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

Syllabus
Students admitted from 2022 onwards

DEPARTMENT OF PHYSICS
KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University Established Under Section 3 of UGC Act, 1956)
Eachanari Post, Coimbatore – 641 021, INDIA.
Phone: 0422-6453777, 6471113-5, 2980011-2980018;
Fax No: 0422 – 2980022, 2980023
Email: info@karpagam.com
Web: www.kahedu.edu.in

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established under Section 3 of UGC Act, 1956)
Coimbatore - 641 021, INDIA
FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

POST-GRADUATE PROGRAMMES
(M.Sc., M.Com.)

REGULAR MODE

CHOICE BASED CREDIT SYSTEM (CBCS)
REGULATIONS - 2022

The following Regulations are effective from the academic year 2022-2023 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.

<div align="center">

QUALIFICATIONS FOR ADMISSION

</div>

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, Industrial Chemistry, Polymer Chemistry
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	22EGPOE301	English for Competitive Examinations
2	M.Com	22CMPOE301	Personal Finance and Planning
3	MBA	22MBAPOE301	Organizational behavior
4	MCA	22CAPOE301	Robotics
5	M.Sc Computer Science	22CSPOE301	Cyber forensics
6	M.Sc Mathematics	22MMPOE301	Coding theory
7	M.Sc Physics	22PHPOE301	Non-destructive techniques – an industrial approach
8	M.Sc Chemistry	22CHPOE301	Applying Chemistry to Society

9	M.Sc Microbiology	22MBPOE301	Fermentation technology
10	M.Sc Biochemistry	22BCPOE301	Nutrition and Dietetics
11	M.Sc Biotechnology	22BTPOE301	Plant Tissue culture and its applications

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	12.2
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)	

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.

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

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

CGPA of the entire programme = $\dfrac{\text{Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$

i.e. **CGPA** of the entire programme = $\dfrac{\sum_n \sum_i CniGPni}{\sum_n \sum_i Cni}$

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.

DEPARTMENT OF PHYSICS
FACULTY OF ARTS, SCIENCE AND HUMANITIES
PG PROGRAM (CBCS) – M.Sc. Physics
(2022-2023 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 40	ESE 60	Total 100	
SEMESTER – I												
22PHP101	Mathematical Physics –I		1	a	4	-	-	4	40	60	100	25
22PHP102	Electromagnetic theory and Electrodynamics		3	a	4	-	-	4	40	60	100	28
22PHP103	Classical Mechanics and Non-Linear Dynamics		3	a	4	-	-	4	40	60	100	31
22PHP104	Semiconductor Devices		7	f	4	-	-	4	40	60	100	34
22PHP105A	Elective -I	Nanoscience and NanoTechnology	1,8	d,c	4	-	-	4	40	60	100	37
22PHP105B		Non-Destrctive Testing										40
22PHP105C		Crystal Growth Techniques										43
22PHP111	General Physics Practical – I		4	e, f	-	-	4	2	40	60	100	45
22PHP112	Electronics Practical – I		7	e	-	-	4	2	40	60	100	47
Journal Paper Analysis & Presentation			1,8	d	2	-	-	-	-	-	-	
Semester Total					22	-	8	24	280	420	700	
SEMESTER – II												
22PHP201	Thermodynamics and Statistical Mechanics		2	a	4	-	-	4	40	60	100	53
22PHP202	Quantum Mechanics – I		3	a,b	4	-	-	4	40	60	100	56
22PHP203	Mathematical Physics-II		1	a	4	-	-	4	40	60	100	59
22PHP204	Spectroscopy		4	c	4	-	-	4	40	60	100	61
22PHP205A	Elective -II	Material Characterization	4,5	d,c	4	-	-	4	40	60	100	64

22PHP205B		Solar Energy and Its Utilizaation										67
22PHP205C		Industrial Electronics										69
22PHP211	General Physics Practical – II		4	e,f	-	-	4	2	40	60	100	72
22PHP212	Electronics Practical – II		7	f	-	-	4	2	40	60	100	74
Journal Paper Analysis & Presentation			1,8	d	2	-	-	-	-	-	-	
Semester Total					22	-	8	24	280	420	700	
SEMESTER – III												
22PHP301	Quantum Mechanics – II		3	a	4	-		4	40	60	100	80
22PHP302	Laser and Non-Linear Optics		2	c,d	4	-		4	40	60	100	83
22PHP303	Condensed Matter Physics		2	a,b	4	-		4	40	60	100	86
22PHP304	Nuclear and Particle Physics		2	a,e	4	-		4	40	60	100	89
22PHP305A	Elective-III	Digital Electronics and Microcontroller	6	a,e	4	-		3	40	60	100	92
22PHP305B		Numerical methods in Physics										95
22PHP305C		Thin Film Physics										98
22PHP311	Advanced Physics Practical		4	f		-	3	2	40	60	100	101
22PHP312	Advanced Electronics Practical		7	f		-	3	2	40	60	100	103
22EGPOE301	Open Elective		4	d	3			2	40	60	100	105
Journal Paper Analysis & Presentation			1,8	d	2	-						
*Internship			4	f				2	100	-	100	
Semester total					24	-	6	27	420	480	900	
SEMESTER – IV												
22PHP491	Project		1,3,6,8	b,c,d,e		-		15	80	120	200	111
Semester total					30	-		15	80	120	200	
*End of II Semester- Internship for 15 days												
Total						-		90	1060	1440	2500	

Elective Courses*

Elective – I (22PHP105)		Elective – II (22PHP205)		Elective – III (22PHP305)	
Course code	Name of the course (Theory)	Course Code	Name of the course (Theory)	Course Code	Name of the course (Theory)
22PHP105A	Nanoscience and NanoTechnology	22PHP205A	Industrial Electronics	22PHP305A	Digital Electronics and Microcontroller
22PHP105B	Non-Destrctive Testing	22PHP205B	Computational Physics	22PHP305B	Numerical methods in Physics
22PHP105C	Crystal Growth Techniques	22PHP205C	Thin Film Physics	22PHP305C	Thin Film Physics

Open Electives

1. Non-Destructive Techniques- An Industrial Approach

List of Value Added Course

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

PROGRAMME OUTCOMES

At the end of the programme, the students will

a) The students will obtain good knowledge in Physical Sciences. They will be trained to compete national level tests like UGC-CSIR NET, JEST, GATE, etc., successfully

b) Acquire scientific knowledge to identify, analyze and solve the complex problems in the field of theoretical & experimental physics.

c) Ability to apply knowledge on the latest development of the topic

d) They can get opportunities after M.Sc. program to do research in leading national and international universities, multidisciplinary laboratories and research institutes.

e) Gain the knowledge and understand the fundamental laws and principles along with its applications in research skills which include advanced laboratory techniques.

f) Gain skill in the acquisition of data using different laboratory instruments and in the analysis and interpretation of data using various algorithms.

