments in groups and by interpreting the results

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Verify laws studied in the different theory course	Understanding
CO2	Measure different properties of materials	Analysis
CO3	Classify the materials with the properties and experimental skill	Apply
CO4	Apply the analytical techniques and graphical analysis to the experimental data	Apply
CO5	Capable to built his own equipments for measuring the properties of materials	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	L	M	M	M	M
CO2	S	S	M	M	S	M	M	S
CO3	S	S	M	S	S	M	S	S
CO4	S	S	M	M	M	S	S	M
CO5	S	S	S	M	M	M	M	M

*S-Strong;M-Medium;L-Low

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.

SUGGESTED READINGS

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

SEMESTER – I

23PHP112 **ELECTRONICS PRACTICAL – I** **4H – 2C**

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

End Semester Exam: 3 Hours

Course Objectives

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To understand 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.
- Know and follow the proper procedures and regulations for safely working in a lab.
- To communicate the concepts and results of their laboratory experiments through effective writing and oral communication skills.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Design and handle various instruments.	Creating
CO2	Verify laws studied in the different theory course	Understanding
CO3	Gain the knowledge in quantization of electromagnetic fields	Analysis
CO4	Analyze the characteristics of oscillators and wave shaping circuits	Apply
CO5	Understand the basic concepts of amplifiers and operational amplifier	Understanding

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**M**	**S**	**M**	**S**	**M**	**L**	**L**	**L**
CO2	**M**	**M**	**S**	**M**	**M**	**M**	**L**	**M**
CO3	**M**	**S**	**S**	**S**	**S**	**L**	**L**	**L**
CO4	**S**	**S**	**M**	**S**	**S**	**M**	**L**	**M**
CO5	**S**	**S**	**M**	**M**	**M**	**L**	**L**	**L**

*S-Strong;M-Medium;L-Low

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. Hartley oscillators using discrete components.
7. Colpitt's oscillators using discrete components
8. Wave form generators (Square wave and Triangular wave) – Op amp.
9. Wein's bridge oscillator – Op amp.
10. Astable and monostable using discrete components.
11. Analog computer setup – Solving simultaneous equations.
12. Design and construct Differential amplifiers and plot the frequency response curve
13. FET characteristics and Source follower.

SUGGESTED READINGS

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
3. Singh S.P., 2000, Advanced Practical Physics – 2, 12th Edition, PragathiPrakashan, Meerut
4. Ramakant A. Gayakwad,2002, Op-amp and Linear Integrated Circuits,4th Edition, Prentice Hall
5. https://nptel.ac.in/courses/122106025/

SEMESTER – I

Value Added Course

PROCESS OF AIR REFRIGERATION **3H-0C**

Course Objectives:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Operate and analyze the refrigeration and air conditioning systems.	Understanding
CO2	Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems	Understanding
CO3	Calculate cooling load for air conditioning systems used for various	Apply
CO4	Present the properties, applications and environmental issues of different refrigerants	Analysis
CO5	Illustrate the fundamental principles and applications of refrigeration and air conditioning system	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**M**
CO2	**S**	**S**	**M**	**M**	**S**	**M**	**M**	**M**
CO3	**M**	**S**	**M**	**S**	**M**	**L**	**L**	**L**
CO4	**M**	**M**	**S**	**M**	**M**	**M**	**L**	**M**
CO5	**M**	**S**	**S**	**S**	**S**	**L**	**L**	**L**

*S-Strong;M-Medium;L-Low

UNIT 1

Introduction to air refrigeration – Design of air refrigeration. Applications – Air Craft Refrigeration -Simple, Bootstrap, Regenerative and Reduced ambient systems – Problems based on different systems.

UNIT 2

Steam Jet refrigeration system: Representation on T-S and H-S diagrams – limitations and applications. Unconventional Refrigeration system – Thermos-electric – Vortex tube; Pulse tube – working principles.

UNIT 3

Process of air –conditioning: Psychometric properties and processes – Construction of Psychometric chart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature.

UNIT 4

Process of air –conditioning systems: All Fresh air , Re-circulated air with and without bypass, with reheat systems – Calculation of Bypass Factor, ADP,RSHF, ESHF and GSHF for different systems.

UNIT 5

Components: Humidification and de humidification equipment – Systems of Air cleaning –Grills and diffusers – Fans and blowers – Measurement and control of Temperature and Humidity.

SUGGESTED READINGS

1. Refrigeration & Air Conditioning /C.P. Arora/TMH

2. Refrigeration & Air Conditioning /Arora &Domkundwar/ Dhanpat Rai

3. Refrigeration and Air Conditioning /Manohar Prasad/

4. Refrigeration and Air Conditioning /Stoecker /Mc Graw Hill

5. Principles of Refrigeration/Dossat /Pearson

6. Refrigeration and Air Conditioning /Ananthanarayana /TMH

7. Refrigeration and Air Conditioning /Jordan&Preister /Prentice Hall

8. Refrigeration and Air Conditioning/Dossat /Mc Graw Hil.

Value Added Course

BASIC DOMESTIC ELECTRICAL APPLIANCES AND SERVICING 3H-0C

COURSE OBJECTIVE

1. To create awareness about types and handling of domestic appliances
2. To acquire knowledge about principle of operation, working and application of various domestic appliances.
3. To acquire skills in assembly, repair, installation, testing and maintenance of domestic appliances.
4. To acquire skills in entrepreneurship
5. To create awareness towards consumption of energy conservation

Course Outcomes

At the end of this course, students 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	Understanding
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	Understanding

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**M**	**M**	**M**	**M**	**M**	**L**	**M**
CO2	**S**	**M**	**M**	**M**	**S**	**M**	**L**	**M**
CO3	**S**	**M**	**M**	**S**	**S**	**M**	**L**	**M**
CO4	**S**	**M**	**L**	**L**	**L**	**S**	**L**	**M**
CO5	**S**	**M**	**M**	**M**	**M**	**M**	**M**	**M**

*S-Strong;M-Medium;L-Low

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 and front loading machines – Problems and Remedies.

UNIT - V ELECTRIC FAN & HAIR DRIER

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.

SUGGESTED READINGS

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

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

SEMESTER – II

23PHP201 THERMODYNAMICS AND STATISTICAL MECHANICS 4H – 4C

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

End Semester Exam: 3 Hours

Course objectives

- Thermodynamics is an important branch of physics, which helps us to understand the different phenomena in the evolution of the universe.
- To introduce the students to the concepts of statistical Thermodynamics. The statistical treatment permits to define the concepts of temperature, heat and entropy strictly from first principles without making use of empirical or axiomatic approach
- This paper gives a basic idea about the laws of thermodynamics and statistical processes.
- To Consolidate the understanding of the laws of thermodynamics and a systematic definition of thermodynamic potentials as the general formalism of thermodynamics.
- To understand 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

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

COs	Course Outcomes	Blooms Level
CO1	Describe the differences between systems of bosons and fermions and how these arise from microscopic consideration	Understanding
CO2	Describe the laws of thermodynamics from both a macroscopic and microscopic point of view	Understanding
CO3	Apply the concepts and laws of thermodynamics to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.	Applying
CO4	Apply the laws of thermodynamics to real physical systems and processes	Applying
CO5	Use the statistical physics methods, such as Boltzmann distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in physical systems	Analyzing

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**M**	**S**	**M**	**M**	**L**	**M**	**L**	**M**
CO2	**M**	**S**	**M**	**M**	**L**	**M**	**L**	**L**
CO3	**S**	**S**	**M**	**S**	**M**	**M**	**S**	**M**
CO4	**S**	**M**	**M**	**M**	**L**	**S**	**S**	**M**
CO5	**S**	**M**	**M**	**M**	**L**	**M**	**M**	**M**

*S-Strong;M-Medium;L-Low

UNITI- LAWS OF THERMODYNAMICS [10 hrs]

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 II- KINETIC THEORY [10 hrs]

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 hrs]

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 [9 hrs]

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 hrs]

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.

SUGGESTED READINGS

1. S.C.Garg, R.M. Bansal, C.F. Ghosh-Thermal Physics, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.
2. Sathya Prakash and Agarwal J.P., Statistical MechanicsKedar Nath Ram -2021 Edition.
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.
6. Sears N. and L. Salinger, 2013, Thermodynamics, 3rd Ed., Narosa Publishing House, New Delhi.
7. Greiner W., L. Neise and H. Stocker, 1st edition, 2007, Thermodynamics and Statistical Mechanics, Springer Verlag, New York.
8. Singh. K. and S.P. Singh reprint 2016, Elements of Statistical Mechanics, S. Chand & Company Ltd., New Delhi.
9. A B Gupta and H.P.Roy, Thermal Physics, Books and Sllied (P) Ltd, Kolkata, 2019.

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

SEMESTER – II

23PHP202 QUANTUM MECHANICS - I 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives

- 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.
- This paper gives an idea about the development of quantum mechanics.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Interpret the wave function and apply operators to it, to obtain information about a particle's physical properties such as position, momentum and energy	Understanding
CO2	Understand the role of uncertainty in quantum physics, and use the commutation relations of operators to determine whether or not two physical properties can be simultaneously measured	Understanding
CO3	Apply special functions as the solutions of differential equation as the wave function/state functions and understanding the physical situations where these can be applied.	Understanding
CO4	They will be able to apply the technique of separation of variables to solve problems in more than one dimension and to understand the role of degeneracy in the occurrence of electron shell structure in atoms.	Applying
CO5	Calculating states of electrons in hydrogen atom and harmonic oscillators and the interpretation of quantum states.	Analyzing
CO6	To solve the Schroedinger equation to obtain wave functions for some basic, physically important types of potential in one dimension, and estimate the shape of the wavefunction based on the shape of the potential	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**M**	**L**	**M**	**M**
CO2	**S**	**S**	**S**	**S**	**S**	**M**	**M**	**L**
CO3	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**L**
CO4	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**M**
CO5	**S**	**S**	**M**	**M**	**M**	**L**	**L**	**M**
CO6	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**M**

*S-Strong;M-Medium;L-Low

UNIT I: GENERAL FORMALISM OF QUANTUM MECHANICS [10 hrs]

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: ENERGY EIGENVALUE PROBLEMS [10 hrs]

Particle in a box – Linear Harmonic oscillator- Tunnelling through a barrier- particle moving in a spherically symmetric potential- System of two interacting particles-Rigid rotator- Hydrogen atom.

UNIT III: ANGULAR MOMENTUM [10 hrs]

Orbital Angular Momentum-Spin Angular Momentum-Total Angular Momentum Operators-Commutation Relations of Total Angular Momentum with Components- Ladder operators-Commutation Relation of J_z with J_+ and J_- - Eigen values of J^2, J_z- Matrix representation of J^2, J_z, J_+ and J_- - Addition of angular momenta- Clebsch-Gordon Coefficients: selection rules – recursion relations-computation of Clebsch-Gordon Coefficients.

UNIT IV:APPROXIMATE METHODS [9 hrs]

Time-Independent Perturbation Theory in Non-Degenerate Case - Anharmonic Oscillator: First order Correction- The ground state of Helium- Degenerate Case - Stark Effect in Hydrogen atom – Spin-orbit interaction - Variation Method – Born-Oppenheimer approximation - WKB Approximation and its validity.

UNIT V: TIME DEPENDENT PERTURBATION THEORY[9 hrs]

Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation- Collision-Adiabatic and Sudden Approximation- A Charged Particle in an Electromagnetic Field.

