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 AND HUMANITIES

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

REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS - 2020

The following Regulations are effective from the academic year 2020-2021 and are applicable to the candidates admitted in Post Graduate (PG) Degree programmes in the Faculty of Arts, Science, and Humanities, Karpagam Academy of Higher Education (KAHE) from the academic year 2020 – 2021 onwards.

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.Sc. Material Science
10	M.Com.
11	M.Com. with Computer Applications

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 Deemed to be University or any other University accepted by the KAHE as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course as given in the table below.

QUALIFICATIONS FOR ADMISSION

S. No.	Name of the Programme Offered	Eligibility
1	M.Sc. Biochemistry	B.Sc. Degree with Biology / Biochemistry / Chemistry with Biology Ancillary Biotech / 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 / Chemistry with Biology 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.Sc. Applied Astrology	B.Sc. Allied Astrology or Equivalent degree
9	M.Sc. Material Science	B.Sc. Physics, B.Sc. Physics (CA) / B.Sc. Applied science

10	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
11	M.Com with Computer Applications	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

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	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 ranges 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. A total of 87 to 93 credits are prescribed for the PG programme (two years)

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 the 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 helping the student in getting placement. Students of all programmes are eligible to enroll for the Value Added Course. 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.

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 a earn a particular Degree.

5. MEDIUM OF INSTRUCTION

The medium of instruction for all courses, examinations, seminar presentations and project/thesis/dissertation reports shall 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 a 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.	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 the Department concerned and Dean to condone the shortage of attendance. The Head of the 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 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 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 is 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. It 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 the 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 mark 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

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12. ESE EXAMINATIONS

12.1End Semester Examination (ESE): ESE will be held at the end of each semester for each course. The question paper is for a maximum of 60 marks.

Pattern of ESE Question Paper

Instruction	Remarks
Maximum Marks	60 marks for ESE
Duration	3 hours (½ Hr for Part – A Online & 2 ½ Hours for Part – B and C
Part – A	20 Questions of 1 mark each (20 x 1 = 20 Marks) Question No. 1 to 20 Online Multiple Choice Questions
Part- B	5 Questions of a six mark 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 mark Question (1 x 10 = 10 Marks)

12.2

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

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

Record Notebooks for Practical Examination

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

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

12.3. **Evaluation of Project Work**

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

12.3.2 The project report 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. Bona fide 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 a *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 guide 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 = (Sum of the product of the GP by the corresponding credits of the courses offered in that Semester) / (Sum of the credits of the courses of that Semester)

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

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

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

where,

Ci is the credit fixed for the course 'i' in any semester

GPi is the grade point obtained for the course 'i' in any semester

'n' refers to the Semester in which such courses are credited

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

17. REVALUATION

Candidate can apply for revaluation and retotalling of his / her semester examination answer script (**theory courses only**), within 2 weeks from the date of declaration of results, on payment of a prescribed fee. For the same, the prescribed application has to be sent to the Controller of Examinations through the HoD. **A candidate can apply for revaluation of answer scripts not exceeding 5 courses at a time.** The Controller of Examination will arrange for the revaluation and the 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-totalling 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), HoD of the 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, may for valid reasons and on prior application, 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 Examination 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

The KAHE 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
(2020-2021 Batch and onwards)

Course code	Name of the course	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks			P.No.
		PEOs	POs	L	T	P		CIA	ESE	Total	
								40	60	100	
SEMESTER – I											
20PHP101	Condensed Matter Physics	1, 3	a	4	-	-	4	40	60	100	24
20PHP102	Electronic Devices and Circuits	2,4	b	4	-	-	4	40	60	100	27
20PHP103	Classical Mechanics and Non-Linear Dynamics	5	e	4	-	-	4	40	60	100	30
20PHP104	Mathematical Physics	1	a, b	4	-	-	4	40	60	100	33
20PHP105A	Elective-I: Material Characterization	3, 6	d, f	4	-	-	4	40	60	100	36
20PHP105B	Elective-I: Astronomy and Astrophysics										39
20PHP105C	Elective-I: Crystal Growth Techniques										41
20PHP111	General Physics Practical – I	4	b, f	-	-	4	2	40	60	100	43
20PHP112	Electronics Practical – I	4	d	-	-	4	2	40	60	100	45
Journal Paper Analysis & Presentation		5,7	d	2	-	-	-	-	-	-	
Semester Total				**22**	**-**	**8**	**24**	**280**	**420**	**700**	
SEMESTER – II											
20PHP201	Thermodynamics and Statistical Mechanics	1	b	4	-	-	4	40	60	100	47
20PHP202	Quantum Mechanics – I	3	c	4	-	-	4	40	60	100	50
20PHP203	Nuclear and Particle Physics	2	d	4	-	-	4	40	60	100	53
20PHP204	Spectroscopy	5	g	4	-	-	4	40	60	100	56
20PHP205A	Digital Signal	6,1	a, f	4	-	-	4	40	60	100	59

	Elective-II	Processing										
20PHP205B		Computational Physics										62
20PHP205C		Thin Film Physics										64
20PHP211	General Physics Practical – II		4	b, f	-	-	4	2	40	60	100	67
20PHP212	Electronics Practical – II		4	d	-	-	4	2	40	60	100	69
Journal Paper Analysis & Presentation			5,7	d	2	-	-	-	-	-	-	
Semester Total					**22**	**-**	**8**	**24**	**280**	**420**	**700**	
Internship/Fellowship												
SEMESTER – III												
20PHP301	Quantum Mechanics – II		3	b, f	4	-		4	40	60	100	71
20PHP302	Laser and Non-Linear Optics		4	e	4	-		4	40	60	100	74
20PHP303	Electromagnetic theory and Electrodynamics		7	a, b	4	-		4	40	60	100	77
20PHP304	Digital Electronics and Microcontroller		2	c	4	-		4	40	60	100	80
20PHP305A	Elective-III	Nanostructures and Characterization	1	d	4	-		4	40	60	100	83
20PHP305B		Solar Energy and its utilization	2, 6	d								86
20PHP305C		Optoelectronics	2	d, e								89
20PHP311	Advanced Physics Practical		4	b, f		-	4	2	40	60	100	92
20PHP312	Advanced Electronics Practical		4	d		-	4	2	40	60	100	94
Journal Paper Analysis & Presentation			5,7	d	2	-						
Semester total					**22**	**-**	**8**	**24**	**280**	**420**	**700**	
SEMESTER – IV												
20PHP491	Project		1,5,6	d, e, f		-		15	80	120	200	96
	Total					-		87	920	1380	2300	

Elective Courses*

Elective – I (20PHP105)		Elective – II (20PHP205)		Elective – III (20PHP305)	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
20PHP105A	Material Characterization	20PHP205A	Digital Signal Processing	20PHP305A	Nanostructure Characterization
20PHP105B	Astronomy and Astrophysics	20PHP205B	Computational Physics	20PHP305B	Solar Energy and its utilization
20PHP105C	Crystal Growth Techniques	20PHP205C	Thin Film Physics	20PHP305C	Optoelectronics

PROGRAMME OUTCOMES

At the end of the programme, the students will

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

b) Apply theoretical knowledge of physics principles and mathematical techniques in research.

c) They can get opportunities after M.Sc. program include doing research in leading national and international universities, laboratories and research institutes.