PROGRAMME SPECIFIC OUTCOMES

g) Recognize how observation, experiment and theory work together.

h) They acquire the knowledge to design and develop a device to meet the social needs or necessity of common people.

i) 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.

j)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

22PHP101   **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

- 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 (COs)

After completing the course the students will / can able to

1. Apply integral transform (Fourier and Laplace) to solve mathematical problems of Fourier transforms as an aid for analyzing experimental data.
2. 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).
3. Students will be able to solve some simple classical variation problems.
4. Intuition of the physical meaning of the various vector calculus operators (div, grad, curl)
5. 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).
6. Solve some simple classical variation problems.

UNIT I - Vector Space and Matrices

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- Kronecker sum and product of matrix- Dirac and Pauli's matrix

UNIT II- Tensor Analysis

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. The Christoffel symbols and their transformation laws. Covariant derivative of tensors.

UNIT III: Complex Variable

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

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 – Frobenius Method - Operators – Sturm Liouville Condition – Self Adjoint Operators.

UNIT V: Group theory and probability

Group Theory Definition of groups, subgroups and conjugate classes - Symmetry elements, Transformation, Matrix representation - Point groups - representation of a group - Reducible and irreducible representations - Orthogonality theorem - character of a representation - character Table C2v and C3v - Application to Infrared and Raman active vibrations of XY3 type molecules. Probability Definitions - Simple Properties – Random Variables - Probability distribution - Binomial Distribution – Poisson Distribution – Gauss's Normal Distribution – Central limit theorem.

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/

22PHP102   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 understanding of Maxwell's equations and be able to apply them to solving practical electromagnetic fields
- To provide the understanding to the propagation of EM wave in free space, conductors & dielectrics.

Course Outcomes (COs)

After completing the course the students will/can able to

1. 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.
2. 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.
3. Understand the theories and properties of electrostatics
4. Analyze the interaction of electrostatic properties with matter.
5. Acquire the fundamental knowledge in Magnetostatics
6. Understand the basic concepts of electrodynamics

UNIT- I - ELECTROSTATICS& MAGNETOSTATICS

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

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

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

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

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 $F_{\mu v}$ - 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 2[nd]edition 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

22PHP103   CLASSICAL MECHANICS AND NON-LINEAR DYNAMICS 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

- Study of Classical Mechanics gives an idea about how classical physics deal with matter and energy.
- It cannot explain many observed phenomena in the case of microparticles and relativistic velocities, it is still valid in the case of macro objects at non-relativistic velocities.
- To give an insight into the classical methods of physics.
- To understand the basic principles of classical mechanics.
- This course will demonstrate the ability to apply basic methods of classical mechanics towards solutions of variousproblems, including the problems of 1) complicated oscillatory systems, 2) the motion of rigid bodies, 3)mechanics of continuous media.
- Is to demonstrate the equations of motion for complicated many body mechanical systems and their solutions.

Course Outcomes (COs)
After completing the course the students will/ can able to

1. Understand the classical laws of motion.
2. Compete in using the essential mathematical skills needed for describing mechanics and special relativity
3. Develop problem solving skills.
4. An appreciation of the influence of classical mechanics and relativity on modern scientific development.
5. Use the general theory of relativity to explain the motion of physical system in space co-ordinates
6. Able to solve central potential problems in n-dimensional space.

Unit I: Lagrangian and Hamiltonian Dynamics

Constraints - generalized coordinates – D'Alembert's Principle - Lagrange's equation for conservative and Non- conservative System-Applications of Lagrange's equation- Hamilton's principle-Lagrange's Equation from Hamilton's Principle – Lagrange's equation from variational principles-Hamilton equations of motion-Cyclic coordinates and Conservation theorems - Hamilton equations from variational principle-The principle of Least action.

Unit II : The Two body Central Force Problem

Conservative central forces-Reduction to the Equivalent One-Body Problem - The Equations of Motion and First Integrals – Classification of Orbits-The Virial Theorem- The Kepler problem; Inverse Square law of Forces; The motion in time in the Kepler Problem – Rutherford scatterings- Scattering in a central force field –Transformation of the scattering problem to laboratory co-ordinates- Three body problem.

Unit III: Rigid body Motion

Coordinates of a rigid body- Properties of the Transformation Matrix- The Euler's Angles-Euler's Theorem- Finite, Infinitesimal Rotation- Angular momentum and Kinetic Energy of motion about a point-The inertia tensor and the moment of inertia. The Euler's Equations of motion-Torque free motion of a rigid body- Symmetric Top with one point fixed.

Unit IV: Small oscillations and Canonical Transformations

Potential energy and equilibrium – general theory of small oscillations – free vibrations vibrations of linear triatomic molecule – The Equations of canonical transformation – Examples-The Harmonic Oscillator-Poisson's brackets and Lagrange's bracket- Fundamental Jacobi's Equation for Hamilton's principal function-The Harmonic Oscillator problem- Hamilton's characteristic function.

Unit V: Nonlinear dynamics

Regular and chaotic motions: linear and nonlinear oscillators-phase trajectories-classification of fixed points-limit cycles-period doubling phenomena and onset of chaos in logistic map solitons: linear and nonlinear waves-Solitary waves-Fermi Pasta Ulam experiment-Numerical experiments of Kurskal and zabusky solutions-KdV equation (no derivation) one solution by Hirota's direct methods.

SUGGESTED READINGS

1) Herbert Goldstein, Charles Poole, John Safko 'Classical Mechanics' III Edition, Pearson Education, Dorling Kindersley Publication, New Delhi (2002**).**
2) M.Lakshmanan and S.Rajesakar, Non-linear Dynamics,Springer(2003)
3) J. C. Upadyaya, 'Classical Mechanics', Himalaya Publishing House, Mumbai (2014).

4) N.C.Rana, P.S.Joag, Classical Mechanics, Tata McGraw Hill, New Delhi (2004).

5) B.D.Gupta and SathyaPrakash, Classical Mechanics, Kethernath, Ramnath publications (2015).

6) Tom W.B. Kibble, Frank H. Berkshire, 'Classical Mechanics',Imperial College Press, London (2004).

7) Wolfgang Kliemann, N. Sri Namachchivaya, 'Nonlinear dynamics and Stochastic Mechanics'CRC Press, USA. (2018).

8) Gerd Baumann, 'Classical Mechanics and Nonlinear dynamics', Second Edition, Springer (2004).