SUGGESTED READINGS

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, 2019th 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.
5. Eugen Merzbacher,2013, Quantum Mechanics, 3rd Edition, Wiley, Weinheim
6. Mathews. P.M. and K. Venkatesan, 2nd Edition, 2013, Textbooks of Quantum Mechanics, McGraw Hill International, Weinheim.
7. Chatwal R.G. and Sk. Anand, 4th edition, 2004, Quantum Mechanics, Himalaya Publishing House, New Delhi
8. Thangappan. V. K., 2nd Edition,2013, Quantum Mechanics, Tata McGraw Hill, New Delhi
9. https://nptel.ac.in/courses/115101107/
10. https://nptel.ac.in/courses/122106034/

SEMESTER – II

23PHP203 MATHEMATICAL PHYSICS-II 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives

- It is necessary for a physics student to be familiar with different methods in mathematics.
- Give a basic idea about different methods of mathematics, used in Physics.
- The purpose of the course is to introduce students to methods of mathematical physics
- To develop required mathematical skills to solve problems in quantum mechanics, electrodynamics and other fields of theoretical physics.
- This course provides the basic concepts in higher level mathematics application to physics
- To impart knowledge about various *mathematical* tools employed to study physics problems.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Apply integral transform (Fourier and Laplace) to solve mathematical problems of Fourier transforms as an aid for analyzing experimental data.	Applying
CO2	Students can formulate and express a physical law in terms of tensors, and simplify it by use the coordinate transforms (example: principal axes of inertia).	Creating
CO3	Students will be able to solve some simple classical variation problems.	Applying
CO4	Intuition of the physical meaning of the various vector calculus operators (div, grad, curl)	Creating
CO5	Students can formulate and express a physical law in terms of tensors, and simplify it by use of coordinate transforms (example: principal axes of inertia).	Understanding
CO6	Solve some simple classical variation problems	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	S	M	L	M	M	M
CO2	S	M	S	L	S	M	M
CO3	M	S	M	M	M	M	M
CO4	S	M	S	L	S	S	M
CO5	M	S	S	M	S	M	M

*S-Strong;M-Medium;L-Low

UNIT I - Partial Differential Equations [10 hrs]

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 II- Fourier Series and Fourier Transform [10 hrs]

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

UNIT III Laplace Transform[10 hrs]

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 - Properties of inverse Laplace Transform – Convolution theorem – Evaluation of Laplace Transform using Convolution theorem.

UNIT - IV -Special Functions -I [9 hrs]

Basic properties of gamma and beta functions-Legendre's polynomials and functions –Rodrigues formula – recurrence relations –Lagurae Polynomials –Differential equation and solution - recurrence relations – generating functions- -Laguerre function - recurrence relations – generating functions ~~– orthogonality relations.~~

UNIT - V -Special Functions -II [9 hrs]

Hermite differential equation and Hermite polynomials-generating function-Recurrence formulae-Rodrigue's formula - Bessel function – Second order Bessel function- Hankel function-- generating function-Recurrence formulae- Rodrigue's formula for Bessel functions.

SUGGESTED READINGS

1. Essential Mathematical Methods for Physicists, George B. Arfken, Hanes J.Weber, Frank E. Harris, 7th Edition, Elsevier, 2012.

2 Mathematical Methods for Physics and Engineering – K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge University Press, 3 rd Edition, 2006.

3. Mathematical Physics – P. K. Chattopadhyay, New Age International Publishers, 2 nd Edition, 2013.

4. Advanced Engineering Mathematics – Erwin Kreyszig, Herbert Kreyszig and Edward J. Norminton, John Wiley & Sons, 10th Edition, 2011

5. Mathematical Methods in the Physical Sciences – Mary L. Boas, John Wiley & Sons, 3rd Edition, 2006.

6. https://nptel.ac.in/courses/115103036/

7. https://nptel.ac.in/courses/115105097/

SEMESTER – II

23PHP204 SPECTROSCOPY 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives

- This paper gives an insight into the theoretical and practical aspects of spectroscopy. it is used as a tool for non-destructive testing of samples. It is important to know the physical aspects of spectroscopy.
- The major objectives of this course are to integrate theory and practice and to bring together different branches of both Academic studies and Industrial Research through the presentation of critical aspects of modern Spectroscopy.
- 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 understanding 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

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

COs	Course Outcomes	Blooms Level
CO1	Understand the basic physical chemistry law that govern molecular spectroscopy	Understanding
CO2	Student will know basic information on molecular methods (IR, Raman, UV-VIS, NMR, EPR)	Understanding
CO3	Select molecular spectroscopy methods suitable for solving given scientific problem	Creating
CO4	Analyze results of measurements using molecular spectroscopy	Analyzing
CO5	Give a view of the modern experimental tools of Atomic- and Molecular Physics.	Creating
CO6	Gain knowledge of the most common atomic and molecular spectroscopic methods and the atomic and molecular properties derived from those	Applying

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**S**	**M**	**M**	**S**	**S**	**M**
CO2	**S**	**S**	**S**	**M**	**M**	**S**	**S**	**M**
CO3	**S**	**S**	**S**	**M**	**M**	**M**	**M**	**S**
CO4	**S**	**S**	**M**	**M**	**M**	**S**	**S**	**M**
CO5	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**M**
CO6	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**M**

*S-Strong;M-Medium;L-Low

UNIT:I: [10 hrs]

Electronic Spectroscopy of AtomsElectronic wave function – atomic quantum numbers – hydrogen atom spectrum – Electronic angular momentum – Fine structure of hydrogen atom – Many-electron atoms – Term symbols – LS and JJ coupling – Spectrum of helium and alkaline earths – Equivalent and non-equivalent electrons – Zeeman effect – Paschen-Back effect – Stark effect – X-ray photoelectron spectroscopy.

UNIT:II [10 hrs]

Aspects of Molecular Spectroscopy and Rotational spectroscopyDiatomic molecule – Molecular orbital theory (LCAO) – Shape of molecular orbitals (Morse Potential) – Born-Oppenheimer approximation – Regions of the electromagnetic spectrum – Width and intensity of spectral lines – Rotation of molecules – Rigid diatomic molecules – Intensity of line spectra – the effect of isotropic substitution – non-rigid rotator and their spectra

UNIT:IIIVibrational Spectroscopy [10 hrs]

Energy of diatomic molecules – Simple Harmonic Oscillator – Anharmonic oscillator – Diatomic vibrating rotator – Vibration-Rotation spectrum of carbon monoxide – Breakdown of Born-Oppenheimer approximation –Vibrations and symmetry of polyatomic molecules – Influence of rotation on the spectra of polyatomic molecules (linear and symmetric top molecules) – Quantum and classical theory of Raman effect – pure rotational Raman spectra (linear and symmetric top

molecules) – Raman active vibrations – Vibrational Raman spectra – Rotational fine structure – Vibrations of spherical tip molecules – Techniques and instrumentation of Infrared and Raman spectrometers.

UNIT IV: NMR Spectroscopy And Nqr Spectroscopy [9 hrs]

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

Quadrupole Effects- Nuclear QuadrupoleExperimental techniques and applications.

UNIT V:

ELECTRON SPIN RESONANCE AND MOSSBAUER SPECTROSCOPY[9 hrs]

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

SUGGESTED READINGS

1. Fundamentals of Molecular Spectroscopy 4th Edition, Colin N. Banwell and Elaine M. McCash, Mcgraw Higher Ed (2017)
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.
4. Chatwall and Anand, 2004, Atomic and Molecular Spectroscopy, 5th Edition, Himalaya Publishing House, New Delhi.
5. Gordon M Barrow,1962, Introduction to Molecular Spectroscopy, McGraw-Hill Inc.,US
6. https://nptel.ac.in/courses/104101099/
7. https://nptel.ac.in/courses/104102113/

SEMESTER – II

23PHP205A DIGITAL ELECTRONICS AND MICROCONTROLLER 4H-4C

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

End Semester Exam: 3 Hours

Course Objectives

- Digital electronics is very important in present day life due to its applications in almost all fields of life. Any signals stored in memory are first digitized. So it is important to have knowledge about digital electronics.
- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
- To prepare students to perform the analysis and design of various digital electronic circuits.
- This paper is intended to give an insight into the theory and applications of digital electronics, design of circuits with digital devices, details of microprocessor and its applications.
- To learn interfacing of real world input and output devices.
- To study various hardware & software tools for developing applications

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Acquire the basic knowledge of digital logic levels and application of digital electronics circuits	Understanding
CO2	Acquire knowledge about Microprocessors and its need	Understanding
CO3	Able to identify basic architecture of different Microprocessors.	Analyzing
CO4	Foster to understand the internal architecture and interfacing of different peripheral devices with 8085 Microprocessor.	Applying
CO5	Perform the analysis and design of various digital electronic circuits	Analyzing
CO6	Foster to write the programming using 8085 microprocessor.	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**M**	**M**	**M**
CO2	**M**	**M**	**L**	**M**	**S**	**L**
CO3	**M**	**S**	**M**	**S**	**L**	**M**
CO4	**S**	**M**	**M**	**L**	**M**	**S**
CO5	**S**	**M**	**L**	**M**	**M**	**L**
CO6	**S**	**S**	**M**	**S**	**S**	**L**

*S-Strong;M-Medium;L-Low

UNIT –I -FLIP FLOPS [10 hrs]

SR, JK, JK Master Slave, T Flip flop & D Flip Flop (Symbol and Truth table)Registers (Types, shift operations) - Counters (Types, Designing of MOD 5 synchronous Counter, Construction and truth table - verification of MOD 16 Asynchronous UP, Down counter) - Multiplexer And demultiplexer (16:1 and 1:16 description and truth table verification) - Decoders and encoders (Definitions, Seven segment decoder, decimal to BCD encoder)

UNIT-II - MEMORY DEVICES[10 hrs]

General Memory Operation, CPU-Memory connection, Read only memories, ROM architecture, ROM timing, and types of ROMs, Flash memory, and ROM applications. Semiconductor RAMs, RAM architectures, static RAM, Dynamic RAM

UNIT-III - SPECIAL FUNCTION ICS[10 hrs]

Timer IC 555 (Block diagram, pin description) , Application as Astable, monostable, bistable multivibrator - VCO IC 566 (Block diagram and pin description) - PLL IC 565 (Block diagram and pin description) - Fixed voltage Regulator ICs 7800 and 7900 series - Voltage Regulator IC 723 (description, designing for low and high voltage)

UNIT- IV - INTRODUCTION TO MICROCONTROLLERS [9 hrs]

Overview of microcontroller: Classification-types of microcontrollers-8051 microcontroller-Architecture- I/O Ports-Memory organization-addressing-modes and instruction set of 8051-simple program. Interrupts- timer/ Counter and serial communication- programming Timer Interrupts-programming-external hardware interrupts-programming the serial communication interrupts-programming 8051 timers and counters.

UNIT- V -ARITHMETIC AND LOGICAL OPERATIONS [9 hrs]

Arithmetic instructions and programs – unsigned addition and subtraction and unsigned Multiplication and division – logic instructions and programs – single bit instructions and programming. – time delay programming – I/O programming – logic operations arithmetic operations.

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SUGGESTED READINGS

1. Floyd, 2003, Digital Fundamentals, 8th Edition, Pearson education, New Delhi.
2. Morris Mano. M, 1st 2002, Digital Logic and Computer Design, Prentice Hall, New Delhi.
3. Ayala, K. J. (2007). The 8051 microcontroller (3rd ed.). Clifton Park, NY: Thomson Delmar Learning.
4. Ray, & Bhurchnadi, (2008). Advanced Microprocessor and Peripherals. (6 th ed.). Tata McGraw Hill Publications.
5. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, “The 8051 Microcontroller And Embedded Systems Using Assembly And C ”, PHI, 2nd edition 2006
6. https://nptel.ac.in/courses/117103064/
7. https://nptel.ac.in/courses/117106086/

SEMESTER II
4H- - 4C

23PHP205B SOLAR ENERGY AND ITS UTILIZATION

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

Course Objectives

- Solar energy harvesting and utilizing for day to day purposes has become order of the day. The scarcity and increasing need of the fossil fuel has made man to think about alternate sources, the easiest and best being Solar energy. Hence the course introduced to get knowledge of solar energy and its utilization.
- To introduce the students to the world of solar energy, its different uses, the different methods of harvesting solar energy.
- To understand the basic concepts of energies produced from various energy sources, advantages and disadvantages
- To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of Solar Power Development and Management.
- To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Solar Power Development and Management.
- To develop a comprehensive technological understanding in solar PV system components

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Impart the knowledge of Storage technologies form the autonomous renewable energy sources.	Understanding
CO2	Explain the principles that underlie the ability of various natural phenomena to deliver solar energy.	Understanding
CO3	Applying the concepts of solar cell and solar energy in day today life	Applying
CO4	Discriminate the positive and negative aspects of solar energy in relation to natural and human aspects of the environment.	Evaluating
CO5	Gain the knowledge about the energy produced from biomass and biogas.	Applying
CO6	Design the basic principles in wind energy conversion and advantage and disadvantage of wind energy conversion systems.	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	M	M	S	L	M
CO2	S	L	M	M	S	M	L	S
CO3	S	L	S	S	L	M	L	S
CO4	S	S	M	S	L	S	L	M
CO5	M	M	S	M	M	M	L	S
CO6	S	S	M	S	S	S	L	M

*S-Strong;M-Medium;L-Low

UNIT –I – SOLAR RADIATION ANALYSIS [10 hrs]

The Solar Constant – Solar Radiation outside the Earth's atmosphere – Solar Radiation at Earth's surface – Basic Earth Sun angles – Determination of Solar Time – Derived Solar angles – Sunrise, Sunset and Daylength

Solar Energy Measuring equipments – Pyrheliometer – Pyranometer – Sunshine Recorder.