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

e) 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

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

g) They acquire the knowledge to design and develop a device to meet the social needs.

h) Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Understanding the advanced trends in Physics.

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: Analyze the quantum methods in the solution of problems involving atomic spectra, blackbody radiation, the photoelectric effect, X-ray emission, the structure of the atom, and one-dimensional potentials.

PEO 4: To understand the classical experimental techniques and modern measurement technology including analog and digital electronics, laboratory test equipment, optics, lasers, and detectors

PEO 5: To develop and strong student competencies in Physics and its applications in a technology-rich, interactive environment.

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

PEO 7: To develop and strong student skills in research, analysis and interpretation of complex information.

Pos	A	B	c	d	e	f	g	h
PEO1		X		X	X			
PEO2	X		X					X
PEO3				X		X	X	X
PEO4		X			X			
PEO5	X	X		X		X		
PEO6	X		X	X		X	X	X
PEO7		X	X		X		X	X

SEMESTER – I

20PHP101 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

- Studying the properties of materials is very important at all times, to choose the correct material for the correct use.
- To aware the students about the field of Condensed matter physics.
- This paper is intended to give the students an idea about importance of crystals and their properties.
- This paper enable the students to understand about the crystal structure, interaction with X-ray, lattice vibrations, defects, electronic properties and the magnetic properties etc.

Course Outcomes (COs)

1. Understand the physics behind structural properties of the solids.
2. Tailor the properties of solids with proper understanding.
3. Students will become comfortable with the language of condensed matter, specialized terms and key theories, thus enabling them to read and understand research papers and produce their own term paper on a relevant topic.
4. Students will learn the importance of different materials in a variety of applications.

UNIT I- Crystal Physics

Crystal - The Lattice, unit cell, Seven crystal systems, Fourteen Barvais lattice Interplanar spacing for SC, FCC, BCC lattices - diamond cubic structure - NaCl structure - The reciprocal lattice and their properties - Bragg condition in terms of reciprocal lattice.

Crystal defects: Classification of defects - Points defect - The Schottky defect - The Frenkel defect -Dislocations - Slip and plastic deformation - Shear strength of single crystals - Edge dislocation - Screw dislocation - Stress field around an edge dislocation.

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 – Thermal conductivity of metals – Wiedemann-Franz law – Nearly free electron model- Kronig Penny model.

UNIT III – DIELECTRICS AND FERROELECTRICS

Dielectrics : Review of basic formulae, dielectric constant and polarizability, local field, ClausiusMossotti relation, polarization catatrophe. Sources of polarizability, Dipolar polarizability : dipolar dispersion, Debye's equations, dielectric loss, dipolar polarization in solids, dielectric relaxation. Ionic polarizability. Electronic polarizability: classical treatment, quantum theory.

Ferroelectrics : General properties of ferroelectrics, classification and properties of representative ferroelectric crystals, dipole theory of ferroelectricity.

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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

Sources of superconductivity – The Meissner effect – Thermodynamics of superconducting transitions – Origin of energy gap – London equations –London Penteration depth – Type I and Type II Sueprconductors - 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. 2005, Introduction to Solid State Physics, 8th Edition, Willey Eastern Ltd., New Delhi.
2. Saxena. B.S., R.C.Gupta and P.N.Saxena, 2012, Fundamentals of Solid State Physics, 15th edition, Pragati Prakashan, Meeru.
3. Dekkar. A.J., revised edition, 2000, Solid State Physics, Macmillan India Ltd., New Delhi.
4. Keer. H.V. 1st edition , 2002, Principles of Solid State, New age international., New Delhi.
5. Pillai S.O., 2005, Solid State Physics, 4th Edition, New Age International Publishers Ltd.
6. https://nptel.ac.in/courses/115106061/
7. https://nptel.ac.in/courses/115101009/

SEMESTER – I

20PHP102 ELECTRONIC DEVICES AND CIRCUITS 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 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, which is very important for knowing the basics of any modern instrument.

Course Outcomes (COs)

1. Students will be able to build, design and analyze analog to digital converter.
2. Students will be able to design digital and analog systems.
3. Ability to understand the basic operation and working of different diodes like FET, MOSFET, CMOS, etc.
4. To understand the high frequency application of diodes.

UNIT I

NETWORK THEORY

Kirchhoff's voltage and current law, Maximum power transfer theorem, Thevenin's theorem and Procedure for finding Thevenin equivalent circuit, Norton's theorem and Procedure for finding Norton equivalent circuit, Superposition theorem

UNIT – II

ELECTRONIC DEVICES

TRANSISTOR BIASING: Introduction, Transistor Biasing, Stabilization and need for stabilization, stability factor. Methods of transistor biasing: Base resistor method, Voltage divider bias method. HYBRID PARAMETERS: Hybrid parameters, Determination of h parameters, h parameter equivalent circuit, h parameters of a transistor, Transistor circuit performance in h parameters, Limitations of h parameters.

POWER ELECTRONICS: Power electronics, Construction and Working of SCR, V-I characteristics of SCR, Construction and Operation of TRIAC, DIAC, UJT.

UNIT – III

ANALOG DEVICES

Principle and working of JFET, Salient features of JFET, Shorted-gate drain current, Pinch off Voltage, Gate-source cut off voltage, expression for drain current, Parameters of JFET. MOSFET, Types of MOSFETs. Low and High frequency response of FET and BJT amplifier. Bode plot, Miller effect capacitance, Square wave testing, Numerical problems.

UNIT – IV

ANALOG CIRCUITS

Analysis of compound configurations, Cascade connection, Darlington connection, Bootstrapping principle, Bootstrapped Emitter Follower, Bootstrapped Darlington Emitter Follower, Feedback pair, CMOS circuits, current source and current mirror circuits, Differential amplifier circuits, Numerical problems.

UNIT – V

POWER AMPLIFIERS

Introduction, Difference between voltage and power amplifiers, Performance quantities of power amplifiers, Classification of power amplifiers, Maximum collector efficiency of Series-Fed and Transformer coupled Class A power amplifier, Thermal runaway, Heat sink.