9) https://nptel.ac.in/courses/115105098/

10) https://nptel.ac.in/courses/115106059/

	SEMESTER – I
22PHP104 **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:

After the completion of the course, students can have the

1. Ability to explain the working, design considerations and applications of various semiconducting devices including p-n junctions, BJTs and FETs.

2. Ability describe the working and design considerations for the various photonic devices like photodetectors, solar-cells and LEDs

3. Ability to determine the suitable device for the application.

4. Ability to design of semiconductor power device and its parameters.

5. Ability to design of protection circuits and control circuits

6. Ability to determine the reliability of the system.

UNIT I

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

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

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

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

Optoelectronic Devices

Principles, Operation and Characteristics OfOpto Electronic Devices - LED: Radiativetransition-Emission spectra-Luminous efficiency and LED materials- – LED – IR Emitter – LCD

– Opto–Couplers - LDR – Photo Diode - Photo Transistor – Photo Voltaic Cell-Solar cell and photodetectors: Ideal conversion efficiency-Fill factor-Equivalent circuit,Voc,Isc and Load resistance-Spectral response. Reverse saturation current in photodetector.

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/

22PHP105A   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 (COs)

At the end of the course, Students will understand and:

1. Distinguish different classes of nanostructured materials and nanostructures based on dimension.

2. Explain the fundamental principles of nanotechnology and their application.

3. Apply engineering and physics concepts to the nano-scale and non-continuum domain.

4. Gain broad understanding of advanced physical techniques employed for the preparation of 1D and 0D nanostructures.

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

6. Appraise the working principle and issues of energy conversion devices.

UNIT – I - GENERIC METHODOLOGIES FOR NANOTECHNOLOGY

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 - Periodicity of crystal lattices - Electronic conduction; Effects of the nanometre length scale - How nanoscale dimensions affect properties

UNIT – II–SYNTHESIS OF NANOSTRUCTURE MATERIALS:

Synthesis of zero-dimensional nanostructures - fundamentals of homogeneous nucleation - subsequent growth of nuclei - colloidal nanosynthesis - inorganic surface modification - shape control - phase transition and phase control - nanocrystal doping - synthesis of metallic (Au, Ag) nanoparticles - synthesis of semiconducting nanoparticles (CdSe, CdS)

Bottom-up and Top-down approaches (various methods to synthesize nanomaterials) - synthesis of oxide nanoparticles - synthesis of multicomponant nanostructures - quantum dot- quantum wells.

UNIT – III–CARBON NANOSTRUCTURES

Carbon Molecules - Nature of the Carbon Bond - New Carbon Structures - Carbon Clusters -Small Carbon Clusters - Carbon Nano tubes - Fabrication - Structure – Electrical Properties - Vibrational Properties – Mechanical Properties - 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 – Mechanical Properties – Nano structured Multi layers -Electrical Properties – Porous Silicon - Metal Nano cluster - Composite Glasses.

UNIT – IV–Industrial Applications of Nanomaterials

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

Issues and Challenges of functional Nanostructured Materials for electrochemical Energy, Conversion Systems, 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.

Principles of photovoltaic energy conversion (PV), Types of photovoltaic Cells, Physics of photovoltaic cells, Organic photovoltaic cell cells, thin-film Dye-Sensitized Solar Cells

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/

22PHP105B **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 (COs)

After successful completion of this course the student will be able to:

1. Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.

2.The student shall be able to solve various problems encountered like leakage, cracks, blowholes etc with the manufacturing process by analyzing the data.

3. Differentiate various defect types and select the appropriate NDT methods for better evaluation.

4. Communicate their conclusions clearly to specialist and non-specialist audiences.

5. Document the testing and evaluation of the results for further analysis.

6. Competent enough to make use of modern tools and softwares for analyzing and solving real life problems.

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

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

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

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

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 limitations

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

22PHP105C   **CRYSTAL GROWTH 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
- To strengthen the students with crystallographic and **crystal growth techniques**
- To provide the general characteristics of crystals, methods of preparation etc.
- Various thin films deposition techniques and thin film characterization techniques are also covered in the course.
- To give an idea about historical importance of crystals, methods of preparation and characterization of crystals etc.
- To explore the knowledge in fundamentals of materials syntheses, crystal growth techniques, zone refining, properties etc.,
- To provide the basic knowledge on crystal structure.

Course Outcomes (COs)
After completing the course the students will / can able to
1. The student will learn about the crystal growth mechanisms and techniques.
2. Understand different crystals having a lot applications in electronics, energetics etc.
3. Acquire the theoretical concept behind electrical and thermal properties of metals
4. Understand the fundamental theories to describe the energy bands in metals
5. Gain the knowledge about Semiconductor Crystals and their properties
6. Gain the knowledge about phonons and its importance in thermal physics

UNIT I- CRYSTAL GROWTH PHENOMENA
The historical development of crystal growth – significance of single crystals - crystal growth techniques - the chemical physics of crystal growth - Theories of nucleation - Gibb's Thompson equation for vapour, melt and solution- energy of formation of spherical nucleus- heterogeneous nucleation - kinetics of crystal growth, singular and rough faces, KSV theory, BCF theory - periodic bond chain theory- The Muller- Krumbhaar model.

UNIT II- CRYSTAL GROWTH FROM MELT AND SOLUTION GROWTH
Growth from the melt - the Bridgmann technique – crystal pulling - Czochralski method- experimental set up - controlling parameters advantages and disadvantages.- convection in melts – liquid solid interface shape - crystal growth by zone melting - Verneuil flame fusion technique.

UNIT III- LOW TEMPERATURE CRYSTAL GROWTH

Low temperature solution growth - methods of crystallization - slow cooling - solvent evaporation, temperature gradient methods - crystal growth system - growth of KDP, ADP and KTP crystals - high temperature solution growth - gel growth.

UNIT IV- VAPOUR GROWTH AND EPITAXIAL GROWTH

Physical vapour deposition - chemical vapour transport – definition - fundamentals, criteria for transport, Specifications, STP, LTVTP & OTP - advantages and limitations of the technique, hydrothermal growth – design aspect of autoclave – growth of quartz, sapphire and garnet.

Advantages of epitaxial growth - epitaxial techniques - liquid phase epitaxy - vapour phase epitaxy - molecular beam epitaxy - chemical beam epitaxy and atomic layer epitaxy

UNIT V- MATERIALS FOR SEMICONDUCTOR DEVICES

Semiconductor optoelectronic properties - band structure - absorption and recombination, semiconductor alloys - group III-V materials selection - binary compounds, ternary alloys - lattice mismatch - lattice mismatched ternary alloy structures - compositional grading, heteroepitaxial ternary alloy structure - Quaternary alloys - Semiconductor Devices **-** Laser diodes, light emitting diodes (LED) – photocathodes - microwave Field-Effect Transistors (FET).