UNIT – II – SOLAR COLLECTORS [10 hrs]

Introduction to liquid flat plate collectors – General description of flat-plate collector – General characteristic of flat-plate collector – Evaluation of overall loss coefficient – Selective absorber coating – Introduction to solar air heaters – Types of air heaters –Performance of air heaters.

UNIT– III- FOCUSING TYPE SOLAR COLLECTOR[10 hrs]

General characteristics of focusing collector system – Evaluation of optical losses – Thermal performance of Focusing collectors – Materials of concentrating collectors and construction of reflectors – Compound parabolic concentrator – cylindrical parabolic concentrator.

UNIT – IV- SOLAR PHOTOVOLTAIC [9 hrs]

Introduction to Solar photovoltaics –Photovoltaic principles – Power output and Conversion efficiency – Basicphotovoltaic system for power generation – Advantages and disadvantages of photovoltaic solar energy conversion– Characteristics of a Photovoltaic Cell - Power of a Solar Cell – Storage batteries

UNIT – V ADDITIONAL METHODS OF SOLAR ENERGY UTILIZATION[9 hrs]

Solar pumping – Solar cooking – Solar drying – Solar furnace – Solar distillation – Industrial process heat – Solar green houses – Solar production of hydrogen – Applications of solar energy in space – Thermo-electric conversion

SUGGESTED READINGS

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.
5. Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala,Fundamentals and Applications of Renewable Energy | Indian Edition (2020)McGraw Hill Education (India) Private Limited.
6. D.S. Chauhan and S.K.Srivastava. 2004, Non Conventional Energy Resources, New Age International Publishers.
7. https://nptel.ac.in/courses/112105050/
8. https://nptel.ac.in/courses/115107116/

SEMESTER – II

23PHP205C **THIN FILM PHYSICS** **4H – 4C**

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

End Semester Exam: 3 Hours

Course Objectives

The objectives of this course are:

- Introduce physical concepts and mathematical tools used to describe surfaces, interfaces and thin films.
- 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.
- Develop an appreciation of the mathematical basis for experimental techniques for deposition and analysis of thin films
- Understand physical phenomena that can be exploited for the deposition of thin films
- To demonstrate knowledge of different thin film deposition strategies

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Discuss the differences and similarities between different vacuum based deposition techniques	Understanding
CO2	The importance of use of thin films in application and research.	Applying
CO3	Select proper deposition techniques for various applications.	Applying
CO4	Evaluate and use models for nucleating and growth of thin films	Evaluating
CO5	Examine the relation between deposition technique, film structure, and film properties, discuss typical thin film applications,	Evaluating
CO6	Crate the basic concepts about the thin film technology	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**M**	**S**	**M**	**S**	**S**
CO2	**M**	**M**	**M**	**L**	**M**	**M**	**S**
CO3	**S**	**S**	**S**	**S**	**M**	**M**	**M**
CO4	**S**	**L**	**S**	**M**	**M**	**S**	**M**
CO5	**M**	**L**	**M**	**S**	**L**	**M**	**M**
CO6	**S**	**S**	**M**	**S**	**S**	**M**	**S**

*S-Strong;M-Medium;L-Low

UNIT I -GROWTH AND STRUCTURE OF FILMS [10 hrs]

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[10 hrs]

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 [10 hrs]

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[9 hrs]

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 [9 hrs]

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.

SUGGESTED READINGS:

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
5. Berry,Hall and Harris (2003) Thin films technology,Van Nostrand Reinhold publishing.
6. George Hass, Physics of thin films, Academic press, 2001.
7. Holland. L, 2004, Vacuum deposition of thin films, Weily Publication
8. Milton Ohring, The Materials Science of Thin Films, Academic Press, 2001
9. Meissel. L.T and R. Glang, 2000 Handbook of thin film technology, Tata McGraw Hill, New Delhi.
10. https://nptel.ac.in/content/storage2/courses/112108092/module2/lec08.pdf
11. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113104075/lec41.pdf

SEMESTER – II

23PHP211 GENERAL PHYSICS PRACTICAL – II 4H – 2C

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

End Semester Exam: 3 Hours

Course Objective

- To gain practical knowledge by applying 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.
- To emphasize the importance of measurement which is central to physics.
- To empower the student to acquire engineering skills and practical knowledge, which help the student in their everyday life.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Determination of characteristics of a solar cell	Understanding
CO2	Classify the materials with the properties	Applying
CO3	Analyse the magnetic Properties of Material	Analysing
CO4	Determine and analysis of Materials	Evaluating
CO5	Overcome the fear of experimental skill Built his own equipments for measuring the properties of materials	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**M**	**S**	**M**	**M**	**M**
CO2	**S**	**S**	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**M**	**M**	**M**	**S**	**S**
CO4	**S**	**S**	**M**	**M**	**M**	**S**	**M**
CO5	**S**	**S**	**M**	**M**	**M**	**S**	**M**

*S-Strong;M-Medium;L-Low

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.

SUGGESTED READINGS:

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
3. Singh S.P., 2000, Advanced Practical Physics – 2, 12th Edition, PragathiPrakashan, Meerut
4. Gupta S.L. and V.Kumar, 2002, Practical Physics, 25th Edition, PragathiPrakashan, Meerut
5. B.L Worsnop& H T Flint,1951,Advanced Practical Physics For Students, 9th revised Edition, Littlehampton Book Services Ltd
6. https://nptel.ac.in/courses/115/105/115105110/

SEMESTER – II

23PHP212 **ELECTRONICS PRACTICAL – II** **4H – 2C**

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

End Semester Exam: 3 Hours

Course Objectives

- The course is designed to train the students so that they can efficiently handle various Instruments
- 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.
- To develop intellectual communication skills and discuss the basic principles of Scientific concepts in a digital electronics

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Understand the basic concepts of amplifiers and operational amplifiers	Understanding
CO2	Gain the knowledge in quantization of electromagnetic fields.	Understanding
CO3	Apply the analytical techniques and graphical analysis to the experimental data.	Applying
CO4	Verify laws studied in the different theory course.	Evaluating
CO5	Analyse different properties of materials.	Analysing
CO6	Analyze the characteristics of oscillators and wave shaping circuits implement	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**S**
CO2	**S**	**S**	**M**	**M**	**S**	**M**	**M**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**M**	**M**	**M**	**S**	**S**	**S**

CO5	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**S**
CO6	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**S**

*S-Strong;M-Medium;L-Low

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. V-I characteristics of a schotkky and photoconductive diode: comparision
4. V-I characteristics ofPhoto Transistor, LDR, LED
5. Op-amp Log and Antilog amplifier.
6. Op-amp –Analog computation second order differential equation
7. Op-amp comparator – Zero crossing detector, Window detector, time marker
8. 555 Timer application –bi-stable multivibrators.
9. Virtual Lab (Flip flop, Logic gates)
10. Characteristics and an application of SCR
11. Study of various types of flip-flops (R-S, J-K, Master Slave J-K)
12. Shift register – Digital IC's
13. JK Flip-Flop and up-down counter
14. PLL characteristics.
15. Pulse width modulation and de-modulation.

SUGGESTED READINGS

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
3. Singh S.P., 2000, Advanced Practical Physics – 2, 12th Edition, PragathiPrakashan, Meerut
4. Gupta S.L. and V.Kumar, 2002, Practical Physics, 25th Edition, PragathiPrakashan, Meerut
5. Ramakant A. Gayakwad, 2002, Op-amp and Linear Integrated Circuits ,4th Edition, Prentice Hall
6. https://nptel.ac.in/courses/122/106/122106025/

SEMESTER – II

Value Added Course

PRINCIPLES OF ELECTRONIC COMMUNICATION 3H-0C

COURSE OBJECTIVES

- 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.

COs	Course Outcomes	Blooms Level
CO1	To Understating the knowledge of some basic electronic components and circuits.	Understanding
CO2	Applying the concepts of transistor and receiver	Applying
CO3	Develop and innovation of electronic communication systems	Applying
CO4	Design and Development by using fundamental concepts and various components of communication systems	Creating

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**L**	**M**	**M**	**L**	**M**	**M**	**M**	**S**
CO2	**M**	**S**	**M**	**M**	**L**	**M**	**M**	**S**
CO3	**M**	**S**	**M**	**L**	**S**	**M**	**S**	**S**
CO4	**M**	**S**	**M**	**M**	**M**	**S**	**S**	**M**

UNIT I -MODULATION TECHNIQUES

Introduction to Communication Systems – Information – Transmitter – Channel – Noise– Receiver –- Need for Modulation Band Width requirement – Amplitude Modulation: AMTheory– Frequency spectrum of AM wave – Representation of AM – Power relations in AMwave –AM Transmitter block diagram – Frequency modulation: System description – Mathematical representation – 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 – Elementary doublet – Current and Voltage Distribution –Resonant antennas, Radiation patterns and Length calculations – Non resonant antennas –Antenna gain and Effective radiated power – Antenna resistance – Bandwidth, Beam width andPolarization – 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.

SUGGESTED READINGS

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

SEMESTER – II

Value Added Course

PROCESS OF VAPOUR COMPRESSION REFRIGERATION 3H-0C

Course Objectives:

- To understand the concept of refrigeration
- To acquire knowledge of methods of refrigeration
- To acquire knowledge of Air refrigeration system
- To acquire knowledge of vapour compression and vapour absorption refrigeration system.
- To acquire knowledge of refrigerants

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Describe the concept of refrigeration and its unit.	Understanding
CO2	Anlayse the concept of differnent methods of refrigeration.	Analysing
CO3	Air refrigeration cycle and its application in air craft.	Applying
CO4	Examine the working concepts Thermostate	Analysing
CO5	Design and introduce the concepts of refrigerator	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**L**	**S**	**M**	**M**	**M**	**S**
CO2	**S**	**S**	**M**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**M**	**L**	**M**	**S**
CO5	**S**	**S**	**M**	**M**	**M**	**M**

*S-Strong;M-Medium;L-Low

UNIT I

Introduction to basic laws of thermodynamics and heat transfer. Reversed Carnot cycle,Refrigeration, Refrigerant, Refrigerator, Heat pump. History of Refrigeration-NaturalRefrigeration: Art of Ice making by Nocturnal Cooling, Evaporative Cooling, Cooling by SaltSolutions.

UNIT II

Artificial Refrigeration: Vapour Compression Refrigeration Systems, Domestic refrigerationsystems, Air conditioning systems, Vapour Absorption Refrigeration Systems, Solar energybased refrigeration systems, Gas Cycle Refrigeration, Steam Jet Refrigeration System,Thermoelectric Refrigeration Systems, Vortex tube systems.

UNIT III

Introduction to vapour compression refrigeration. Performance of Complete vaporcompression system. Components of Vapor Compression System: The condensing unit –Evaporators – Expansion valve – Refrigerants – Properties – ODP; GWP - Load balancingof vapor compression Unit.

UNIT IV

Compound Compression: Flash inter-cooling – flash chamber – Multi-evaporator&Multistage systems. Production of low temperature: Liquefaction system; Cascade System –Applications. Dry ice system.

UNIT V

Vapor absorption system – Simple and modified aqua – ammonia system – Representation on Enthalpy –Concentration diagram. Lithium – Bromide system Three fluid system – HCOP.

SUGGESTED READINGS

1. Refrigeration & Air Conditioning /C.P. Arora/TMH
2. Refrigeration & Air Conditioning /Arora &Domkundwar/ Dhanpat Rai
3. Refrigeration and Air Conditioning /Manohar Prasad/
4. Refrigeration and Air Conditioning /Stoecker /Mc Graw Hill
5. Principles of Refrigeration/Dossat /Pearson
6. Refrigeration and Air Conditioning /Ananthanarayana /TMH
7. Refrigeration and Air Conditioning /Jordan&Preister /Prentice Hall
8. Refrigeration and Air Conditioning/Dossat /Mc Graw Hill

SEMESTER III
4H- 4C

23PHP301 QUANTUM MECHANICS – II

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

Course Objectives

- The aim of this course is to make the students to understand the concepts of quantum physics and their applications in microscopic systems
- This course develops concepts in quantum mechanics such that the behaviour of the physical universe can be understood from a fundamental point of view.
- To acquire working knowledge of the Quantum Mechanics postulate on the physical systems
- This is a continuation of Quantum Mechanics – I. More detailed study of problems like scattering problem, relativistic quantum mechanics, quantum electrodynamics etc, are added in this paper to enrich the theoritical knowledge.
- To make the students capable of analyzing theoretical problems like interaction of particles, scattering of particles etc.
- To impart knowledge of advanced quantum mechanics for solving relevant physical problems

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Differntiate non-relativistic and relativistic quantum mechanics including timedependent	Analyzing
CO2	Acquire the basic knowledge Eigen values and Eigen functions, bound systems, angular momentum of quantum mechanical systems	Understanding
CO3	Understand concepts and to perform calculations of scattering of particles.	Evaluating
CO4	Evaluate modern research utilizing quantum theory in condensed matter, nuclear and particle physics	Evaluating
CO5	Applying the perturbation theory, scattering theory, relativistic wave equations in day to day life.	Applying
CO6	Solving the quantum equation and derivation	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	L	S	M
CO2	S	S	S	M	L	M	S
CO3	M	M	S	S	L	S	M
CO4	M	S	S	S	L	M	M
CO5	S	S	S	L	L	S	M

*S-Strong;M-Medium;L-Low

UNIT – I: ANGULAR MOMENTUM [10 hrs]

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 II: SCATTERING THEORY [10 hrs]

Scattering cross-section – Scattering amplitude – 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 – Phase shift analysis and scattering amplitude and cross section. Applications to various systems; s-wave scattering, effective range theory – Zero energy and low energy scattering discussions – Two-body scattering in center-of mass frames and laboratory frames; scattering of identical particles.