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SUGGESTED READINGS

1. Mehta V.K. – Principles of electronics – S. Chand & Co. Ltd., 11th Edition, 2008.
2. Badge M.K. Singh S.P. – Elements of Electronics - S. Chand & Co. Ltd., 2002.
3. Subramanyam. A - Applied Electronics – The national publishing company, 2006.
4. Boyle L. stad and Louis Nashelsky, 10th edition, 2013, Electronic devices and circuit theory, Prentice - Hall of India, Delhi.
5. Millman and Halkias, 48th reprint, 2008, Integrated electronics, Tata McGraw-Hill, New Delhi.
6. Malvino A.P., Electronics Principles, 10th edition, 2013, Tata McGraw Hill, New Delhi.
7. Mottershed, 1st edition, 2002, Electronic devices and circuits: An introduction, Prentice Hall of lndia, New Delhi.

8. M. S. Ghausi1st edition, 2013, Electronic devices and circuits, CBS.
9. Donald L. Schilling, Charles Belove, 3rd edition, 2009, Electronic circuits discrete and integrated, Tata McGraw-Hill, New Delhi.
10. Millman and Grabel, 2nd edition, 2001, Microelectronics; Tata McGraw-Hill, New Delhi.
11. T.F. Bogart and J.S. beasely and G. Rico, 5th edition, 2000, Electronic devices and circuits, Prentice hall; New Delhi, Hall of India.
12. A. Nagoor Kani, 1st edition, 2014, Circuit theory, RBA publications.
13. https://nptel.ac.in/courses/122106025/
14. https://nptel.ac.in/courses/108108112/

SEMESTER – I

20PHP103 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 Objectives:

- Students will demonstrate conceptual understanding of the basic principles of classical mechanics.
- Students 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.
- Students will demonstrate the equations of motion for complicated nonlinear mechanical systems and their solutions.

Student Learning Outcomes

After successfully completed course, student will be able to

1. Define and understand basic mechanical concepts related to discrete and continuous mechanical systems
2. Students will know the concepts of classical mechanics and demonstrate a proficiency in the fundamental concepts in this area of science.
3. Students will understand the planar and spatial motion of a rigid body,
4. Students can formulate the equation of motion for a mechanical system using Lagrange-Hamilton formalism.
5. They will learn the basics of nonlinear dynamics and use critical thinking skills to formulate and solve quantitative problems in applied physics.

Unit I: Lagrangian Dynamics

Mechanics of a system of particles - Generalized Co-ordinates - Constraints - D' Alembert's Principle and Lagrange's Equations - Velocity-Dependent Potentials and the Dissipation Function – Simple applications of Lagrangian Formulation - Hamilton's Principle - Derivation of Lagrange's Equations from Hamilton's Principle - Conservation Theorems and Symmetry Properties - Energy Function and the Conservation of Energy.

Unit II :Central Force Problem and Classical Scattering

Reduction to the Equivalent One-Body Problem - The Equations of Motion and First Integrals – Classification of Orbits – The Viral Theorem – Kepler's Problem: Inverse Square Law of Force – The Motion in time in the Kepler's problem - Scattering in a Central Force Field - Transformation of the Scattering Problem to Laboratory Coordinates- Three body problem.

Unit III: Rigid body Dynamics and Small Oscillations

The Independent coordinates of a Rigid Body - Orthogonal Transformations - The Euler Angles - Angular Momentum and Kinetic Energy of Motion about a Point – Tensors - the Inertia Tensor and the Moment of Inertia - The Eigen values of the Inertia Tensor and the Principal Axis Transformation - Solving Rigid Body Problems and the Euler Equations of Motion. Small Oscillations - Frequencies of Free Vibration, and Normal Coordinates, Linear Tri atomic Molecule.

Unit IV: Hamiltonian dynamics and Canonical Transformations

Legendre Transformations and the Hamilton Equations of Motion - Cyclic Coordinates and Conservation Theorems – Derivation of Hamilton's Equation from Variational principle – Principle of Least Action - Equations of Canonical Transformation - Examples of Canonical Transformations - The Harmonic Oscillator - The Symplectic Approach to Canonical Transformations - Poisson Brackets and Other Canonical Invariants - The Angular Momentum Poisson Bracket Relations.

Unit V: Nonlinear classical 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

20PHP104 **MATHEMATICAL 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

- 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.

Course Outcomes (COs)

1. Students will be able to apply integral transform (Fourier and Laplace) to solve mathematical problems of interest in physics, use 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 of coordinate transforms (example: principal axes of inertia).
3. Students will be able to Solve some simple classical variation problems.

UNIT I - VECTOR SPACE

Definition of vector space – Linear dependence – Linear independence – Basis – Dimension of a vector space – Representation of Vectors and linear operators with respect to basis – Schmidt orthogonalization process – Inner product.

Tensors : Transformation of coordinates – Summation convention – Contravariant Tensor – Covariant Tensor – Mixed Tensor – Rank of a Tensor – Kronecker delta symbol – symmetric and antisymmetric tensors – Invariant tensors.

UNIT II- 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 III- 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

FOURIER SERIES

Dirichlet's theorem – change of interval – complex form – Fourier series in the interval (0, T) – Uses of Fourier series -

UNIT IV LAPLACE TRANSFORM AND BESSEL FUNCTION

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. Bessel function –-– Second order Bessel function- Hankel function- Modified Bessel function- Spherical Bessel function.

UNIT V- SPECIAL 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- Bessel function – Second order Bessel function- Hankel function- Modified Bessel function- Spherical Bessel function.

SUGGESTED READINGS

1. Satya Prakash.,2002. Mathematical Physics , 4th edition, S.Chand & Co, New Delhi.
2. Gupta.B.D., 2002, .Mathematical Physics, 2nd edition, Vikas publishing company, New Delhi.
3. Singaravelu.V., 2008. Numerical methods, 2nd edition, Meenakshi publications, Sirkali.
4. Rajput.B.S., 2003. Mathematical Physics, 16th edition, Pragati Prakashan, Meerut.
5. Gupta. P.P., Yadav., and Malik.,2012. Mathematical Physics, Kedar Nath & Ram Nath, Meerut.
6. Venkataraman.M.K., 2003. Numerical methods in Science & Engineering, 5th edition, The National Publishing Company, Chennai.
7. Butkov, 2007, Mathematical Physics, Addison Wesley, New York

8. A.W. Joshi, 2008, Tensors and Matrices, reprint, Wiley Interscience, New York.
9. George B. Arfken, Hans J. Weber, Frank E. Harris, 7 edition, 2012, Academic Press;
10. https://nptel.ac.in/courses/115103036/
11. https://nptel.ac.in/courses/115105097/

SEMESTER – I

20PHP105A **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

- Study of 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.