SUGGESTED READINGS

1. R.A. Laudise, 2006, Illustrated edition, The Growth of Single Crystal, Prentice Hall, NJ.
2. A.W. Vere, 2012 edition, Crystal Growth: Principles and Progres, Springer press.
3. P.S. Raghavan and P.Ramasamy, 2000 Hard cover edition. Crystal Growth Processes and methods, KRU Publications.
4. B.R. Pamplin, 2nd edition Crystal Growth, Pergamon, (2012).
5. Heinz K Henish, 1st edition 2005, Crystal Growth in Gel, Dover Publication.
6. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113105025/lec12.pdf
7. https://nptel.ac.in/courses/113/104/113104014/
8. https://nptel.ac.in/courses/113/103/113103072/
9. https://nptel.ac.in/courses/113/102/113102080/

22PHP111   **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 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 experience the practical difficulties to find the physical constant values.
- To apply the theoretical knowledge into the experiments and find the solutions.
- Students will be observe the readings practically.
- Students will experience the phenomena of reflection, refraction, etc.,

Course Outcomes (COs)

After completing the practical course students will/can able to

1. Apply the analytical techniques and graphical analysis to the experimental data.
2. Verify laws studied in the different theory course.
3. Measure different properties of materials.
4. classify the materials with the properties
5. overcome the fear of experimental skill
6. Capable to built his own equipments for measuring the properties of materials

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 $d\lambda$.

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
22PHP112 **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 learn the usage of optical systems for various measurements.
- To apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientificconcepts in a group.
- 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 (COs)

After completing the practical course students will/can able to

1. Design and handle various instruments.
2. Verify laws studied in the different theory course.
3. Measure different properties of materials.
4. Gain the knowledge in quantization of electromagnetic fields.
5. Analyze the characteristics of oscillators and wave shaping circuits
6. Understand the basic concepts of amplifiers and operational amplifier

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/

Value Added Course
PROCESS OF AIR REFRIGERATION

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:

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system

2. Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems

3. Present the properties, applications and environmental issues of different refrigerants

4. Calculate cooling load for air conditioning systems used for various

5. Operate and analyze the refrigeration and air conditioning systems.

UNIT 1

Introduction to air refrigeration – Design of air refrigeration. Applications – Air CraftRefrigeration -Simple, Bootstrap, Regenerative and Reduced ambient systems – Problemsbased on different systems.

UNIT 2

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

UNIT 3

Process of air –conditioning: Psychrometric properties and processes – Construction ofPsychrometric chart. Requirements of Comfort Air –conditioning – Thermodynamics ofhuman body – Effective temperature and Comfort chart – Parameters influencing theEffective Temperature.

UNIT 4

Process of air –conditioning systems: All Fresh air , Re-circulated air with and withoutbypass, with reheat systems – Calculation of Bypass Factor, ADP,RSHF, ESHF and GSHFfor different systems.

UNIT 5

Components: Humidification and dehumidification equipment – Systems of Air cleaning –Grills and diffusers – Fans and blowers – Measurement and control of Temperature andHumidity.

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

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 OUTCOME

1. Repair maintenance of the basic electrical and electronics appliances.

2. Identification to protective devices

3. Repair and maintenance of the split Vacuum Cleaner and washing machine

4. Able to do domestic wring and maintenance.

5. Acquire knowledge about tools, equipment and Instruments.

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.

22PHP201   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 know the foundations of equilibrium statistical physics as the microscopic theory of matter and fields.
- To apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems

Course Outcomes (COs)

After completing the course students will/can able to

1. Apply the concepts and laws of thermodynamics to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.
2. Describe the laws of thermodynamics from both a macroscopic and microscopic point of view.
3. Use the statistical physics methods, such as Boltzmann distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in physical systems.
4. Apply the laws of thermodynamics to real physical systems and processes.
5. Describe the properties of ideal gases using Boltzmann statistics.
6. Describe the differences between systems of bosons and fermions and how these arise from microscopic consideration

UNITI- LAWS OF THERMODYNAMICS

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 – Density of states – Expression for density of states in energy space and momentum space

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

Assumptions of kinetic theory-Distribution function and its evolution − Boltzmann transport equation and its validity − Boltzmann's H-theorem − Maxwell-Boltzmann distribution of velocities − 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

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 - Microcanonical Ensemble-Ideal gases in Microcanonical Ensemble (Sackur –Tetrode formula)

UNIT IV- QUANTUM STATISTICAL MECHANICS

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

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

SUGGESTED READINGS

1. Sathya Prakash and Agarwal J.P., Statistical Mechanics Kedar Nath Ram -2021 Edition.
2. Agarwal B.K. and M. Eisner, 3rd edition, 2013, Statistical Mechanics, New age international Limited, New Delhi.
3. Reif F., 2008, Fundamentals of Statistical and Thermal Physics, (Reprint), McGraw Hill International Edition, Singapore.
4. Gupta and Kumar, reprint, 2014, Elements of Statistical Mechanics, Pragati Prakashan, Meerut.
5. Sears N. and L. Salinger, 2013, Thermodynamics, 3rd Ed., Narosa Publishing House, New Delhi.
6. Greiner W., L. Neise and H. Stocker, 1st edition, 2007, Thermodynamics and Statistical Mechanics, Springer Verlag, New York.
7. Singh. K. and S.P. Singh reprint 2016, Elements of Statistical Mechanics, S. Chand & Company Ltd., New Delhi.
8. A B Gupta and H.P.Roy, Thermal Physics, Books and Sllied (P) Ltd, Kolkata, 2019.
9. https://nptel.ac.in/courses/115103113/
10. https://nptel.ac.in/courses/115/103/115103028/
11. https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/lecture-notes/

22PHP202   **QUANTUM MECHANICS - I**

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 (COs)

After completing the course the students can/will able to

1. Interpret the wave function and apply operators to it, to obtain information about a particle's physical properties such as position, momentum and energy
2. 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
3. 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
4. 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.
5. 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.
6. Calculating states of electrons in hydrogen atom and harmonic oscillators and the interpretation of quantum states.

UNIT I

Limitation of classical physics – Origin of quantum theory – Interpretation and conditions on the wave function; Ehrenfest's theorem; Stationary States; Postulates of Quantum Mechanics; Hermitian Operators for Dynamical Variables; Eigen values and Eigen functions; Matter waves –

Uncertainty principle –Wave packet – Group and phase velocity – Time dependent and Time-independent Schrodinger equations for a free particle and particle in a potential.