UNIT III: MANY ELECTRON PROBLEM[10 hrs]

Indistinguishable particles, 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 – Hartree equation – Hartree-Fock equation – Molecular orbital theory: Hydrogen molecule ion H2+- Valence bond theory – Heitler-London theory of hydrogen molecule.

UNIT IV: RELATIVISTIC QUANTUM MECHANICS[9hrs]

Klein Gordon Equation and associated problems – The Dirac equation – properties of alpha, beta matrices. Solution to free Dirac equation. Spin of the Dirac particle. Dirac equation in a Central (Coulomb) potential – Lorentz covariance of the Dirac equation; Gamma matrices and properties. Lorentz covariance of continuity equation– Bilinearcovariants and Lorentz transformationproperties– Magnetic moment of the electron – Spin-orbit interaction – Radial equation for an electron in a central potential.

UNIT V: FIELD THEORY [9 hrs]

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 – Quantisation of non-relativistic Schroedinger equation – Creation, annihilation and number operators.

SUGGESTED READINGS

1. Aruldhas. G, 2008, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi.
2. Gupta, Kumar and Sharma, 2002, Quantum Mechanics, 22nd Edition, Jai Prakash Nath & Co, Meerut.
3. Satya Prakash, 2003, Quantum Mechanics, New Edition Kedar Nath & Ram Nath & Co, Meerut.
4. Leonard I. Schiff, 2006, Quantum Mechanics, 3rd Edition, McGraw Hill International, Auckland.
7. Eugen Merzbacher, 2014, Quantum Mechanics, 3rd Edition, Wiley, Weinheim.
8. Mathews. P.M. and K. Venkatesan, 2nd edition 2013, Textbook of Quantum Mechanics, McGraw Hill International, Weinheim.
9. Chatwal R.G. and Sk. Anand, 4theditin 2004, Quantum Mechanics, Himalaya Publishing House, New Delhi
10. Thangappan. V. K., 2nd edition 2007, Quantum Mechanics, Tata McGraw Hill, New Delhi
11. https://nptel.ac.in/courses/115102024/
12. https://nptel.ac.in/courses/122/106/122106034/
13. https://nptel.ac.in/courses/115/101/115101107/

SEMESTER III
4H- - 4C

23PHP302 LASER AND NON-LINEAR OPTICS

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

Course Objectives

- Laser is a versatile tool with applications in almost all fields from medical to astronomy, communications, welding, cutting etc.
- This paper explains the characteristics of lasers, different types of lasers and their construction to apply for industircal use. Applications of lasers in different fields are also explained.
- 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

At the end of this course, students 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	Understanding
CO2	Describe modes in multimode fibers and mode field parameter in single-mode fibers	Understanding
CO3	Differntiate the absorption and spontaneous and stimulated emission in two level system	Analyzing
CO4	Operate and analyze the properties of laser ,Types of laser and its application..	Evaluating
CO5	Explain and Classify fibers as single-mode, multimode step index and multi-mode graded index.	Analyzing
CO6	The effects of homogeneous and in homogeneous line broadening, and the conditions for laser in daily life .	Applying

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	M	L	M	M	S
CO2	S	S	M	M	M	M	M	M
CO3	S	M	L	S	L	S	S	M
CO4	S	S	M	M	L	S	S	L
CO5	S	M	M	M	M	M	M	M
CO6	S	S	M	S	M	M	S	M

*S-Strong;M-Medium;L-Low

UNIT- I –LASER CHARACTERISTICS [10 hrs]

Spontaneous and stimulated emission, Einstein's quantum theory of radiation- Einstein A and B coefficient - theory of some optical processes, coherence and monochromaticity, kinetics of optical absorption, line broadening mechanism, Basic principle of lasers, population inversion, laser pumping, two & three level laser systems, resonator, Q-factor, losses in cavity, threshold condition, quantum yield.

UNIT – II - LASER SYSTEMS [10 hrs]

Solid state lasers- the ruby laser, Nd:YAG laser, ND: Glass laser, semiconductor lasers – features of semiconductor lasers, intrinsic semiconductor lasers, Gas laser - neutral atom gas laser, He-Ne laser, molecular gas lasers, CO2 laser, Liquid lasers, dye lasers and chemical laser.

UNIT-III - ADVANCES IN LASER PHYSICS[10 hrs]

Production of giant pulse -Q-switching, giant pulse dynamics, laser amplifiers, mode locking and pulling.

Non-linear optics - Harmonic generation, second harmonic generation - Sum and different frequency generation - Phase matching - third harmonic generation - optical mixing, parametric generation - self-focusing of light.

UNIT – IV - MULTI-PHOTON PROCESSES [9 hrs]

Multi-quantum photoelectric effect, Theory of two-photon process, three- photon process, second harmonic generation, parametric generation of light.

Laser spectroscopy : Rayleigh and Raman scattering, Stimulated Raman effect, Hyper-Raman effect, Coherent anti-stokes Raman Scattering, Photo-acoustic Raman spectroscopy.

UNIT – V - LASER APPLICATIONS[9 hrs]

Ether drift and absolute rotation of the Earth, isotope separation, Plasma, thermonuclear fusion, laser applications in chemistry, biology, astronomy, engineering and medicine. Communication by lasers: ranging, fiber Optics Communication- Defense application –Laser range finder – Laser guided antitank missile - Lithography

SUGGESTED READINGS

1. AjoyGhatakThyagarajan, 2013, Laser Fundamentals and applications Laxmi Publications (P) Ltd
2. Laud, B.B. 2011 Lasers and nonlinear optics, New Age Int.Pub.
3. Thyagarajan, K and Ghatak, A.K 2009: Lasers theory and applications Plenum press,
4. Ghatak, A.K.andThyagarajan, K (2010) Optical electronics Cambridge Univ. Press
5. Maitland, A. and Dunn, M.H. 2013 : Laser Physics N.H.Amsterdam.
6. Hecht, (2012) Laser Guide book McGraw Hill, NY.
7. https://nptel.ac.in/courses/115/105/115105105/
8. https://nptel.ac.in/courses/115/101/115101008/
9. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ph10/

23PHP303 CONDENSED MATTER PHYSICS 4H – 4C

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

Course Objectives

- This course provide the study of properties of materials is very important at all times, to choose the correct material for the correct use.
- With the development of nanotechnology, it is important to give an idea about the preparation methods and characterization of different materials.
- This paper is intended to give the students an idea about importance of crystals and their properties.
- This course will teach you the fundamental physics behind different materials we commonly see in the world around us.
- The course will demonstrate the link between microscopic structure and bulk properties in a variety of systems in hard and soft condensed matter
- To study some of the basic properties of the **condensed** phase of **matter** especially solids.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Classify condensed matter upon its degree of order, with emphasis on scattering experiments	Understanding
CO2	Analyze the electronic, magnetic and thermal properties of materials	Analyzing
CO3	Explain various types of magnetic phenomenon, physics behind them, their properties and applications.	Analyzing
CO4	Explain superconductivity, its properties, important parameters related to possible applications	Analyzing
CO5	Explain superconductivity, its properties, important parameters related to possible applications	Applying
CO6	Develop the superconducting materials and understand the materials property the basic concept of superconductor	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**L**	**S**	**M**	**M**	**M**	**S**	**S**	**L**
CO2	**S**	**L**	**S**	**S**	**M**	**M**	**S**	**L**	**L**	**S**
CO3	**S**	**M**	**S**	**S**	**L**	**M**	**M**	**S**	**M**	**S**
CO4	**S**	**L**	**M**	**M**	**S**	**S**	**M**	**S**	**L**	**M**
CO5	**S**	**S**	**S**	**M**	**L**	**M**	**M**	**S**	**S**	**S**
CO6	**S**	**S**	**L**	**S**	**M**	**M**	**M**	**S**	**S**	**L**

*S-Strong;M-Medium;L-Low

UNIT I- Crystal Physics [10 hrs]

Introduction to Types of solids. Basics of crystals and crystallographic parameters. TheLattice - Basis - unit cell - Seven types of crystal systems. Bravais lattices –Interplanarspacing for SC, FCC, BCC lattices - diamond cubic structure - NaCl structure –Thereciprocal lattice and their properties. Symmetry in crystals - point groups and space groups.X-ray Diffraction: Bragg's law - Concept of Brillion Zone - Ewald construction –Structurefactor.

Crystal defects: Classification of defects - Points defect - line defect – Surface defect – volume defect - Fick's Law.

UNIT II– THERMAL PROPERTIES OF SOLIDS AND THEORY OF SEMICONDUCTORS [10 hrs]

Introduction – classical theory and Einstein's theory of specific heat – Debye's theory - Intrinsic and extrinsic semiconductors - Free carrier concentration in semiconductors – Fermi level and carrier concentration in semiconductors – Mobility of charge carriers – Effect of temperature on mobility – electrical conductivity of semiconductors – Hall Effect in semiconductors – Drude Model of electrical and thermal conductivity-Thermal conductivity of metals – Wiedemann-Franz law – Nearly free electron model- Bloch's theorem-Kronig Penny model.

UNIT III – DIELECTRICS AND FERROELECTRICS

Dielectrics: Dielectric properties of insulators, Review of basic formulae, Types ofpolarizations and their polarizability equations, Local field of the solid, Claussius- Mossottirelation, Debye's equations, Dielectric constant and dielectric loss. Applications of dielectric materials.Ferroelectrics: General properties of ferroelectrics, classification and properties offerroelectric crystals, dipole theory of ferroelectricity, Applications of ferroelectric materials. Piezoelectricity: General properties of piezoelectric materials and their applications.

UNIT IV –MAGNETIC PROPERTIS OF SOLIDS

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 antiferromagnetism.

UNIT V-SUPERCONDUCTIVITY

Introduction to superconducators-Sources of superconductivity – The Meissner effect – Type I and Type II Sueprconductors - Thermodynamics of superconducting transitions – Origin of energy gap – London equations –London Penteration depth –Coherence length – BCS theory – Flux quantization – Theory of DC and AC Josephesen effect – Recent high temperature superconductor – Recent applications of superconductivity.

SUGGESTED READINGS

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. Pillai S.O., 2005, Solid State Physics, 4 th Edition, New Age International Publishers Ltd.

4. Saxena. B.S., R.C.Gupta and P.N.Saxena, 2012, Fundamentals of Solid State Physics, 15thedition, Pragati Prakashan, Meerut.

5. Dekkar. A.J., revised edition, 2000, Solid State Physics, Macmillan India Ltd., New Delhi.

6. Keer. H.V. 1 stedition , 2002, Principles of Solid State, New age international., New Delhi.

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

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

9. Advances in Solid State Physics, 1998, Springer Book series, Electronic ISSN number: 1617-5034.

10. Emerging Trends in Terahertz Solid-State Physics and Devices, 2020, eBook ISBN978-981-15-3235-1, Springer, Singapore.