Course Outcomes (COs)

1. The students are exposed 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.

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 volumes 1 and 2, John Wiley & Sons, Inc., Hoboken, New Jersey, 2003.
2. Cullity B D., Stock S R "Elements of X-ray Diffraction", Prentice Hall, Inc 2001.
3. D.Kealey & P.J.Haines, Analytical Chemistry, Viva Books Private Limited, New Delhi, 2002.
4. Banwell, Fundamentals of Molecular Spectroscopy, McGraw-Hill Education, Pvt. Ltd., 2013.
5. Surface Characterization Methods: Principles, Techniques and Applications; Milling; CRC Press; 1999
6. Encyclopedia of Materials Characterization - Surfaces, Interfaces, Thin Films; Brundle, Richard, Evans & Shaun; Elsevier; 1992
7. R.A.Stradling and P.C.Klipstain. Growth and Characterization of semiconductors. Adam Hilger, Bristol, 1990.
8. J.A.Belk. Electron Microscopy and Microanalysis of Crystalline Materials. Applied Science Publishers, London, 1979.
9. L. E.Murr. Electron and Ion microscopy and Microanalysis principles and Applications. Marcel Dekker Inc., New York, 1991.
10. ASM Handbook: Volume 10: Materials Characterization; Crankovic; ASM International; 1986
11. Microstructural Characterization of Materials; Brandon & Kaplan; Wiley; 2008
12. Characterization of Semiconductor Materials - Principles and Methods; McGuire; William Andrew Publishing/Noyes; 1989
13. https://nptel.ac.in/courses/115103030/
14. https://nptel.ac.in/courses/113106034/

SEMESTER – I

20PHP105B ASTRONOMY AND ASTROPHYSICS 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

- Astronomy and Astrophysics is a very fundamental subject in Physics.
- Includes study of the solar system, evolution of stars, different physical processes going on stellar bodies, life cycle of stars etc.

Course Outcomes (COs)

Students will have understanding of:

1. Plan and engage in an independent and sustained critical investigation of a chosen research topic to generate new knowledge in an area of astronomy and astrophysics.
2. Systematically evaluate the relevant theory and concepts in astronomy and astrophysics, relate these to appropriate methodologies and evidence and draw appropriate conclusions.
1. Demonstrate capacity for astronomy and astrophysics reasoning through analyzing, proving and explaining concepts from the chosen research area.

UNIT I- ASTROPHYSICS

Introduction - Astrophysics and Astronomy - Celestial coordinate systems (Sun-Earth system, Galactic Coordinate system)

UNIT II- STELLAR STRUCTURE AND EVOLUTION

Star formation - Stellar Magnitudes - Classification of stars - H-D classification - Saha Equation of ionization - Hertzsprung-Russel (H-R) diagram - Gravitational energy - Virial theorem - Equations of stellar structure and evolution - Pre-main sequence evolution - Jeans criteria for star formation - fragmentation and adiabatic contraction - Evolution on the main sequence - Post main sequence evolution

UNIT III - NUCLEAR ASTROPHYSICS

Thermonuclear reactions in stars - pp chains and CNO cycle - Solar Neutrino problem - subsequent thermonuclear reactions - Helium burning and onwards - nucleosynthesis beyond iron - r- and s-processes

Stellar Objects & Stellar Explosions: Qualitative discussions on: Galaxies – Nabulae – Quasars - Brown dwarfs - Red Giant Stars – Nova - Supernova.

UNIT IV- GRAVITATIONAL COLLAPSE AND RELATIVISTIC ASTROPHYSICS

Newtonian theory of stellar equilibrium - White Dwarfs - Electron degeneracy and equation of States - Chandrasekhar Limit - Mass-Radius relation of WD - Neutron Stars - Spherically symmetric distribution of perfect fluid in equilibrium - Tolman-Oppenheimer-Volkoff (TOF) equation – Mass - Radius relations of NS – Pulsars - Magnetars - Gamma ray bursts - Black holes - Collapse to a black hole (Oppenheimer and Snyder) - event horizon - singularity.

UNIT V - ACCRETION DISKS

Formation of Accretion Disks - Differentially rotation systems in Astrophysics - Disk dynamics - Steady Disks - Disk formation in close binary systems through mass transfer - Accretion onto compact objects.

SUGGESTED READINGS

1. V.B.Bhatia, 1st edition, 2001; Textbook of astronomy and astrophysics with elements of cosmology, Alpha science international.
2. K. D. Abhyankar, 1st edition Astrophysics – Stars and Galaxies,University Press, 2001.
3. S.L.Shapiro and S.A.Teukolsky, 1st edition Black Holes, White Dwarfs and Neutron Stars (John Wiley, 2002)
4. E.W.Kolb and M.S.Turner, 1st edition, 2007, The Early Universe Sarth book house and distributers
5. J.V.Narlikar, 3rd edition 2012 Introduction to Cosmology, Cambridge University Press.
6. A.K.Raychaudhuri, S.Banerji and A.Banerjee, General Relativity, Astrophysics and Cosmology – 1st edition (Springer-Verla, 2001)
7. S. Banerji and A. Banerjee, General Relativity and Cosmology – 1st edition (Elsevier, 2007)
8. https://nptel.ac.in/courses/115105046/
9. http://www.nptelvideos.in/2012/12/astrophysics-cosmology.html

SEMESTER – I

20PHP105C **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

- Will give knowledge on Crystals and its applications in electronics, energetics etc.
- Gives the general characteristics of crystals, methods of preparation etc.
- To give an idea about historical importance of crystals, methods of preparation and characterization of crystals etc.

Course Outcomes (COs)

1. The student will learn about the crystal growth mechanisms and techniques.
2. Various thin films deposition techniques and thin film characterization techniques are also covered in the course.

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. F.C. Auluck, A Short course in Solid State Physics, Vol. I, Thomson Press India Ltd.
5. B.R. Pamplin, 2nd edition Crystal Growth, Pergamon, (2012).
6. Heinz K Henish, 1st edition 2005, Crystal Growth in Gel, Dover Publication.
7. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113105025/lec12.pdf
8. http://mgcl.iitr.ac.in/49200-nptel-video-lecture-topics.pdf

SEMESTER – I

20PHP111 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

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

Course Outcomes (COs)

1. The course is designed to train the students so that they can efficiently handle various instruments.
2. Students will verify laws studied in the different theory course.
3. Students will measure different 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 dλ.
4. 'e/m' by Thomson's method and Magnetron method.
5. Young's Modulus – Hyperbolic Fringes (Cornu's method).
6. Determination of Plank's constant using Photo cell.
7. Forbe's method – Thermal conductivity.
8. 'e' by Millikan's method.
9. Ferguson's method - Specific heat of a liquid.
10. Faraday effect – Determination of Verdet constant using He-Ne laser.
11. Cornu's Method – Determination of Elastic Constants of Transparent Materials
12. Kerr effect –determination of Kerr constant of a Liquid.
13. To determine reduction factor K using Helmholtz Galvanometer.
14. To determination of wavelength of monochromatic source by Acoustic Diffraction method.