Unit II: ONE DIMENSIONAL POTENTIAL PROBLEMS

Square-well potential with rigid walls – Square-wellpotential with finite walls – Square-well potential barrier – Alpha emission – Bloch waves in a periodic potential – Linear harmonic oscillator (Schrodinger method and operator method) – Free particle.

UNIT III: THREE DIMENSIONAL POTENTIAL PROBLEMS AND MATRIX MECHANICS

Particle moving in a spherically symmetric potential – System of two interacting particles – Rigid rotator – Hydrogen atom – Three-dimensional square-well potential - Deutron.

Hilbert Space – Dirac notation – representation theory – coordinate and momentum representations, time evolution – Schrodinger, Heisenberg and Interaction pictures – Properties of matrix elements – Schroedinger equation in matrix form –Unitary Transformations – Linear harmonic oscillator.

UNITIV:TIME-INDEPENDENT PERTURBATION THEORY

Basic concepts – Non-degenerate energy levels – First and Second order corrections for energy and wave functions – Ground state of Helium atom – Effect of electric field on the ground state of hydrogen atom (Stark effect) – Degenerate energy levels – Effect of electric field on the n=2 state of hydrogen atom.

UNIT V: WKB APPROXIMATION AND TIME DEPENDENT PERTURBATION THEORY

Variational method, Variational principle – Variation method for excited states – Application of variation method to ground state of helium – The WKB method

Introduction – First-order perturbation – Harmonic perturbation – Transition to continuum states (Fermi's Golden rule) – Absorption and emission of radiation – Transition probability – Selection rules.

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

22PHP203   **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 (COs)

After completing the course the students will / can able to

1. Apply integral transform (Fourier and Laplace) to solve mathematical problems of Fourier transforms as an aid for analyzing experimental data.
2. 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).
3. Students will be able to solve some simple classical variation problems.
4. Intuition of the physical meaning of the various vector calculus operators (div, grad, curl)
5. 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).
6. Solve some simple classical variation problems.

UNIT I - Partial Differential Equations

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

UNIT II- Fourier Series and Fourier Transform

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 – Finite Fourier transforms – Simple Applications of FT - Introduction to Discrete Fourier Transform.

UNIT III Laplace Transform

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

UNIT - IV -Special Functions -I

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

Hermite differential equation and Hermite polynomials-generating function-Recurrence formulae-Rodrigue's formula - Bessel function – Second order Bessel function- Hankel function- Modified Bessel function- Spherical Bessel 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

22PHP204   **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 (COs)

After completing the course the students will / can able to

1. Understand the basic physical chemistry law that govern molecular spectroscopy
2. Student will know basic information on molecular methods (IR, Raman, UV-VIS, NMR, EPR)
3. Select molecular spectroscopy methods suitable for solving given scientific problem
4. Analyze results of measurements using molecular spectroscopy
5. Give a view of the modern experimental tools of Atomic- and Molecular Physics.
6. Gain knowledge of the most common atomic and molecular spectroscopic methods and the atomic and molecular properties derived from those.

UNIT I: ATOMIC AND MICROWAVE SPECTROSCOPY

Electromagnetic spectrum – Absorption or Emission of radiation – Line width- Natural line broadening-Doppler broadening –Pressure broadening Interaction of light with matter - Spectra of Alkali Metal Vapours - Normal Zeeman Effect - Anomalous Zeeman Effect -

Magnetic Moment of Atom and the G Factor - Lande's 'g' Formula - Paschen Back Effect - Hyperfine Structure of Spectral Lines - Characteristic X-ray spectra.

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

UNIT II: INFRA-RED AND RAMAN SPECTROSCOPY:

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

Raman Spectroscopy: Introduction- Pure rotational Raman Spectra- Vibrational Raman Spectra- Polarization of Light and the Raman Effect- Structure Determination from Raman and Infra-red spectroscopy- techniques and Instrumentation.

UNIT III: ELECTRONIC SPECTRA: FLUORESCENCE & PHOSPHORESCENCE SPECTROSCOPY

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

UNIT IV: NMR SPECTROSCOPY AND NQR SPECTROSCOPY

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

UNIT V: ELECTRON SPIN RESONANCE AND MOSSBAUER SPECTROSCOPY

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

SUGGESTED READINGS

1. Fundamentals of Molecular Spectroscopy 4th Edition, Colin N. Banwell and Elaine M. McCash, Mcgraw Higher Ed (2017)
2. Aruldhas. G., 2008, 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/

22PHP205A   **MATERIAL CHARACTERIZATION**   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 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 (COs)

After completing the course the students will / can able to

1. Handle with X-ray, thermal, microscopic, and electrical methods of characterization.
2. Understand and describe the fundamental principles behind the methods of characterization which are included in the curriculum
3. Analyze, interpret and present observations from the different methods.
4. Evaluate the uncertainty of observations and results from the different methods.
5. Understand the history of materials science with basic understanding of metals, binary alloys, magnetic materials, dielectric materials and polymers
6. Understand nucleation, growth and phase transformation kinetics

UNIT I- STRUCTURAL ANALYSIS

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 Photoelectron Spectroscopy, Surface X-Ray Diffraction.

Neutron Techniques

Introduction, Neutron Powder Diffraction, Single Crystal Neutron Diffraction.

UNIT II - MORPHOLOGICAL ANALYSIS

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

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

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

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/

<div align="right">

SEMESTER II
4H- - 4C

</div>

22PHP205B   **SOLAR ENERGY AND ITS UTILIZATION**

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

<div align="right">

End Semester Exam: 3 Hours

</div>

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 (COs)

At the end of the course, Students will / can be able to

1. Impart the knowledge of Storage technologies form the autonomous renewable energy sources.
2. Explain the principles that underlie the ability of various natural phenomena to deliver solar energy.
3. Discuss the positive and negative aspects of solar energy in relation to natural and human aspects of the environment.
4. Understand the basic principles in wind energy conversion and advantage and disadvantage of wind energy conversion systems.
5. Gain the knowledge about the energy produced from biomass and biogas.
6. Understand the concepts of solar cell and solar energy

UNIT –I – SOLAR RADIATION ANALYSIS

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

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

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

Introduction to Solar photovoltaics –Photovoltaic principles – Power output and Conversion efficiency – Basic photovoltaic 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

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 convesion

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

22PHP205A **INDUSTRIAL ELECTRONICS** **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:

- Analyze and evaluate performance parameters of AC and DC motors.

- Design and analyze circuits containing digital components and microprocessors.

- To learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective.

- To impart knowledge on practical control system and PLC applications.

- To demonstrate applications of machines & electronic devices with control systems.

- To understand concepts of medical electronics and imaging system for diagnosis.