SEMESTER –III

23PHP304 NUCLEAR AND PARTICLE PHYSICS 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives

- Nuclear physics is one of the fundamental subjects of physics. It is important to know about the physics of nuclei and the different energies involved in the nuclear processes.
- Nuclear energy is one of the major sources of energy, which, with proper careful usage, can solve the energy crisis to a large extent.
- To impart knowledge about basic nuclear physics properties and nuclear models for understanding of related reaction dynamics
- to introduce students to the fundamental concepts of nuclear and sub-nuclear physics
- This paper is intended to give an insight into the different nuclear processes and the fundamental particles, which are the real building blocks of the universe.
- To introduce students to the fundamental concepts of nuclear and sub-nuclear physics

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Explain central concepts, laws and models in nuclear and particle physics.	Understanding
CO2	Interpret basic experiments using basic laws and relations to solve simple problems	Creating
CO3	Understand the basic principle, type of accelerators, working and operation of accelerators.	Understanding
CO4	Learn the basic of ion sources, beam transport and application of accelerator in different branches of science	Applying
CO5	Explore their knowledge in reactors to the atomic agency	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**S**	**M**	**M**	**M**	**S**	**M**
CO2	**M**	**M**	**S**	**L**	**M**	**L**	**S**	**L**
CO3	**S**	**S**	**M**	**S**	**S**	**M**	**M**	**L**

CO4	**S**	**L**	**M**	**S**	**M**	**L**	**S**	**M**
CO5	**L**	**M**	**M**	**S**	**L**	**M**	**L**	**M**
CO6	**S**	**L**	**M**	**S**	**M**	**L**	**S**	**M**

*S-Strong;M-Medium;L-Low

UNIT I - GENERAL PROPERTIES OF ATOMIC NUCLEI [10 hrs]

Nuclear size – Binding energy – Semi-empirical mass formula – Angular momentum of the nucleus – Nuclear magnetism – Electric quadupole moment – Parity – Isotopic spin – Deutron – Ground state of Deutron – Excited states of Deutron

UNIT II - NUCLEAR MODELS [10 hrs]

Liquid drop model - Bohr Wheeler theory of fission - Condition for spontaneous fission - Shell model: Explanation for magic numbers - Prediction of shell model – Collective model – Optical model – Degenerate gas model – α-particle model

UNIT III- RADIOACTIVITY [10 hrs]

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

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 [9 hrs]

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 - Evaporation probability and cross section – Kinematics of stopping and pickup reaction - Surface reaction.

Nuclear reactors in India and abroad for extracting energy with specifications and uses.

UNIT V - ELEMENTARY PARTICLES [9 hrs]

Classification of Elementary particles – Fundamental interactions conservation laws, charge-conjugation, Parity and Time reversal, CPT theorem, GellMann-Nishijima formula, intrinsic parity of pions, resonances, symmetry classification of elementary particles, quark hypothesis, charm, beauty and truth, gluons, quark confinement, asymptotic freedom- Higgs bosons-particle in LHC experiment- Experiment for the cosmic ray detectedin space

SUGGESTED READINGS

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- Harald, Enge, The Perseus Books Group.
4. Nuclear Physics: Theory and Experiment-R. R. Roy, B.P. Nigam, New Age International Pvt Ltd.
5. Kenneth S.Karne, , 1st edition, 2008, Introducing Nuclear Physics, John Wiley and Sons, New York.
6. Sharma. D.C 2004, Nuclear Physics, - K. Nath & Co, Meerut.
7. Bernard L. Cohen, , 1st edition, 2011, Concept of Nuclear Physics, Tata Mc Graw Hill, New Delhi.
8. Devanathan V.,2nd edition, 2008, Nuclear Physics, Narosa Book Distributers Pvt. Ltd., New Delhi.
9. Kaplan Irving, 2002, Nuclear Physics, 2nd Edition, Narosa Book Distributers Pvt. Ltd., New Delhi.
10. https://nptel.ac.in/courses/115103101/
11. https://nptel.ac.in/courses/115104043/

SEMESTER-III

23PHP305C ADVANCED INSTRUMENTATION TECHNIQUES 4H – 3C

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

End Semester Exam: 3 Hours

Course Objectives

- To Study materials is always important, for any application, including fabrication of satellites.
- To introduce various methods available for characterizing the materials. The characterization of materials specifically addresses that portfolio with which researchers and educators must have working familiarity.
- To provide an introduction to materials characterization and its importance
- To discuss different types of characterization techniques and their uses.
- To introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques Introduction:
- To understand the materials characterization and available techniques

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Understand and describe the fundamental principles behind the methods of characterization which are included in the curriculum	Understanding
CO2	Understand the history of materials science with basic understanding of metals, binary alloys, magnetic materials, dielectric materials and polymers	Understanding
CO3	Analyze, interpret and present observations from the different methods	Analyzing
CO4	Evaluate the uncertainty of observations and results from the different methods	Evaluating
CO5	Handle with X-ray, thermal, microscopic, and electrical methods of characterization	Applying
CO6	Fabricate an instrument from acquired knowledge.	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**M**	**M**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**M**	**L**	**M**	**S**	**S**
CO3	**L**	**S**	**L**	**M**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**L**	**L**	**M**	**M**
CO5	**L**	**S**	**M**	**S**	**S**	**S**	**M**
CO6	**M**	**M**	**M**	**S**	**S**	**S**	**M**

*S-Strong;M-Medium;L-Low

UNIT I- STRUCTURAL ANALYSIS [10 hrs]

X-Ray Techniques : Introduction, X-Ray Powder Diffraction - Rotatory crystal method of X ray diffraction - experiment- Particle size - strain determination, Single Crystal X-Ray Structure Determination, GIXRD and its applications, X-Ray Photo electron Spectroscopy, Surface X-Ray Diffraction.

UNIT II - MORPHOLOGICAL ANALYSIS [10 hrs]

Electron Microscopy: Electron diffraction technique - High energy electron diffraction – Low energy electron diffraction - Electron microscopy – Scanning electron microscopy (SEM) - FESEM - EDAX - TEM - HRTEM: working principle and Instrumentation - sample preparation - Advantages/disadvantages.

Scanning Probe Microscopy: Scanning probe microscopy - AFM - EPMA - working principle and Instrumentation - Advantages/disadvantages.

UNIT III - OPTICAL MICROSCOPY[10 hrs]

Optical microscopy techniques - Bright field - Dark field optical microscopy - phase contrast microscopy -differential interference contrast microscopy - fluorescence microscopy - confocal microscopy - Metallurgical microscope - Introduction to Photoluminescence and Electroluminescence.

UNIT IV - THERMAL ANALYSIS [9 hrs]

Introduction - Definitions, Codes of Practice and Nomenclature - thermogravimetric analysis (TGA) - instrumentation - determination of weight loss and decomposition products - differential thermal analysis (DTA) - cooling curves - differential scanning calorimetry (DSC) - instrumentation - specific heat capacity measurements - determination of thermomechanical parameters .

UNIT V - MAGNETIC AND ELECTRICAL ANALYSIS [9 hrs]

Vibrating sample magnetometer (VSM) - Superconducting Quantum Interference Device (SQUID): Introduction - construction and working principle.

Two probe and four probe methods - van der Pauw method - Hall probe and measurement - scattering mechanism - C-V, I-V characteristics - Schottky barrier capacitance - impurity concentration - electrochemical C-V profiling - limitations - Applications. Dielectrics - working principle and Instrumentation - Applications.

SUGGESTED READINGS

1. Elton N. Kaufmann, Characterization of Materials, John Wiley & Sons, Inc., Hoboken, New Jersey, 2003.
2. R.A.Stradling and P.C.Klipstain. Growth and Characterization of semiconductors. Adam Hilger, Bristol, 1990.
3. Cullity B D., Stock S R “Elements of X-ray Diffraction”, Prentice Hall, Inc 2001.
4. J.A.Belk. Electron Microscopy and Microanalysis of Crystalline Materials. Applied Science Publishers, London, 1979.
5. 5. Banwell, Fundamentals of Molecular Spectroscopy, McGraw-Hill Education, Pvt. Ltd., 2013.
6. D.Kealey&P.J.Haines, Analytical Chemistry, Viva Books Private Limited, New Delhi, 2002.
7. Microstructural Characterization of Materials; Brandon & Kaplan; Wiley; 2008
8. Characterization of Semiconductor Materials - Principles and Methods; McGuire; William Andrew Publishing/Noyes; 1989
9. https://nptel.ac.in/courses/115103030/
10. https://nptel.ac.in/courses/113106034/

SEMESTER – III

23PHP305B NUMERICAL METHODS IN PHYSICS 4H – 3C

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

End Semester Exam: 3 Hours

Course Objectives

- Computational physics may be broadly defined as 'the science 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
- Computers now play a role in almost every branch of physics like large scale quantum mechanical calculations in nuclear, atomic, molecular and condensed matter physics, large scale calculations in such fields as hydrodynamics, astrophysics, plasma physics, meteorology and geophysics etc.
- The huge increase in the power of computers in recent years has made an impact on the role of computational physics.
- This paper gives idea about different types of computations involved in Physics, like curve fitting, interpolation, extrapolation, numerical calculations etc.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Describe the characteristics of various numerical methods	Understanding
CO2	Programme numerical methods and their implementation like applying to problem in	Applying
CO3	physics, including modeling of classical physics to quantum system as well as data analysis (Linear and non linear).	Analyzing
CO4	Analysis techniques for propagating error, representing data graphically. Create, solve and interpret basic mathematical tool	Analyzing
CO5	Program independently computers using leading-edge tools,	Applying
CO6	formulate and computationally solve a selection of problems in physics,	Evaluating
CO7	Use the tools, methodologies, language and conventions of physics to test and Communicate ideas and explanations.	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**M**	**M**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**M**	**L**	**M**	**S**	**S**
CO3	**L**	**S**	**L**	**M**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**L**	**L**	**M**	**M**
CO5	**L**	**S**	**M**	**S**	**S**	**S**	**M**
CO6	**M**	**M**	**M**	**S**	**S**	**S**	**M**
CO7	**S**	**S**	**M**	**S**	**S**	**M**	**S**

*S-Strong;M-Medium;L-Low

UNIT I - CURVE FITTING [10 hrs]

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 hrs]

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 hrs]

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 [9 hrs]

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 hrs]

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

SUGGESTED READINGS:

1. G. Shanker Rao, K. Keshava Reddy, Mathematical Methods, I.K. , 1^{st} edition 2009, 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.
4. Tao Pang, 1^{st} edition, 2006.An Introduction to Computational Physics, Cambridge University Press
5. James B Scarborough, Numerical Mathematical Analysis,6^{th} Edition (2008)Oxford &Ibh Publishing Co. Pvt Ltd.
6. https://nptel.ac.in/courses/115106118/
7. https://nptel.ac.in/courses/115104095/

SEMESTER –III

23PHP305C INDUSTRIAL AND POWER ELECTRONICS 4H – 3C

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

End Semester Exam: 3 Hours

Course Objectives:

- 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

Course Outcomes

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

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

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**M**	**M**	**M**	**S**	**S**	**S**	**M**	**M**
CO2	**S**	**M**	**M**	**L**	**M**	**S**	**S**	**M**
CO3	**L**	**S**	**L**	**M**	**S**	**S**	**S**	**M**
CO4	**S**	**S**	**S**	**L**	**L**	**M**	**M**	**M**
CO5	**L**	**S**	**M**	**S**	**S**	**S**	**M**	**M**

*S-Strong;M-Medium;L-Low

UNIT – I POWER TRANSISTORS AND THYRISTORS [10 hrs]

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 [10 hrs]

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

UNIT -III CONTROLLED RECTIFIERS INVERTERS [10 hrs]

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 [9 hrs]

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[9 hrs]

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.