15. To determine theenergy of electron in-elastic scattering: Frank-Hertz experiment.

SUGGESTED READINGS

1. Ouseph C.C., U.J. Rao and V. Vijayendran 2007, Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai
2. Singh S.P., 2003, Advanced Practical Physics – 1, 13th Edition, Pragathi Prakashan, Meerut
3. Gupta S.L. and V.Kumar, 2002, Practical Physics, 25th Edition, Pragathi Prakashan, 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

20PHP112 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 Objective

1. To understand the Biasing network for BJT and FET, transient analysis and frequency response of BJT and FET in single stage and multistage amplifier
2. To understand the frequency response feedback amplifier using BJT and FET and Tuned amplifier
3. To understand the operation of Oscillators and waveform generators

Course Outcomes (COs)

- Students will practically study the working of different electronic components/ circuits.
- Learn to minimize contributing variables and recognize the limitations of the equipment.
- Design and construction of circuits using analog component and trouble shooting of the circuits.

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

SEMESTER – II

20PHP201 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.
- This paper gives a basic idea about the laws of thermodynamics and statistical processes.

Course Outcomes (COs)

1. Identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, partition functions.
2. Use the statistical physics methods, such as Boltzmann distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in physical systems.
3. Apply the concepts and laws of thermodynamics to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.

UNITI- LAWS OF THERMODYNAMICS

Laws of thermodynamics and basic defenitions− Entropy − Calculation of entropy changes in reversible processes. The principle of increase of entropy − Thermodynamic functions –Maxwell relations- The Clausius-Clayperon equation − Van der Waals equation of state- Adiabatic equation of a perfect gas- Limit of thermodynamics

UNIT II- 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-Mean free path -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

Basic postulates of quantum statistical mechanics –B.E energy distribution for energies in the range E to E + dE – Condition for B.E distribution to approach classical M.B distribution – Limiting case of Bose-Einstein statistics - Planck's law from B.E law - Microcanonical ensemble –Canonical ensemble – Grand canonical ensemble

Fermi Dirac distribution law - FD law for the energies in the range E to E+dE – Fermi energy - Effect of temperature - Energy distribution curve - Free electron in a metal - Fermi temperature and Thermionic emission - Comparison of MB,BE and FD statistics.

UNIT V- APPLICATIONS OF QUANTUM STATISTICAL MECHANICS

Ideal Bose gas : Photons − Black body and Planck radiation − Specific heat of solids: Einstein Theory and Debye's Theory− Liquid Helium.

Ideal Fermi gas : Properties – Degeneracy: strong and weak degeneracy − Electron gas − Pauli paramagnetism

Ferromagnetism : Ising and Heisenberg models - Bragg Williams's approximation

SUGGESTED READINGS

1. Sathya Prakash and Agarwal J.P. Statistical MechanicsKedar Nath Ram .
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. S.K. Sinha Introduction to statistical Mechanics Narosa, 2007, New Delhi
9. https://nptel.ac.in/courses/115103113/

SEMESTER – II

20PHP202 QUANTUM MECHANICS - I 4H – 4C

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

Course Objectives

- Quantum mechanics is the most important branch of physics, as it has got application in any other branch of physics.
- 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)

Students can

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. Be able 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. Be able to 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

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-well potential 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.

UNIT IV: 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, 2000, Quantum Mechanics, 3rd Edition, McGraw Hill International, Auckland
3. Satya Prakash, New Edition, 2003, 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. Arthur Beiser, Concepts of Modern Physics, 6th Edition, McGraw Hill Education, 2009.
10. https://nptel.ac.in/courses/115101107/
11. https://nptel.ac.in/courses/122106034/

SEMESTER –II

20PHP203 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.
- 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.

Course Outcomes (COs)

Students who have completed this course should

1. Understand the relation between the standard model and QCD
2. Understand the importance of models in describing the properties of nuclei and nuclear collisions
3. Be able to make quantitative estimates of phenomena involving nuclei.

UNIT I - NUCLEAR MASS AND CHARGE

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

UNIT II - NUCLEAR MODELS

Liquid drop model - Bohr Wheeler theory of fission - Condition for spontaneous fission - Shell model: Explanation for magic numbers - Prediction of shell model -Prediction of spin and parity - Nuclear statistics - Magnetic moment of nuclei - Schmidt lines-Nuclear isomerism - Collective model: Explanation of Quadrupole moments - Prediction of sign of electric quadrupole moments. Optical model: Nilsson model - Elementary ideas-Introduction of Astronuclear Physics

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 - α disintegration energy-Low range α particles

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

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

UNIT IV - NUCLEAR REACTIONS

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

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

SUGGESTED READINGS

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

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

SEMESTER – II

20PHP204 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

The course will provide and introduction to modern optical spectroscopic and imaging techniques and their applications to biology and chemistry. First part of the course will be an introduction to fundamental concepts of light-matter interaction, lasers and laser systems, detectors and other relevant aspects of instrumentation necessary for spectroscopy and imaging.

In the second part of the course we will discuss various modern spectroscopic techniques. Discussion of each technique will be followed by examples from classic and contemporary literature.

Course Outcomes
After successfully completed course, student will be able to

1. Student shows interest in the phenomenon of the interaction of light with matter in terms of the relationship with the molecular structure

2. Understand quantum chemical principles

3. Student will know the basic physical chemistry law that govern molecular spectroscopy

4. Student will know basic information on molecular methods (IR, Raman, UV-VIS, NMR, EPR)

5. Student will be able to select molecular spectroscopy methods suitable for solving given scientific problem

6. Student will be able to analyze results of measurements using molecular spectroscopy methods

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. Colin N. Banwell and Elaine M. McCash, Fundamentals of Molecular Spectroscopy, Fourth edition, Tata-McGraw Hill, (2002).
2. Peter W. Atkins – Physical Chemistry, eighth Edition, New York, 2006, Chapters 10-15, page 320-560.
3) H. E. White, Introduction to Atomic Spectra. Tata McGraw Hill.1934.
4) Tores and Schawlow, Microwave Spectroscopy. McGraw Hill.1955.
5) D. A. Long, Raman Spectroscopy, McGraw Hill, 1977.
6) B. P. Straughan and S. Walker, Spectroscopy Vol.I, II, III.Springer, 1976.
7) Schnoider and Berstin, High Resolution NMR. McGraw Hill,1959.
8) T. P. Das and E.E. Hahn, Nuclear Quadrupole Resonance Spectroscopy. Academic Press.
9) Colin N. Banwell and Elaine M. McCash, Fundamentals of Molecular Spectroscopy, Fourth edition, Tata-McGraw Hill, (2002).
10) Peter J. Larkin, IR and Raman Spectroscopy, Principles and Spectral Interpretation, Elsevier, 2011.
11) https://nptel.ac.in/courses/104101099/
12) https://nptel.ac.in/courses/104102113/

SEMESTER – II

20PHP205A **DIGITAL SIGNAL PROCESSING** **4H – 4C**

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

End Semester Exam: 3 Hours

Course Objectives

- Digital processing of signals has an extensive range of applications, from the military to the medical, from entertainment to mass production.
- In many areas of application the advent of these specially designed DSP devices has started a revolution in engineering which will pervade most areas of modern life.
- To give idea about different classifications of signals, different methods of recording and processing.