Course Outcomes:

1. Ability to simulate and analyse the semiconductor controlled AC and DC drive system.

2. Equip the skill to design and develop a regulated power supply and get familiar with electrical and electronic system in the vehicle.

3. Ability to understand the basics of embedded systems.

4. Ability to understand the origin of various bioelectric signals and issues related to its acquisition.

5. Acquire knowledge on the basic components and working principle behind different imaging modalities.

6. Ability to understand the concepts of Programmable Logic Controller

UNIT I - INDUSTRIAL POWER SUPPLIES

Performance parameters of power supplies-Comparison of rectifier circuits-Filters-Regulated power supplies-Switching regulators-Switch mode converter.

Power factor Control: Static reactive power compensation-Shunt reactive power compensator-Application of static SCR controlled shunt compensators for load compensation-

Power factor improvement and harmonic control of converter fed systems-Methods employing natural and forced commutation schemes-Methods of implementation of forced commutation.

UNIT II - INDUSTRIAL MOTOR CONTROL

Voltage control at constant frequency-PWM control-Synchronous tap changer-Phase control of DC motor-Servomechanism-PLL control of a DC motor.

Electrical and electronic systems in the vehicle: Overview-Motronic-engine management system, Electronic diesel control-Lighting technology-Electronic stability program-Adaptive cruise control-Occupant-protection systems.

UNIT III - INTRODUCTION TO EMBEDDED SYSTEMS

Embedded systems-Processor Embedded into a system-Embedded Hardware Units and Devices in a system-Embedded Software in a system-Examples of Embedded Systems-Embedded SOC and use of VLSI Circuit Design Technology-Complex system Design and processors-Design Process in Embedded system-Formalization of System Design-Design Process and Design Examples.

UNIT IV - MEDICAL ELECTRONICS

Sources of biomedical signals- Basic medical instrumentation system-General constraints in design of medical instrumentation systems-Origin of bioelectric signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrodes – Electrode-tissue interface, Polarization, Skin contact impedance, Motion artifacts, Silver-Silver Chloride electrodes, Electrical conductivity of electrode jellies and creams.

Medical Imaging Systems: Basic components and working principle of X-rays, Ultrasound, Computed Tomography (CT), Magnetic Resonance Imaging (MRI) & Radionuclide Imaging.

UNIT V - PROGRAMMABLE LOGIC CONTROLLER

Programmable Logic Controller: Introduction-PLC-functions of PLC-Applications of PLC-advantages and disadvantages of relay type control-Comparison of data processing computer and

process control computer-functional block diagram of PLC-central processing unit or PLC processor-Input/Output (I/O) modules-Interfaces-Programming devices-Racks and chassis.

SUGGESTED READINGS

1.   Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6th Edn., 2004.
2. Industrial Electronics –Circuits, Instruments, and Control Techniques by Terry Bartelt, Cengage Learning India Pvt. Ltd, New Delhi, 1stIndian Reprint: 2009
3. The Power Electronics Handbook –Industrial Electronics Series Edited by Timothy L. Skvarenina, CRC press LLC, USA: 2002
4. Dubey, G.K., Power Semiconductor Controlled Drives, Prentice Hall inc. (1989)
5. Paul, B., Industrial Electronic and Control, Prentice Hall of India Private Limited, 2014.
6. Handbook of Biomedical Instrumentation, R.S. Khandpur, Tata McGraw-Hill Publishing Company Ltd, New Delhi, Second edition: 2003
7. https://nptel.ac.in/courses/108/105/108105091/
8. https://nptel.ac.in/courses/108/102/108102145/
9. https://nptel.ac.in/courses/108/105/108105066/

SEMESTER – II

22PHP211   **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 (COs)

After the course the student will/ can able to

1. Handle various difficult instruments.
2. Verify laws studied in the different theory course.
3. Measure different properties of materials.
4. Classify the materials with the properties
5. Overcome the fear of experimental skill
6. Built his own equipments for measuring the properties of materials

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. Hall Effect

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.

14. Non-destructive testing – ultrasonic interferometer and diffractotmeter

15. Determination of the spectroscopic splitting factor of a given sample using electron spin resonance.

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/

22PHP212   **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 (COs)

After completing the practical course the students can / will able to

1. Apply the analytical techniques and graphical analysis to the experimental data.
2. Verify laws studied in the different theory course.
3. Measure different properties of materials.
4. Gain the knowledge in quantization of electromagnetic fields.
5. Analyze the characteristics of oscillators and wave shaping circuits
6. Understand the basic concepts of amplifiers and operational amplifiers

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/

Value Added Course
PRINCIPLES OF ELECTRONIC COMMUNICATION

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.

Course Outcome

- To give knowledge of some basic electronic components and circuits.
- Understand and identify the fundamental concepts and various components of communication systems
- To introduce basics of transistor and receiver.
- To introduce basic aspect of electronic communication systems.

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 – differentialphase shift keying – differentially encoded PSK - Quadrature Phase Shift Keying – Quadratureamplitudeshift 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.

Value Added Course
PROCESS OF VAPOUR COMPRESSION REFRIGERATION

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 Outcome

1. Describe the concept of refrigeration and its unit.

2 Describe different methods of refrigeration.

3 Explain air refrigeration cycle and its application in air craft.

4 Explain vapour compression refrigeration system

5 Explain vapour absorption refrigeration system

6 Explain properties of refrigerants

UNIT I

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

UNIT II

Artificial Refrigeration: Vapour Compression Refrigeration Systems, Domestic refrigeration systems, Air conditioning systems, Vapour Absorption Refrigeration Systems, Solar energy based 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 vapor compression system. Components of Vapor Compression System: The condensing unit – Evaporators –

Expansion valve – Refrigerants – Properties – ODP; GWP - Load balancing of 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

22PHP301   **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 (COs)
After completing the course the student will/can able to
1. Get the knowledge of non-relativistic and relativistic quantum mechanics including timedependent
2. perturbation theory, scattering theory, relativistic wave equations, and second quantization.
3. Understand concepts and to perform calculations of scattering of particles.
4. Understand and evaluate modern research utilizing quantum theory in condensed matter, nuclear and particle physics.
5. Acquire the basic knowledge on Eigen values and Eigen functions
6. Apply the Schrodinger wave equation to get Eigen values of bound systems
7. Understand the matrix formulation in quantum mechanics
8. Acquire the basic knowledge on angular momentum of quantum mechanical systems

UNIT – I: ANGULAR MOMENTUM

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

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

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

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– Bilinear covariants and Lorentz transformationproperties– Magnetic moment of the electron – Spin-orbit interaction – Radial equation for an electron in a central potential.