SUGGESTED READINGS

1 Power Electronics: Circuits Devices and Applications Mohammad H Rashid, Pearson 4th Edition, 2014

2. MDSingh, ―PowerElectronics‖, 2ndEdition, Tata-McGrawHill, 2007

3. Power Electronics P.S. Bimbhra Khanna Publishers 5th Edition, 2012

4. Power Electronics: Converters, Applications and Design Ned Mohan et al Wiley 3rd Edition,

2014

5. Power Electronics Daniel W Hart McGraw Hill 1st Edition, 2011

6. Elements of Power Electronics Philip T Krein Oxford Indian Edition, 2008

7. Harish C Rai, "Industrial and Power Electronics" 10th edition, Umesh publications 2002

8. Timothy J Maloni, "Industrial Solid State Electronic Devices and Circuits" 2nd edition 1999

SEMESTER – III
3H- - 2C

23PHP311 ADVANCED PHYSICS PRACTICAL

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

Course Objective

- To gain practical knowledge by applying 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.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.
- To understand the programming knowledge in SCILAB for various physics problems and electronic circuits

Course Outcomes

At the end of this course, students 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	Understanding
CO2	Gain the knowledge in quantization of electromagnetic fields.	Understanding
CO3	Able to use Scilab for interactive computations	Applying
CO4	Apply the laws studied in the different theory courses.	Creating
CO5	Theoretical and practical skills along with problem solving ability will be developed	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**L**	**S**	**S**	**M**
CO2	**M**	**S**	**L**	**M**	**M**	**L**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**M**	**M**	**M**	**L**
CO4	**M**	**M**	**S**	**L**	**S**	**S**	**L**	**M**
CO5	**S**	**L**	**M**	**M**	**M**	**S**	**S**	**S**

*S-Strong;M-Medium;L-Low

ANY TEN EXPERIMENTS

1. Two-probe DC conductivity and carrier density evaluation of a semiconductor.
2. Two-probe DC conductivity and carrier density evaluation of a pellet prepared through coldpressing.
3. Efficiency of G.M.Counter various sources, absorption co- efficient and half-life.
4. Pockel effect- electro-optic property of a crystal.
5. Thin Film Deposition and Measurement of Electrical Conductivity– Four Probe Method
6. X-Ray Diffraction – Determination of lattice parameters of a crystalline solid.
7. Measurement of thickness of a thin film using MBI technique.
8. Find the Variation of grain size and porosity of sintered/thin film specimens sintered at differenttemperatures by optical microscope.
9. Experiment on rotatory dispersion of quartz.
10. Scilab Programming-Radioactive Decay
11. Scilab Programming-Numerical Integration
12. Scilab Programming-Computer Simulation of Equations of Motion for a System of Particles
13. Scilab Programming-Computer Simulation of 1-D and 2-D Lattice Vibrations
14. Scilab Programming-Computer Simulation of Kronig-Penney Model.
15. Micro wave characteristics and measurement of di-electric constant.

SUGGESTED READINGS

1. Ouseph C.C., U.J. Rao and V. Vijayendran 2019, Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.
2. Singh S.P., 2003, Advanced Practical Physics – 1, 2017, PragathiPrakashan, Meerut, ISBN: 978-93-86633-90-3
3. B.L Worsnop& H T Flint. Advanced Practical Physics For Students, 9th Edition, Littlehampton Book Services Ltd.
4. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge05/
5. https://nptel.ac.in/courses/111/102/111102137/

SEMESTER – III
3H- - 2C

23PHP312 ADVANCED ELECTRONICS PRACTICAL

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

Course Objectives

- 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.
- To design and construction of circuits using analog component and trouble shooting of the circuits.
- To provide the real time experience on microprocessor in traffic signal and industry

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Understand and apply the fundamentals of assembly level programming of microprocessors and microcontroller.	Understanding
CO2	Work with standard microprocessor real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters;	Understanding
CO3	Troubleshoot interactions between software and hardware;	Analyzing
CO4	Analyze abstract problems and apply a combination of hardware and software to address the problem	Creating
CO5	Practically study the working of different electronic components circuits.	Creating
CO6	Learn to minimize contributing variables and recognize the limitations of the equipment.	Applying

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**M**
CO2	**S**	**S**	**M**	**M**	**S**	**M**	**M**	**M**
CO3	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**M**
CO4	**S**	**S**	**M**	**M**	**M**	**S**	**S**	**M**
CO5	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**M**
CO6	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**M**

*S-Strong;M-Medium;L-Low

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

SUGGESTED READINGS

1. Ramesh Gaonkar, 2013, Microprocessor Architecture Programming and Applications with 8085, 6th edition, PENRAM International Pvt Ltd.
2. P. Horowitz and W. Hill, The Art of Electronics, Second edition, Cambridge University Press, 1989.
3. Ayala, K. J. (2007). The 8051 microcontroller (3rd ed.). Clifton Park, NY: Thomson
4. Delmar Learning.
5. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, “The 8051
6. Microcontroller And Embedded Systems Using Assembly And C ”, PHI, 2nd edition 2006
7. https://nptel.ac.in/courses/108/105/108105102/
8. https://nptel.ac.in/courses/115/102/115102014/

23MBAPOE301	**ORGANIZATIONAL BEHAVIOUR**	**SEMESTER–III**
		3H – 2C

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

End Semester Exam:3Hours

COURSE OBJECTIVES:

To make the students

- To understand the basic concepts of organizational behavior.
- To analyze the individual behavior traits required for performing as an individual or group.
- To obtain the perceiving skills to judge the situation and communicate the thoughts and ideas.
- To understand how to perform in group and team and how to manage the power, politicsand conflict.
- To recognize the importance of organizational culture and organizationalchange.
- To realise the importance of groups and teamwork and managing of conflict between themembers ofthe organization

COURSE OUTCOMES:

Learners should be able to

1. Analyse organizational behavior issues in the context of the organizational behaviortheories and concepts.
2. Assess the behavior of the individuals and groups in organization and manage the stress.
3. Manage team, power, politics and conflict arising between the members.
4. Explain how organizational change and culture affect the working relationship within organizations.
5. Understand and exhibit the communication skills to convey the thoughts and ideas of case analysis to the individuals and group.
6. Understand the application of OB using appropriate concepts, logic and thetorical conventions

UNIT I Organization behaviour : Introduction **8 hours**

Organization Behavior: Meaning and definition - Fundamental concepts of OB - Contributing disciplines to the OBfield – OB Model - Significance of OB in the organization success - Challengesand Opportunitiesfor OB.

UNIT II Behaviour and Personality **6 hours**

Attitudes – Sources - Types - Functions of Attitudes. Values – Importance - Types of Values. Personality – Determinants of personality- Theories of Personality - psycho-analytical, social learning, job-fit, and trait theories.

UNIT III Perception **8 hours**

Perception – factors influencing perception - Person Perception – Attribution Theory – Frequently UsedShortcuts in Judging Others- Perceptual Process- Perceptual Selectivity - Organization Error of perception – Linkage between perception and Decision making.

UNIT IV Group and Stress Management **6 hours**

Foundation of Group Behavior - Types of Groups - Stages of Group Development - Group Norms - Group Cohesiveness – Stress – Causes of stress – Effects of Occupational Stress- Coping Strategies for Stress.

UNIT V Organization Culture and Change **8 hours**

Organizational culture- Characteristics of Culture- Types of Culture – Creating and Maintaining an Organizational Culture. Organizational change – Meaning - Forces for Change - Factors in Organizational Change - Resistance to change- Overcoming resistance to change.

SUGGESTED READINGS:

1. Fred Luthans. (2017). *Organizational Behavior: An Evidence - Based Approach*, 12th edition, Mcgraw Hill Education, NewDelhi.
2. Steven Mcshane and Mary Ann VonGlinow (2017), *Organizational Behavior*, 6th edition, McGraw Hill Education, NewDelhi
3. Robbins, S. P., and Judge, T.A. (2016). *Organizational Behaviour*.(16th edition).New Delhi: PrenticeHall of India.
4. Laurie J. Mullins (2016), *Management and Organisationalbehaviour*, 10th edition, Pearson Education, NewDelhi
5. Robbins, S. P., and Judge, T.A. (2016). *Essentials of Organizational Behavior*.13th edition, Pearson Education.
6. https://nptel.ac.in/courses/110/105/110105033/

SEMESTER–III

23CAPOE30 ROBOTICS AND AUTOMATION PROCESS 3H – 2C

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

Course objectives

Enable the student

- Learn the concepts of RPA, its benefits, types and models
- Gain the knowledge in application of RPA in Business Scenarios
- Identify measures and skills required for RPA
- Adopt to the implementations of Automation
- Able to process information and draw inference
- Understand the concepts of robot skills

Course Outcomes (COs)

Upon completion of this course students will be able to:

1. Demonstrate the benefits and ethics of RPA K1, K2
2. Understand the Automation cycle and its techniques K2
3. Draw inferences and information processing of RPA K3, K4
4. Understand the Automation concepts
5. Implement & Apply RPA in Business Scenarios K5
6. Analyze on Robots & leveraging automation

Unit I - Introduction **8 hours**

Introduction to RPA - Overview of RPA - Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA - Centre of Excellence –Types and their applications - Building an RPA team - Approach for implementing RPA initiatives.

Unit II - Automation **6 hours**

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 -Understanding the Automation cycle – First 3 automation stages and activities performed by different people **Unit III - Automation Implementation** **8 hours**

Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed bydifferent people - Role of a Business Manager in successful completion – Part 2 - Activities to be performedpost-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows

Unit IV – Robot **8 hours**

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

Unit V – Robot Skill **8 hours**

Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.

Suggested Readings

1. Tom Taulli, February 2020. "The Robotic Process Automation Handbook" Apress , Reference Books 1Steve Kaelble" Robotic Process Automation" John Wiley & Sons, Ltd.
2. Alok Mani Tripathi, March 2018. "Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool", Packet Publishing Limited

Websites

1. https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm
2. https://www.javatpoint.com/rpa 3 https://onlinecourses.nptel.ac.in/noc19_me74/preview

SEMESTER–III

23BCPOE301 NUTRITION AND DIETETICS 3H – 2C

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

Course Objectives

To equip the students with

- Fundamentals of food, nutrients and their relationship to health
- Respect to deriving maximum benefit from available food resources
- Understanding of the consequences of vitamin and mineral deficiency/excess ofvitamin
- Respect to the nutrition in adult age
- Nutrition deficiency diseases and their consequences
- Food adulteration and prevention of food adulteration

Course Outcomes (CO's)

After successful completion, the students will understand:

COs	Course Outcomes	Blooms Level
CO1	The fundamentals of nutrition and their relationship to health	Understand
CO2	To derive maximum benefits from available food resources	Understand
CO3	The consequences of vitamin and mineral deficiency/excess of vitamin	Understand
CO4	The nutrition in adult age	Remember
CO5	Nutrition deficiency diseases and their consequences	Remember
CO6	The sources of food adulteration and measures to prevent it	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	L	L	L	L	L	L	L
CO2	L	L	L	L	L	L	L
CO3	L	L	L	L	L	L	L
CO4	L	L	L	L	L	L	L
CO5	L	L	L	L	L	L	L
CO6	L	L	L	L	L	L	L

S-Strong; M-Medium; L-Low

UNIT 1 **8 hours**

Basic concepts in food and nutrition- Understanding relationship between food, nutrition andhealth, Functions of food-Physiological, psychological and social. Dietary guidelines for Indians food pyramid. Junk foods and its causes.

UNIT II **6 hours**

Nutrients - Functions, dietary sources and clinical manifestations of deficiency/ excess of the following nutrients: Carbohydrates, lipids and proteins, Fat soluble vitamins-A, D, E andK, Water soluble vitamins –thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C, Minerals – calcium, iron and iodine

UNIT III **6 hours**

Adult nutrition

Physiological changes, RDA, nutritional guidelines, nutritional concerns and healthy food choices -Adult, Pregnant woman, Lactating mother, Elderly. Nutrition during childhood -Growth and development, nutritional guidelines, nutritional concerns and healthy food choices -Infants, Preschool children, School children, Adolescents. Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and Counselling, Infant and young child feeding and care - Current feeding practices andnutritional concerns, guidelines for infant and young childfeeding, Breast feeding, weaning and complementary feeding. Assessment and management of moderate and severe malnutrition among children, Micronutrient malnutrition among preschool children. Child health andmorbidity, neonatal, infant and child mortality.

UNIT IV **8 hours**

Introduction to Nutritional deficiency diseases -Causes, symptoms, treatment, prevention of the following:Protein Energy Malnutrition (PEM), Vitamin A Deficiency (VAD), Iron Deficiency Anaemia (IDA), Iodine Deficiency Disorders (IDD), Zinc Deficiency, Flurosis Nutritional needs during pregnancy, common disorders of pregnancy (Anaemia, HIV infection, Pregnancy induced hypertension), relationship between maternal diet and birth. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

UNIT V **8 hours**

Dietetics : Diet for diabetes mellitus-Nutrition recommendations for patient with diabetes, Meal planning, Exchange list of different food groups, Glycemic index based formulation of diet for diabetic individual, Diabetic diets menu wise. Diet for Cardiovascular Diseases -Dietary management and general guidelines for coronary heart disease, Dietary recommendations of WHO. Diet for Acute cardiac diseases. Influence of diet on carcinogenesis, Dietary risk factors and cancers at various sites in the human body, diet therapy, diet for cancerpatients, managing eating problems during treatment. Hormonal imbalance-Poly cystic ovarian syndrome, hypogonadism, cushing syndrome. Causes of hormonal imbalance. Treatment- Dietary and stress management protocols to be followed.

SUGGESTED READING

1. Gordon M, Wardlaw and Paul M. (2012). Perspectives in Nutrition: U.S.A. McGraw Hill Publishers. 9rd Edition. New Delhi
2. Srilakshmi.B. (2014) Nutrition Science: New Age International (P) Ltd. Publishers.4th Edition. New Delhi.
3. Srilakshmi.B. (2015) Food Science:. New Age International (P) Ltd. Publishers. 6nd Edition., New Delhi
4.Darshan Sohi (2012). A Comprehensive Textbook of Nutrition & Therapeutic Diets. Jaypee Brothers Medical Publishers Pvt. Ltd.