Course Outcomes (COs)

1. determine the spectral coefficients and the Fourier series components of discrete-time signals.
2. determine the frequency response and the z-transform of discrete-time systems.
3. determine the discrete Fourier transform of discrete-time signals.
4. calculate the outputs of discrete-time systems in response to inputs.

UNIT I- SIGNALS AND SYSTEMS

Introduction- Classification of signals - Concept of frequency in continuous time and discrete–time signals. Theory of A/D and D/A conversion - Sampling of analog signals -sampling theorem - Quantization of continuous amplitude signals - Quantization of sinusoidal signal - Coding of quantized – samples - Digital to analog conversion

UNIT II- DISCRETE- TIME SIGNALS AND SYSTEMS

Discrete - time linear time-invariant systems-Techniques of analysis of linear systems - Resolution of a discrete time signal into impulses - Response of LTI systems to arbitrary inputs : Convolution sum - Properties of convolution and the interconnection of LTI systems - Casual LTI systems Stability of LTI systems - Systems with finite duration and infinite duration impulse – response

UNIT III- THE Z-TRANSFORM

The Direct Z-Transform - The Inverse Z-Transform - Properties of Z-transform - Rational Z-transforms - Poles and zeros - Inversion of Z-transforms. The inverse Z-Transform by contour

integration - Power series expansion - Partial fraction expansion – Decomposition of rational Z-transform – Analysis of linear time invariant systems in the Z-domain – one sided Z-Transform.

UNIT IV-FREQUENCY ANALYSIS OF SIGNALS AND SYSTEMS

Frequency analysis of continuous - time signals. The Fourier Series for continuous Time Periodic Signals - Power Density Spectrum of Periodic Signals - The Fourier Transform of Continuous - Time Aperiodic Signals - Energy Density Spectrum of Aperiodic Signals - Frequency analysis of discrete time signals – The Fourier Series for discrete time Periodic Signals - Power Density Spectrum of Periodic Signals – Fourier transform for discrete time Aperiodic signal - Convergence of the Fourier Transform - Energy Density Spectrum of Aperiodic signals - Relationship of the Fourier Transform to the Z Transform.

UNIT V- DISCRETE FOURIER TRANSFORM

Frequency domain sampling and reconstruction of discrete time signals – The Discrete Fourier transform – DFT as a linear transformation - Relationship of the DFT to the other transforms. Properties of DFT - Multiplication of two DFTs and Circular convolution - Linear filtering methods based on DFT - Frequency analysis of signals using the DFT – Discrete cosine transform - Computation of the Discrete Fourier Transform

SUGGESTED READINGS

1. Oppenheim and Schafer, 1st edition, Digital Signal Processing, Prentice Hall India –1999
2. Paulo S.R. Piniz, Eduardo A.B. De Silva and Sergio Netto,2nd+ edition, 2010, Digital Signal Processing, Cambridge University Press
3. Rabiner and Gold, 1st edition ,Theory and Applications of Digital Signal Processing, Prentice Hall India -2011.
4. Digital Signal Processing Video Prof. T.K. Basu IIT Kharagpur,
5. Fundamentals of Digital Signal processing using MATLAB, R.J. Schilling and S.L. Harris, 2005, Cengage Learning.
6. Fundamentals of signals and systems, P.D. Cha and J.I. Molinder, 2007, Cambridge University Press, Digital Signal Processing Principles Algorithm & Applications, J.G. Proakis and D.G. Manolakis, 2007, 4th Edn., Prentice Hall.

7. Fundamentals of Digital Signal processing using MATLAB, R.J. Schilling and S.L. Harris, 2011, Cengage Learning, Digital Signal Processing , J.G. Proakis and D.G. Manolakis, 2013., Prentice.
8. https://nptel.ac.in/courses/104/106/104106122/
9. https://nptel.ac.in/courses/104101099/
10. http://nptel.iitm.ac.in/video.php?subjectId=10810505520.

SEMESTER – II

20PHP205B COMPUTATIONAL 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'.
- 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)

At the end of the course

1. The students programming tactics, numerical methods and their implementation like applying to problem in physics, including modeling of classical physics to quantum system as well as data analysis (Linear and non linear) will be improved.
2. Use analysis techniques for propagating error, representing data graphically. Create, solve and interpret basic mathematical tool.

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 4^{th} order methods - adaptive step size R-K method - predictor - corrector methods - Milne's method - Adam-Mouton method.

Numerical Solution of System of Equations**:**Gauss-Jordan elimination Method - Gauss-Seidel iteration method – Gauss elimination method and Gauss-Jordan method to find inverse of a matrix - 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. , 1^{st} edition 2009, International Publishing House, Pvt. Ltd.
2. S.S. Sastry,5^{th} edition 2013, Introductory Methods of Numerical Analysis, PHI Pvt. Ltd.
3. Singaravelu.A,Numerical Methods,2008,New Revised Edition, Meenakshi Agencies Pvt.Ltd
4. Tao Pang, 1^{st} edition , 2006.An Introduction to Computational Physics, Cambridge University Press
5. James B Scarborough, Numerical Mathematical Analysis,6^{th} Edition, Baltimore : Johns Hopkins Press
6. https://nptel.ac.in/courses/115106118/
7. https://nptel.ac.in/courses/115104095/

SEMESTER – II

20PHP205C **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 Develop an intuition for surface and thin film physical principles through plotting of functions using Maple
- Relate the mathematical results to practical applications and experiments 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 Demonstrate knowledge of different thin film deposition strategies

Course Outcomes (COs)

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

1. the basic concepts about the thin film technology
2. 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

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. Ist edition 2004, Thin film Phenomena, Mc Graw hill
2. Chopra, K.L. and Das, S.R Ist edition2013 Thin films solar cells. Springer.
3. Thin Film Fundamentals- A. Goswami, New Age International Pvt Ltd.
4. Holland, L Ist edition 2004, Vacuum deposition of thin films.Weily Publication
5. Meissel. L.T and R. Glang., 2000 Handbook of thin film technology, Tata McGraw Hill, New Delhi.
6. M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Ed., Academic Press (An Imprint of Elsevier), 2006

7. Copper Zinc Tin Sulfide-Based Thin-Film Solar Cells Edited by Kentaro ITO, (John Wiley & Sons, Ltd), 2015.
8. https://nptel.ac.in/content/storage2/courses/112108092/module2/lec08.pdf
9. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113104075/lec41.pdf

SEMESTER – II

20PHP211 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

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

Course Outcomes (COs)

1. The course is designed to train the students so that they can efficiently handle various instruments.
2. Students will verify laws studied in the different theory course.
3. Students will measure different 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

SEMESTER – II

20PHP212 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 Objective

1. To understand the Biasing network for BJT and FET, transient analysis and frequency response of BJT and FET in single stage and multistage amplifier
2. To understand the frequency response feedback amplifier using BJT and FET and Tuned amplifier
3. To understand the operation of Oscillators and waveform generators

Course Outcomes (COs)

1. Students will practically study the working of different electronic components/ circuits.
2. Learn to minimize contributing variables and recognize the limitations of equipment.
3. Design and construction of circuits using analog component and trouble shooting of the circuits.