UNIT V: FIELD THEORY

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, 4^{th}editin 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/115102023/
12. https://nptel.ac.in/courses/122/106/122106034/
13. https://nptel.ac.in/courses/115/101/115101107/

22PHP302   **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 (COs)

After completing the course the students can/will able to

1. Acquire fundamentals and principles of Laser action and Understand the basic conceptsof different types of lasers
2. Understand the absorption and spontaneous and stimulated emission in two level system,
3. The effects of homogeneous and inhomogeneous line broadening, and the conditions for laser amplification.
4. Operate and analyze the properties of the most common laser types, He-Ne, Argon-ion,and carbon-dioxide, ruby, titanium sapphire, neodymium YAG and glass, knowledge of other main laser types.
5. Classify fibers as single-mode, multimode step index and multi-mode graded index.
6. Describe modes in multimode fibers and mode field parameter in single-mode fibers

UNIT- I –LASERCHARACTERISTICS

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

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, CO_2 laser, Liquid lasers, dye lasers and chemical laser.

UNIT-III - ADVANCES IN LASER PHYSICS

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

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

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/

SEMESTER III

22PHP303   **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 (COs)
After completing the course students will/can able to
1. Analyze the electronic, magnetic and thermal properties of materials.
2. classify condensed matter upon its degree of order, with emphasis on scattering experiments.
3. Differentiate materials in a variety of applications.
4. Explain various types of magnetic phenomenon, physics behind them, their properties and applications.
5. Explain superconductivity, its properties, important parameters related to possible applications.
6. Develop the superconducting materials and understand the materials property the basic concept of superconductor

UNIT I- Crystal Physics

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

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.

22PHP304   **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 (COs)

After completing the course the students will / can able to

1. Explain central concepts, laws and models in nuclear and particle physics.
2. Interpret basic experiments using basic laws and relations to solve simple problems.
3. Students understand the basic principle, type of accelerators, working and operation of accelerators.
4. Learn the basic of ion sources, beam transport and application of accelerator in different branches of science.
5. Get trained in research institute and academic Universities to handle such complicated machine such as reactors.
6. Explore their knowledge in reactors to the atomic agency

UNIT I - GENERAL PROPERTIES OF ATOMIC NUCLEI

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

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

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

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

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/

<div align="right">

SEMESTER-III

4H- - 4C
</div>

22PHP305A   DIGITAL ELECTRONICS AND MICROCONTROLLER

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

<div align="right">

End Semester Exam: 3 Hours
</div>

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 (COs)

At the end of the course, Students can

1. Acquire the basic knowledge of digital logic levels and application of digital electronics circuits.
2. Perform the analysis and design of various digital electronic circuits.
3. Acquire knowledge about Microprocessors and its need.
4. Able to identify basic architecture of different Microprocessors.
5. Foster to write the programming using 8085 microprocessor.
6. Foster to understand the internal architecture and interfacing of different peripheral devices with 8085 Microprocessor.

UNIT –I -FLIP FLOPS

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

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

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
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

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.
.

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 Gillispie Mazidi 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 – III

22PHP305B   **NUMERICAL METHODS IN PHYSICS**   **4H – 4C**

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

                                                 End Semester Exam: 3 Hours

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 (COs)

After completing the course the students will/able to

1. Programme numerical methods and their implementation like applying to problem in
2. physics, including modeling of classical physics to quantum system as well as data analysis (Linear and non linear).
3. Analysis techniques for propagating error, representing data graphically. Create, solve and interpret basic mathematical tool.
4. Program independently computers using leading-edge tools,
5. formulate and computationally solve a selection of problems in physics,
6. Use the tools, methodologies, language and conventions of physics to test and Communicate ideas and explanations.
7. Identify and describe the characteristics of various numerical methods

UNIT I - CURVE FITTING

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

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

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

Numerical Solution of Ordinary Differential Equations:Euler method - modified Euler method and Runge - Kutta 4th 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 - Power method and Jacobi's method to solve eigenvalue problems.

UNIT V- NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS

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. , 1st edition 2009, International Publishing House, Pvt. Ltd.
2. S.S. Sastry,5th edition 2013, Introductory Methods of Numerical Analysis, PHI Pvt. Ltd.
3. Singaravelu.A,Numerical Methods, (2020) Meenakshi Agencies Pvt.Ltd, Chennai.

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

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

6. https://nptel.ac.in/courses/115106118/

7. https://nptel.ac.in/courses/115104095/

22PHP305C   **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 (COs)

At the end of the course, the students can/will be able to

1. Discuss the differences and similarities between different vacuum based deposition techniques
2. Evaluate and use models for nucleating and growth of thin films
3. Examine the relation between deposition technique, film structure, and film properties, discuss typical thin film applications,
4. Select proper deposition techniques for various applications.
5. Understand the basic concepts about the thin film technology
6. The importance of use of thin films in application and research.

UNIT I -GROWTH AND STRUCTURE OF FILMS

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

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

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

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

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

22PHP311   **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 (COs)

At the end of the course, Students will / can be able to

1. Design and efficiently handle various instruments.
2. Verify laws studied in the different theory course.
3. Gain the knowledge in quantization of electromagnetic fields.
4. Theoretical and practical skills along with problem solving ability will be developed.
5. Students will be able to write basic programming for numerical analysis, matrix manipulation, 2D and 3D plotting using SCILAB.
6. Able to use Scilab for interactive computations

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
4H- - 2C

22PHP312   **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 (COs)

On completion of this lab course the students will be able to:

1. Understand and apply the fundamentals of assembly level programming of microprocessors and microcontroller.
2. Work with standard microprocessor real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters;
3. Troubleshoot interactions between software and hardware;
4. Analyze abstract problems and apply a combination of hardware and software to address the problem
5. Practically study the working of different electronic components circuits.
6. Learn to minimize contributing variables and recognize the limitations of the equipment.

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 Delmar Learning.
4. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051 Microcontroller And Embedded Systems Using Assembly And C ", PHI, 2nd edition 2006
5. https://nptel.ac.in/courses/108/105/108105102/
6. https://nptel.ac.in/courses/115/102/115102014/

OPEN ELECTIVE

22PHPOE301   Non-Destructive Techniques- An Industrial Approach

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

End Semester Exam: 3 Hours

Course Objective

- 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 (COs)

After successful completion of this course the student will be able to:

1. Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.

2.The student shall be able to solve various problems encountered like leakage, cracks, blowholes etc with the manufacturing process by analyzing the data.

3. Differentiate various defect types and select the appropriate NDT methods for better evaluation.

4. Communicate their conclusions clearly to specialist and non-specialist audiences.

5. Document the testing and evaluation of the results for further analysis.

6. Competent enough to make use of modern tools and softwares for analyzing and solving real life problems.

Unit-I: Introduction

Fundamentals, introduction to destructive and non-destructive testing. Scope and limitations

of NDT, Visual examination methods, Different visual examination aids.