23CSPOE301 **CYBER FORENSICS** **3H – 2C**

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

Course Objectives

- To understand about computer forensics and investigations.
- To know about digital evidence and crime.
- To analyse and validate forensics data.
- To know about e-mail investigation.
- To understand about Mobile device forensics.

Course Outcomes (COs)

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

COs	Course Outcomes	Blooms Level
CO1	Define, understand and explain various investigation procedures and summarize duplication of digital evidence.	Remember
CO2	Apply the knowledge of digital evidences.	Understand
CO3	Design and develop various forensics tools and analyse the network forensics.	Create
CO4	Demonstrate the systematic study of high-tech forensics	Understand
CO5	Understand the importance of reports.	Evaluate

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	M	L	M	M	M	M	L	L	M	M
CO2	S	M	M	M	L	L	M	M	S	S	L	M
CO3	S	M	L	L	S	S	L	M	S	S	S	L
CO4	L	S	S	S	M	M	S	L	L	L	M	S
CO5	L	M	S	M	L	L	S	S	L	L	L	S

S-Strong; M-Medium; L-Low

Unit I – Computer forensics and investigations **(7 HOURS)**

Computer forensics and investigations as a profession – Preparing for computer investigations – Taking asystematic approach–Procedures for corporate high-tech investigations–Data recovery work stations andsoftware– Conducting an investigation.

Unit II – Data Acquisition **(7 HOURS)**

Data acquisition – Storage formats for digital evidence – Validating data acquisitions – Processing crime and incident scenes– Identifying digital evidence–Collecting evidence in private sector incident scenes – Preparing for search-seizing digital evidence at the scene-storing digital evidence –Reviewing a case.

Unit III – Computer Forensics Tools **(7 HOURS)**

Current computer forensics tools–Software tools–Hardware tools–The Macintosh file structure and boot process – Computer forensics analysis and validation – Addressing data –Hiding techniques.

Unit IV – Network Forensics **(7 HOURS)**

Virtual machines – Network forensics – Developing standard procedures – Live acquisitions – email investigations – Investigating e-mail crimes and violations – Understanding e-mail servers – Cell phone and mobile device forensics.

Unit V – Mobile Device Forensics **(8 HOURS)**

Understanding mobile device forensics – Acquisition procedures –Report writing for high-tech investigations – Importanceof reports – Guidelines for writing reports –Expert testimony in high-tech investigations.

SUGGESTED READINGS

1. Bill Nelson, Amelia Phillips and Christopher Steuart. (2018). Computer Forensics and Investigations, Cengage Learning, 5th Edition.
2. Eoghan Casey. (2017). "Handbook of Digital Forensics and Investigation", Academic Press, 1st Edition,
3. John R Vacca,.(2016)."Computer Forensics", Cengage Learning, 2nd Edition.

WEB LINKS

1. www.cps.brockport.edu/~shen/cps301/figures/figure1.pdf
2. www.forensicsguru.com/devicedataextractionsimcell.php
3. www.nptel.ac.in/courses/106101060
4. www.samsclass.info/121/ppt/ch11.ppt
5. www.garykessler.net/library/role_of_computer_forensics.html
6. www.ukessays.com/essays/information-technology/computer-forensics-and-crime investigations-information-technology-essay.php

SEMESTER–III

23CMPOE301 PERSONAL FINANCE AND PLANNING 3H – 2C

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

COURSE OBJECTIVES:

To make the students

1. To familiarize with regard to the concept of Investment Planning and its methods
2. To examine the scope and ways of Personal Tax Planning;
3. To analyze Insurance Planning and its relevance
4. To develop an insight in to retirement planning and its relevance.
5. To construct an optimal portfolio in real life situations

COURSE OUTCOMES:

Learners should be able to

COs	Course Outcomes	Blooms Level
CO1	Familiarize with regard to the concept of Investment Planning and its methods	Understand
CO2	Examine the scope and ways of Personal Tax Planning;	Analyze
CO3	Analyze Insurance Planning and its relevance	Analyze
CO4	Develop an insight in to retirement planning and its relevance.	Create
CO5	Construct an optimal portfolio in real life situations	Create

UNIT I **8 hours**

Introduction to Financial Planning - Financial goals, Time value of money, steps in financial planning, personal finance/loans, education loan, car loan & home loan schemes. Introduction to savings, benefits ofsavings, management of spending & financial discipline, Net banking and UPI, digital wallets, security andprecautions against Ponzi schemes and online frauds such as phishing, credit card cloning, skimming.

UNIT II **6 hours**

Investment Planning - Process and objectives of investment, Concept and measurement of return & risk for various assets class, Measurement of portfolio risk and return,Diversification & Portfolio formation. Gold Bond; Real estate; Investment in Greenfield and brownfield Projects; Investment in fixed income instruments- financial derivatives& Commodity market in India. Mutual fund schemes including SIP; International investment avenues.

UNIT III **6 hours**

Personal Tax Planning - Tax Structure in India for personal taxation, Scope of Personal tax planning, Exemptions and deductions available to individuals under different heads ofincome and gross total income,Special provision u/s 115BAC vis-à-vis General provisions of the Income-tax Act, 1961. Tax avoidance versus tax evasion.

UNIT IV **8 hours**

Insurance Planning - Need for Protection planning. Risk of mortality, health, disability andproperty. Importance of Insurance: life and non-life insurance schemes. Deductions availableunder the Income-tax Act for premium paid for different policies.

UNIT V **8 hours**

Retirement Benefits Planning - Retirement Planning Goals, Process of retirement planning, Pension plans available in India, Reverse mortgage, New Pension Scheme. Exemption availableunder the Income-tax Act, 1961 for retirement benefits.

SUGGESTED READINGS

1. Indian Institute of Banking & Finance. (2017). Introduction to Financial Planning. New Delhi: Taxmann Publication.
2. Pandit, A. (2014). The Only Financial Planning Book that You Will Ever Need. Mumbai: Network Publications Ltd.
3. Sinha, M. (2008). Financial Planning: A Ready Reckoner. New York: McGraw Hill Education.
4. Halan, M. (2018). Let's Talk Money: You've Worked Hard for It, Now Make It Work for You. New York: HarperCollins Publishers.
5. Tripathi, V. (2017). Fundamentals of Investment. New Delhi: Taxmann Publication

SEMESTER–III

23CHEOE301 CHEMISTRY IN EVERYDAY LIFE 3H – 2C

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to

- Gain knowledge in the importance of chemistry in food industry.
- Understand the chemistry of medicines and cosmetics.
- Evaluate the solar energy utilization and its storage.
- Knowledge about the production of electricity by a nuclear reactor.
- Know about the chemistry of soaps, detergents and textiles.
- Know about the chemistry behind the polymers, fuel and agriculture.

Course Outcomes (CO's)

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

1. Know the importance of chemistry in food industry.
2. Understood the chemistry of medicines and cosmetics.
3. Evaluate the solar energy utilization and its storage.
4. Understood the production process of electricity by a nuclear reactor.
5. Know about the chemistry of soaps, detergents and textiles.
6. Know the chemistry behind the polymers, fuel and agriculture.

UNIT - I Importance of Chemistry in food **8 hours**

Chemicals in food, colouring agents, artificial preservatives, flow stabilizers, binding substance, flavours and sweeteners, antioxidants, minerals, vitamins. Chemistry at the breakfast table, raising agents- gluten, thetaste maker- glutamic acid, stimulants-Caffeine, chemistry of onion, garlic and curcumin.

UNIT - II Chemistry in medicines and cosmetics **6 hours**

Elements in the human body, drugs and their classification, drug-target interaction, action of different classes of drugs, antiseptics and disinfectants.

Cosmetics: Chemistry behind the lotions, fragrances, talcum powder, sunblock and sunscreen, toothpaste, lipsticks, nail polishes.

UNIT - III Chemistry in energy **6 hours**

Solar energy - fuel from sun light - splitting of water - hydrogen from sunlight - hydrogen economy - fuel cells - batteries - photovoltaics - stealing the sun - nuclear energy - nuclear fission and fusion - production ofelectricity by a nuclear reactor - radioactivity and the hazards of radioactivity - living with nuclear power.

UNIT - IV Importance of chemistry in soaps, detergents and textiles **8 hours**

Detergents and soaps, types of soaps and detergents, saponification, cleansing action of soaps and detergents, perfumes used in soaps.

Textiles: Chemistry behind wool, silk, jute, cotton, glass fibre, polyester, acrylic, nylon, and other raw materials.

UNIT - V Chemistry of polymers, fuel and agriculture **8 hours**

Polymers, types, polyethylene, plastics, disposal of plastics, degradation of polymers and plastics using nano materials. Petrochemistry, petrol, diesel, LPG, CNG, kerosene, oils, and other fuels. Agriculture: fertilizers, herbicides, insecticides, and fungicides.

SUGGESTED READINGS

1. Tripathy, S. N., & Sunakar Panda (2004). *Fundamentals of Environmental Studies* (II Edition). NewDelhi: Vrianda Publications Private Ltd.
2. Arvind Kumar (2004). *A Textbook of Environmental Science*. New Delhi: APH Publishing Corporation.
3. Anubha Kaushik, C. P., & Kaushik (2004). *Perspectives in Environmental Studies*. New Delhi: New Age International Pvt. Ltd. Publications.
4. Seymour R. B., & Charles, E. (2003). *Seymour's Polymer Chemistry: An Introduction.* Marcel Dekker,Inc.
5. Stocchi. E, (1990). *Industrial Chemistry* (Vol–I). UK: Ellis Horwood Ltd.
6. Jain, P. C., & Jain, M. (2004). *Engineering Chemistry*. Delhi: Dhanpat Rai & Sons.
7. Sharma, B. K., & Gaur, H. (1996). *Industrial Chemistry.* Meerut : Goel Publishing House.

SEMESTER–III

23MBPOE301 FERMENTATION TECHNOLOGY 3H – 2C

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

COURSE OBJECTIVE

- To encompass the use of microorganisms in the manufacture of food or industrial products on the basis of employment.
- Get equipped with a theoretical and practical understanding of industrial microbiology
- Appreciate how microbiology is applied in the manufacture of industrial products
- Know how to source microorganisms of industrial importance from the environment
- Know about the design of bioreactors, factors affecting growth and production, heat transfer, oxygen transfer
- Understand the rationale in medium formulation & design for microbial fermentation, and sterilization of medium and air.

COURSE OUTCOME

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	Provides knowledge in the large scale production of industrial product, and teaches the modern employment trends to cater the needs of industry.	Understand
CO2	Students will differentiate the types of fermentation processes	Apply
CO3	Understand the biochemistry of various fermentations	Understand
CO4	Identify techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatorymechanisms	Analyze
CO5	Comprehend the techniques and the underlying principles in downstream processing	Apply
CO6	Students can able to explore the practical skills in research activities.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	M	S	L	M	M	M	M	M	M
CO2	M	M	S	S	L	L	M	M	M	M	M
CO3	M	S	M	M	M	M	M	M	M	M	M
CO4	M	S	M	M	M	S	S	M	M	M	M
CO5	L	S	M	M	M	M	M	S	L	S	L
CO6	S	S	S	L	M	M	M	M	L	M	M

S-Strong; M-Medium; L-Low

Unit I - Basics of fermentation processes **8 hours**

Definition, scope, history, and chronological development of the fermentation industry. Component parts of the fermentation process. y. Component parts of fermentation process. Microbial growth kinetics, batch and continuous, direct, dual or multiple fermentations; scaleup of fermentation, comparison of batch and continuous culture as investigative tools, examples of the use of fed batch culture.

Unit II Isolation and Preservation **6 hours**

Isolation, preservation, and strain improvement of industrially important microorganisms. Use of recombination system (Parasexual cycle, protoplast fusion techniques), application of recombinant strains, and the development of new fermentation products.

Unit III –Screening and Inoculum development **6 hours**

Screening (primary and secondary screening); detection and assay of fermentation products (Physico-chemical assay, biological assays). Inoculum development, criteria for transfer of inoculum, development of inoculum: Bacteria, Fungiand Yeast.

Unit IV–Microbial Production **8 hours**

Fermentation type reactions (Alcoholic, bacterial, mixed acid, propionic acid, butanediol and acetone-butanol). Microbial production of enzymes (amylases, Proteases, cellulases, pectinases and lipases) primary screening for producers, large scale production. Immobilization methods.