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 of Photo 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, Pragathi Prakashan, Meerut
3. Singh S.P., 2000, Advanced Practical Physics – 2, 12th Edition, Pragathi Prakashan, Meerut
4. Gupta S.L. and V.Kumar, 2002, Practical Physics, 25th Edition, Pragathi Prakashan, Meerut
6. Ramakant A. Gayakwad, 2002, Op-amp and Linear Integrated Circuits, 4th Edition, Prentice Hall

SEMESTER III
4H- - 4C

20PHP301 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

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 make the students capable of analyzing theoretical problems like interaction of particles, scattering of particles etc.

Course Outcomes (COs)

1. Students will get the knowledge of non-relativistic and relativistic quantum mechanics including time-dependent perturbation theory, scattering theory, relativistic wave equations, and second quantization.
2. Students will be able to understand concepts and to perform calculations of scattering of particles.
3. Students will be able to understand and evaluate modern research utilizing quantum theory in condensed matter, nuclear and particle physics.

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, 2009, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, New Delhi.
2. Leonard I. Schiff, 2000, Quantum Mechanics, 3rd Edition, McGraw Hill International, Auckland
3. Satya Prakash, New Edition, 2003, 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. Arthur Beiser, Concepts of Modern Physics, 6th Edition, McGraw Hill Education, 2009
10. https://nptel.ac.in/courses/115102023/

SEMESTER III
4H- - 4C

20PHP302 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. 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.

Course Outcomes (COs)
Students can understand

1. absorption and spontaneous and stimulated emission in two level system, the effects of homogeneous and inhomogeneous line broadening, and the conditions for laser amplification.
2. operations and basic 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.
3. Classify fibers as single-mode, multimode step index and multi-mode graded index.
4. Describe modes in multimode fibers and mode field parameter in single-mode fibers.

UNIT- I

Laser Characteristics: 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, CO2 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. Ajoy Ghatak & Thyagarajan 2nd edition, 2013, Laser Fundamentals and applications Laxmi Publications (P) Ltd
2. Laud, B.B.1st Edition 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.and Thyagarajan, K :2010 Optical electronics Cambridge Univ. Press
5. Maitland, A. and Dunn, M.H. 2013 : Laser Physics N.H.Amsterdam.
6. Principles of Lasers, Orazio Svetlo; Springer; 5 ed. 2010
7. Demtroder, W. : Laser Spectroscopy, Springe series in chemical physics vol.5, Springer verlag, Berlin, 2014.
8. Advances in laser materials processing: technology, research and applications, 2nd edition, J. R. Lawrance, 2017, Woodhead Publishing
9. Laser and Fundamentals, W. T. Silfvast, , Cambridge University Press (2004).

10. https://nptel.ac.in/courses/115101008/
11. https://nptel.ac.in/content/syllabus_pdf/104104085.pdf

SEMESTER III
4H- - 4C

20PHP303 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). It is very important to understand the propagation of waves in different media, its transmission and reception.

Course Outcomes (COs)

Students will:

- 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. .
- 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.

UNIT- I

Electrostatics: Electric intensity – Electric potential – Gauss Law - Dielectric and its polarization - Electric displacement D – Dielectric constant ε_r – Polarisibiltiy α - 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

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 (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 $F_{\mu\nu}$ - Transformation equations for the field vectors E and B - Covariance of field equations in terms of 4-vectors - Covariance of Maxwell equations in 4-tensor forms – Covariance and transformation law of Lorentz force.

SUGGESTED READINGS

1. Chopra & Agarwal 2004, Electromagnetic theory, 6th Edition, Nath & Co, Meerut.
2. Griffiths D., 2013, Introduction to Electrodynamics, 4th Edition, Printice Hall of India, New Delhi.
3. Paul Lorrain and Dale R Corson , Electromagnetic fields and waves , 3rd Edition, **W**. H. Freeman and Company New York.
4. Jacson. J.D., 2009, Classical Electro dynamics, 3rd Edition, Willey Eastern, New Delhi.
5. Schwaritz. M. 2008, Principles of Electro dynamics, McGraw Hill, Auckland.
6. Jordon and Balmain 2nd 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/115104088/
10. https://nptel.ac.in/courses/115101005/

SEMESTER III
4H- - 4C

20PHP304 DIGITAL ELECTRONICS AND MICROCONTROLLER

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

Course Objectives

Digital electronics is very important in present day life due to its applications in almost all fields of life. Any signals stored in memory are first digitized. So it is important to have knowledge about digital electronics. 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.

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. Acquired knowledge about Microprocessors and its need.
4. Ability to identify basic architecture of different Microprocessors.
5. Foster ability to write the programming using 8085 microprocessor.
6. Foster ability 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

PIC microcontrollers: History and features-CCS C Compiler and PIC18F Development System-PIC Architecture & Programming-PIC I/O Port -PIC Programming in C-PIC18 Hardware Connection and ROM loaders-PIC18 Timers-PIC18 Serial Port-Interrupt-Applications - LCD and Keypad Interface -External EEPROM and I^2C-USB and HID Class-ADC and DAC -Sensor and other Applications.

SUGGESTED READINGS

1. Floyd, 2003, Digital Fundamentals, 8th Edition, Pearson education, New Delhi.
2. Ramesh Gaonkar 6th edition 2013 Microprocessor Architecture, Programming and Applications with 8085 ,PENRAM International P Ltd
3. Malvino and Leach, 2006, Digital Principles and Applications, 3rd Edition, Tata McGrawHill, New Delhi.
4. Aditya P. Mathur, 24th reprint 2006, Introduction to Microprocessor, 3rd Edition, Tata McGrawHill, New Delhi.
5. Morris Mano. M, 1st 2002, Digital Logic and Computer Design, Prentice Hall, New Delhi.
6. Kenneth. J. Ayala. The 8051 microcontroller , 3rd edition, Cengage learning, 2010

7. Ajay. V. Deshmukh Microcontrollers and application, TMGH. 2005.
8. K.Uma Rao, Andhe Pallavi, The 8051 Microcontrollers, Architecture and programming and Applications, Pearson, 2009.
9. A. K. Ray and K.M. Bhurchandani, Advanced Microprocessors and Peripherals, TMH, 2nd edition 2006.
10. Muhammad Ali Mazidi, Rolin D. McKinlay, and Danny Causey, The PIC Microcontroller and Embedded systems – Using Assembly and C for PIC18, Prentice Hall, 2007
11. Design reference notes and data sheets of Microchips.
12. https://nptel.ac.in/courses/117103064/
13. https://nptel.ac.in/courses/117106086/

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SEMESTER – III
4H- - 4C

20PHP305A NANOSTRUCTURES AND CHARACTERIZATION

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 of key 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-art nanomanufacturing processes.