Unit-II: Dye penetrant Testing/ Liquid Penetrant Testing

Principle, procedure, characteristics of penetrant, types of penetrants, penetrant testing

materials, fluorescent penetrant testing method– sensitivity, application and limitations

Unit-III: Magnetic Particle Testing

Important terminologies related to magnetic properties of material, principle, magnetizing

technique, procedure, equipment, fluorescent magnetic particle testing method, sensitivity,

application and limitations

Unit-IV: Ultrasonic Testing

Basic principles of sound propagation, types of sound waves, Principle of UT, methods ofUT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe,Calibration methods, use of standard blocks, technique for normal beam inspection, flawcharacterization technique, defects in welded products by UT, Thickness determination by ultrasonicmethod, Study of A, B and C scan presentations, advantage, limitations acoustic emission testing –principles of AET and techniques

Unit-V: Radiographic Testing

X-ray and Gamma-Ray radiography, Their principles, methods of generation, Industrialradiography techniques, inspection techniques, applications, limitations, Types of films, screens and penetrameters. Interpretation of radiographs, Safety in industrial radiography.

Books Recommended

1. Malhotra, "Handbook on Non-destructive Testing of Concrete", Publisher: CRC Press, 2002.

2. Mix, Paul E, "Introduction To Nondestructive Testing: A Training Guide", John Wiley and Sons Ltd, 1999.

3. Blitz and Jack, "Electrical and Magnetic Methods of Nondestructive Testing", Institute of Physics Publishing, 2001.

4. Achenbach, J D, "Evaluation of Materials and Structures by Quantitative Ultrasonics", Springer-Verlag Vienna, 2001.

5. Henrique L M, "Non Destructive Testing and Evaluation for Manufacturing and Construction, Hemisphere Publishers.

6. http://www.digimat.in/nptel/courses/video/113106070/L16.html

Value Added Course
EMBEDDED SYSTEMS

Course Objectives:

- To provide a broad overview of both theoretical and practical aspects of a design flow

- To understand the need and application of Microcontrollers in embedded system.

- To understand architecture and features of typical Microcontroller

- Learn interfacing of real world input and output device

- To study various hardware and software tools for developing application in embedded

- system

Course Outcomes:

- Understand hardware and software design requirements of embedded systems.

- Acquire knowledge about embedded processors and their applications.

- Analyze the embedded systems specification and develop software programs.

- Ability to design an Embedded System, component or process to meet desired needs

- within realistic constraint

- Explore the features of the microcontroller and provide solutions for embedded

- applications

UNIT I - Introduction to Embedded Systems

Overview of Embedded Systems - Features - Requirements and Applications – RecentTrends in the Embedded System Design - Common architectures for the Embedded SystemDesign - Embedded Software design issues.

UNIT II - Embedded Design Process

Embedded Design Life Cycle – Product Specification – Hardware / Software Partitioning– Detailed Hardware and Software Design – Integration – Product Testing – Selection Processes– Microprocessor Vs Micro Controller – Performance Tools – Bench Marking – RTOS

UNIT III - Introduction to Microcontrollers

Overview of Harvard architecture and Von Neumann architecture - RISC and CISCmicrocontrollers - AVR RISC Microcontrollers: Introduction to AVR RISC Microcontrollers -Architecture overview - Status register - General purpose register file

UNIT IV - Interrupts and Timer

Memories - Instruction set - Data Transfer Instructions - Arithmetic and LogicInstructions Branch Instructions - Bit and Bit-test Instructions - MCU ControlInstructions - Simple programs in Assembly Language / C Language - Introduction toSystem Clock Reset sources.

UNIT V – Peripherals

Introduction to interrupts - External interrupts - IO Ports - 8-bit and 16-bit Timers -Introduction to different modes - Input Capture and Compare Match Analog Comparator -Analog-to-Digital Converter - Serial Peripheral Interface (SPI) - The Universal Synchronous andAsynchronous serial Receiver and Transmitter (USART) - I2C bus.

SUGGESTED READINGS

1. Andrew, N., Sloss, Dominic Symes, & Chris Wright, (2011). ARM SystemDeveloper's

Guide – Designing and Optimizing System Software, (1st ed.). Morgan.:KaufmannPublishers

2. Predko, M. (2007). Programming and Customizing the PIC Microcontroller. New

York:Tab.

3. Smith, W. A. (2010). ARM Microcontroller Interfacing hardware and software.

Susteren:Elektor

4. International Journal of Research in Electronics and Communication Technology

5. International Journal of Engineering and Technology

6. www.embeddedrelated.com

Value Added Course

WATER RESOURCE MANAGEMENT

Course Objectives

1. To prepare the students for a successful career as water professionals.
2. To develop the ability among students to synthesis data and technical concepts for application in Integrated Water Resources Management.
3. To provide students an opportunity to work as a part of an interdisciplinary team.
4. 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.
5. 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

1. An ability to choose and use Research methodologies, Integrated Water Resources Management and gender relations and roles, legal aspects as it applies to the field of Water Resources Management.
2. An ability to design and construct hardware and software water resource system components or processes to meet desired needs within realistic constraints such as environmental, socio-economical, water governance, political, ethical, health and safety, and sustainability.
3. An understanding of professional, institutional arrangements, legal and ethical issues, and responsibilities as it pertain to water resource management.
4. An ability to use the techniques, skills, and modern modeling software tools necessary for water resource planning and management.
5. The broad education necessary to understand the impact of water and water related issues in a global, economic, environmental, and societal context.

Unit I

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

Unit II

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

Unit III

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

---

Unit IV

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

Unit V

Water Pollution- Introduction- Types of pollution- controlling methods

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.

		SEMESTER IV
22PHP491	**PROJECT**	**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 andmethodology 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 (COs)

After successful completion of the course, the student is expected to

1. Complete an independent research project, resulting in research outputs in terms of publications in journals and conference proceedings.

2. Demonstrate a depth of knowledge of Physics.

3. Complete an independent research project, resulting in research outputs in terms of publications in journals and conference proceedings.

4. Demonstrate knowledge of contemporary issues in their chosen field of research.

5. Demonstrate an ability to present and defend their research work.

6. Demonstrate an ability to succeed in problem solving in electronics

7. Solve physics problems using qualitative and quantitative reasoning including sophisticated mathematical techniques

8. Conduct independent research or work successfully in a technical position.

9. 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.

10. Apply their knowledge to develop the instruments.

11. Verify the basic principles and laws experimentally as a project.