Unit V – Alcohols and Beverages **8 hours**

Fermentative production of industrial alcohol, production of beverages. Production of organic acids: citric acid, aminoacids: glutamic acid, production of vitamins. fungal enzymes and Single cell protein.

SUGGESTED READING

1. Casida, L.E.2007. Industrial microbiology, New age international (P) Ltd., New Delhi.
2. Clark, D.P and Pazdernik, N.J.2009. Biotechnology applying the genetic revolution, Elsevier Academic Press, UK.
3. Glazer, A and Nikaido.1995. Microbial biotechnology fundamentals of applied microbiology, W.H.Freemn and company, USA.
4. Glick, B.R and Pasternak, J.J.2003. Molecular Biotechnology Principles and Applications ofRecombinant DNA, 3rd edition, ASM Press, USA.
5. Harider, S.I. and Ashok, A. 2009. Biotechnology, A Comprehensive Training Guide for theBiotechnology Industry, CRC Press, New York.
6. Sridhar, S.2010. Industrial Microbiology, Dominant Publishers, New Delhi.
7. Tanuja.S and Purohit, S.S. 2008. Fermentation Technology, Agrobios Publication, Jodhpur, India.

SEMESTER–III

23EGPOE301 ENGLISH FOR COMPETITIVE EXAMINATION 3H – 2C

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

Course Objectives

•To train learners to crack competitive exams
•To know of various tools that is essential for Competitive Exams
•To enhance their ability to speak in English and face an interview.
•To make the student apply, prepare and clear the competitive exams.
•To prepare the student to concentrate, stay positive and confident.
•To take even failure at ease and continue the target of clearing competitive exams.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	The student may settle in life with a government job.	Apply
CO2	The student may develop various skills	Understand
CO3	The successful student may guide other students to success.	Understand
CO4	Analyse logical reasoning questions, error analysis, and correctusage of words.	Analyse
CO5	Develop the knowledge of grammatical system of English language.	Apply
CO6	Elaborate on the correct structure of sentence	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	M	M	S	L	M	M	L
CO2	L	M	M	M	M	L	M	S	M	L
CO3	L	M	L	M	M	L	L	M	M	L
CO4	M	M	M	S	S	M	M	S	M	L
CO5	M	S	M	M	M	M	L	M	M	L

S-Strong; M-Medium; L-Low

UNIT I Grammar **8 hours**

Number-Subject, Verb and Agreement-Articles-Sequences of Tenses-Common Errors

UNIT II Word Power **6 hours**

Idioms and Phrases-One word substitution-Synonyms-Antonyms-Words often confused

UNIT III Paragraph **6 hours**

Expansion of an idea

UNIT IV Writing **8 hours**

Essay- Letters-Memos-Agenda-Resume writing

UNIT V Speaking **8 hours**

Public Speaking-Group discussion-Interview-Spoken English

SUGGESTED BOOKS

V. Saraswathi, Maya K. Mudbhatkal (2014). English for Competitive Examinations. Emerald: Chennai.

SEMESTER–III

23BTPOE301 SERICULTURE 3H – 2C

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

Course Objectives

The main objectives of the course are

- To apply knowledge and skills of seribiotechnology for development new mulberry variety and silkworm breeds suitable for varied agro-climatic zones.
- To apply tools and techniques of biostatics for critical analysis and interpretation of data accrueded.
- To use bioinformatics tools and techniques for the analysis and interpretation of bimolecular data for better understating mulberry and silkworm.
- To demonstrate communication skills, scientific writing, data collection and interpretation abilities in all the fields of seribiotechnology.
- Thorough knowledge and application of good laboratory and good manufacturing practices in sericulture and biotech industries.
- To demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.

Course Outcomes

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Know the different components and chain link of sericulture industry.	Understand
CO2	Understand concepts of sericulture industry and demonstrate interdisciplinary skills acquired in mulberry plant cultivation and silkworm rearing.	Understand
CO3	Demonstrating the Laboratory and field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.	Create
CO4	To transfer the knowledge and technical skills to the Seri-farmers.	Understand
CO5	To analyze the environmental issues and apply in management of mulberry garden and silkworm rearing at field.	Analyze
CO6	Demonstrate comprehensive innovations and skills in improvement of mulberry andsilkworm varieties for betterment of sericulture industry and human welfare.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	L	S	S
CO2	S	S	S	S	L	S	S
CO3	S	S	S	S	L	S	S

CO4	M	M	M	M	L	M	M
CO5	M	M	M	M	L	M	M
CO6	M	M	M	M	L	M	M

S-Strong; M-Medium; L-Low

UNIT I **6 hours**

Introduction to Sericulture - History of Sericulture – Sericulture organization in India, By products of silk industry. Mulberry and Non – mulberry silkworm types–Morphology and Life cycle of Bombyxmori,

UNIT II **8 hours**

Mulberry Cultivation: Mulberry Varieties – Methods of Irrigation –Nutrient Management and Weed control. Pruning and Harvesting – Crop improvement – Me chanism in Moriculture – Pest and Disease, deficiencies and symptoms in Mulberry.

UNIT III **8 hours**

Rearing of silkworm – Rearing Appliances – rearing operation. Harvesting and marketing of cocoons.Cocoon processing and reeling - Appliances used for reeling. Pre reeling process – Cocoon boiling. Reeling technology – re-reeling technology.

UNIT IV **8 hours**

Non – Mulberry Sericulture Scope of Non-mulberry Sericulture - Non-mulberry silk varieties and fauna, tasar, muga, eri – Silk Production and Marketing – Tropical tasar / muga – Morphology, anatomy grainage **UNIT V** **6 hours**

Diseases of silkworm –Pebrine Protozoan, Flacheriebacterial,Nuclear Polyhedrosisviral and Muscardine fungal diseases. Pests of Silkworm.

REFERENCES:

1. Krisnamoorthy S., Improved Method of Rearing Young Age Silk Worms: Reprinted by CSB, Bangalore,1986.
2. Tanaka Y., Sericology, CSB, Pub., Bangalore, 1964.
3. Ullal S.R., and Narasimhan M.N., Hand Book of Practical Sericulture, CSB, Bangalore, 1987.
4. HisaoAruga, Principles of sericulture, Oxford and IBH Publishing Company, 1994.
5. Hrccrama Reddy, G. 1998. Silkworm Breeding, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
6. Otsuki el.al. 1987. Silkworm Egg Production (Translated from Japanese Language), Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Yasuji Hamamura, 2001 Silkworm Rearing on Artificial Diet (Translated from Japanese Language), Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Mahadevappa, D. Halliyal, V.G., Sankar, D.G and Bhandiwad, R. 2000. Mulberry Silk Reeling Technology, Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
9. Dandin, S.B et.al. 2003. Advances in Tropical Sericulture, National Academy of Sericulture Sciences India, Central Silk Board, Bangalore, India.
10. Ganga G., Sulochanachetty. J. An Introduction of Sericulture. Oxford, New Delhi – 1977.
11. Johnson M., and Kesary M., Sericulture, CSI Press, Marthandam, 2008.
12. Text Book of Tropical Sericulture, Pub., Japan Overseas Volunteers, 1975

SEMESTER–III

23MMPOE301 CODING THEORY 3H – 2C

InstructionHours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External:**60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- Elements of coding theory and its applications.
- Understand the concept of bounds in coding theory.
- About the encoding and decoding.
- Analyze the concept of cyclic coding
- Acquiring the knowledge special cyclic codes.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Recognize the basic concepts of coding theory.	Apply
CO2	Understand the importance of finite fields in the design of codes.	Understand
CO3	Detect and correct the errors occur in communication channels with the help of methods of coding theory.	Apply
CO4	Apply the tools of linear algebra to construct special type of codes.	Apply
CO5	Use algebraic techniques in designing efficient and reliable data transmission methods.	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1							S			
CO2							S			
CO3							S			
CO4							S			
CO5							S			

S-Strong; M-Medium; L-Low

UNIT I - ERROR DETECTION, CORRECTION AND DECODING **8 hours**

Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbourhoodminimum distance decoding – Distance of a code.

UNIT II - LINEAR CODES **6 hours**

Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Enconding with a linear code – Decoding of linear codes – Syndrome decoding.

UNIT III - BOUNDS IN CODING THEORY: 6 hours

The main coding theory problem – lower bounds - Sphere covering bound – Gilbert Varshamov bound – Binary Hamming codes – q-ary Hamming codes – Golay codes – Singleton bound and MDS codes – Plotkin bound.

UNIT IV - CYCLIC CODES: 8 hours

Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.

UNIT V - SPECIAL CYCLIC CODES: 8 hours

BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.

SUGGESTED BOOKS

1. San Ling and Chaoping Xing (2004). Coding Theory: A first course, Cambridge University Press.
2. Lin. S & Costello. D. J. (1983). Jr., Error Control Coding: Fundamentals and Applications, Prentice-Hall,Inc., New Jersey.
3. Vera Pless (1982). Introduction to the Theory of Error Correcting Codes, Wiley, New York.
4. Berlekamp E.R. (1968). Algebriac Coding Theory, Mc Graw-Hill.
5. H. Hill (1986). A First Course in Coding Theory, OUP.

WEB LINKS

1. https://www.youtube.com/watch?v=XepXtl9YKwc
2. https://www.youtube.com/watch?v=oeQWxhlnCHM
3. https://www.youtube.com/watch?v=Z-QGtxlQWak

SEMESTER – III

Value Added Course **3H-0C**

WATER RESOURCE MANAGEMENT

Course Objectives

- 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.
- To promote student awareness for the life-long learning and to introduce them professional ethics and codes of professional practice in water resources management.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Understanding Research methodologies and Water Resources Management.	Understanding
CO2	Design and construct hardware and software water resource system	Creating
CO3	Classification of environmental, socio-economical, water governance, political, ethical, health and safety.	Analysing
CO4	An ability to use the techniques, skills, and modern modeling software tools necessary for water resource planning and management.	Applying
CO5	Adapting water and water-related issues in a global, economic, environmental, and societal context.	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**M**	**S**	**M**	**M**	**L**	**M**
CO2	**M**	**S**	**L**	**M**	**L**	**M**
CO3	**S**	**S**	**L**	**S**	**M**	**M**
CO4	**M**	**S**	**M**	**M**	**L**	**S**
CO5	**M**	**S**	**M**	**M**	**M**	**M**

*S-Strong; M-Medium; L-Low

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-Industrialpurposes

Unit V

Water Pollution- Introduction- Types of pollution- controlling methods

SUGGESTED READINGS

1. Arul.P (2000) A text book of Ground water, Dhanam Agency, Virudhachalam 2nd Ed.
2. Raghunath H.M (2015) Hydrology 3rd ed. New Age International publisher. Todd, D.K. (1980).Groundwater Hydrology, John Wiley and Sons, 2nd Ed.

23PHP491 **PROJECT** **SEMESTER IV**
30H- - 15C

Instruction Hours / week: L: 0 T: 0 P: 30 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

- The aim of the M.Sc. Research project work is to expose the students to preliminaries and methodology of research in Theoretical Physics and Experimental Physics.
- 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.
- To provide the student with different practical, intellectual and transferable skills.
- To understand the objective of a physics laboratory experiment, properly carry out the experiments, and appropriately record and analyze the results.
- To think creatively about scientific problems and their solutions.
- To design experiments, and to constructively question results they are presented with, whether these results are in a newspaper, in a classroom, or elsewhere.

Course Outcomes

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

Cos	Course Outcomes	Blooms Level
CO1	Apply their knowledge to develop the instruments	Applying
CO2	Successfully pursue career objectives in graduate school or professional schools, in a scientific career in government or industry, in a teaching career, or in a related Career	Applying
CO3	Conduct independent research or work successfully in a technical position.	Applying
CO4	Verify the basic principles and laws experimentally as a project	Analysing
CO5	An independent research project, resulting in research outputs	Analysing
CO6	An ability to succeed in problem solving in Research, present and defend their research work	Analysing
CO7	Solve physics problems using qualitative and quantitative reasoning including sophisticated mathematical techniques	Creating

Mapping with Programm Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**S**	**S**	**M**	**M**	**M**	**L**	**S**	**M**
CO2	**S**	**M**	**M**	**M**	**S**	**M**	**M**	**S**
CO3	**S**	**M**	**M**	**S**	**S**	**L**	**S**	**M**
CO4	**M**	**S**	**M**	**L**	**M**	**S**	**M**	**S**
CO5	**S**	**M**	**M**	**M**	**M**	**L**	**S**	**M**
CO6	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**
CO7	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**M**

*S-Strong; M-Medium; L-Low