Course Outcomes (COs)

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

1. Explain the fundamental principles of nanotechnology and their application to biomedical engineering.
2. Apply engineering and physics concepts to the nano-scale and non-continuum domain.
3. Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature.
4. Design processing conditions to engineer functional nanomaterials.
5. Evaluate current constraints, such as regulatory, ethical, political, social and economical, encountered when solving problems in living systems.

UNIT - I

Low Dimensional Structures : Preparation of quantum nanostructures - size and dimensionality effects - size effects - potential wells - partial confinement - conduction electrons and dimensionality - Fermi gas and density of states - properties dependent on density of states - excitons - single-electron tunneling - Aplications - infrared detectors - quantum dot lasers - superconductivity. Microelectromechanical Systems (MEMS) - Nanoelectromechanical Systems

(NEMS) –Fabrication of nanodevices and nanomachines - Molecular and Supramolecular Switches.

UNIT - II

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 - III

Thermal, Microscopic and Infrared Analysis : Thermal analysis – DTA, DSC and TGA – methodology of DTA, DSC and TGA and Instrumentation. Microscopy – Electron microscopy – Principles and instrumentation – resolution limit – scanning tunnelling microscopy – principles – scanning tunnelling microscope - SEM & TEM. Atomic force microscope

UNIT - IV

Instrumentation:IR spectrophotometers – Theory and Instrumentation- Applications. Fourier transform techniques – FTIR principles and instrumentation. Raman spectroscopy – Principles, Instrumentation and Applications. Microwave Spectroscopy -Instrumentation and Applications

UNIT - V

Mass Spectrometry, Resonance Spectroscopy : Mass Spectrometry - Principle – Instrumentation – Types of ions produced in a Mass spectrometer - Interpretation of Mass spectra – Applications. NMR – Principles and Instrumentation – Chemical shift - Spin-spin coupling - Applications of NMR - Electron spin resonance spectrometry – Theory of ESR –Instrumentation - Interpretation of ESR spectra - Applications.

SUGGESTED READINGS

1. Charles P. Poole, Jr. and Frank J. Owens, Ist edition 2003, Introduction to Nanotechnology,Wiley,
2. Cornelius T Leondes, MEMS/NEMS: micro electro mechanical systems/nano electromechanical systems Volume 1, Design Methods, Springer, (2006).
3. G. Chatwal & Sham Anand, 5th edition 2013 ,Instrumental methods of Chemical Analysis, Himalaya
4. Norman D Colthup, Lawrence H Daly and Stephen E Wiberley, 2001 Introduction to Infrared and Raman spectroscopy, Academic press, NY.
5. H.H. Willard, L.L. Merrit, J.A.Dean & F.A. Settle, 7th Instrumental methods of analysis, CBS Pub.
6. https://nptel.ac.in/courses/118104008/
7. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/118104008/lec10.pdf

SEMESTER III
4H- - 4C

20PHP305B SOLAR ENERGY AND ITS UTILIZATION

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

Course Objectives

Solar energy harvesting and utilizing for day to day purposes has become order of the day. The scarcity and increasing need of the fossil fuel has made man to think about alternate sources, the easiest and best being Solar energy. To introduce the students to the world of solar energy, its different uses, the different methods of harvesting solar energy.

Course Outcomes (COs)

Students 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.

UNIT –I –Solar Energy Fundamental

Introduction to Solar Energy Applications Essential Subsystems in Solar Energy Plant Solar Energy Chains and their Prospects Various Terms and Definitions Units of Solar Power and Solar Energy Merits and Limitation of Solar Energy Conversion and Utilization Historical Review and Future Prospects Basic Approach and Objectives Phenomenon of light and Energy Energy from Sun Solar Constant Components of Sun Light and Solar Spectrum Power Density in Sun Light Clarity Index

UNIT – II – Solar Thermal energy conversion system

Introduction Subsystems Solar Thermal Collectors - Simple Flat Plate Collector - Installation of Flat Plate Collector - Modified Flat Plate Collector - Parabolic through Collectors Paraboloidal - Dish Collectors - Fresnel Lens Point Focus Collectors - Heliostats with Central Receiver Heat

Transfer Fluids - Solar Distributed Collector Thermal Power Plant - Solar Central Receiver Thermal Power Plant

UNIT– III- Solar Thermal Power Plants

Various Ratings of a Solar Energy Plants Solar Boiler/ Steam Generator with large Reflector and Central Receiver Solar Pond (Solar Salt Pond) Solar Thermal Power Supply System for Space Station Solar Energy from Satellite to Earth Station Solar Thermo-Electric Convertor Solar Systems for Residential Houses.

UNIT – IV-Solar Photovoltaic

Introduction of Solar Photovoltaic Systems Merits and Limitations of Solar PV Systems Prospects of Solar PV Systems Economy consideration of Solar PV System in Rural Area Principle of a Photovoltaic Cell V-I Characteristics of a Photovoltaic Cell Power of a Solar Cell and Solar PV Panel Interconnection of a Solar Cells Efficiency of Solar Cell and Solar PV module Spectral Response Configuration of a Solar PV Panel Small and Large Solar PV Systems PV Cell Technology.

UNIT – V Industrial Processes & Systems

Industrial process heat: Temperature requirements, consumption pattern; Applications of solar flat plate water heater & air heater for industrial process heat; Designing thermal storage; Transport of energy. Solar still; Solar cooker: Solar pond; Solar passive heating and cooling systems: Trombe wall; Greenhouse technology: Fundamentals, design, modeling and applications.

SUGGESTED READINGS

1. Solar Engineering of Thermal Processes – Duffie and Beckman – 4th Edition – 2013 –
2. G.D.Rai, 2011 , Non conventional energy sources, Khanna Publishers
3. H P Garg & Prakash, 2000, Solar Energy -Fundementals and Applications ,First Revised Edition Tata McGraw-Hill Education, New Delhi.
4. S.P.Sukhatme. 2008 , Solar Energy, Tata McGraw-Hill Publishing Co. Ltd.

5. D. Mukherjee and S. Chakrabarti, 2005, Fundamentals of Renewable Energy Systems, New Age International Publishers.
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 – III
4H- - 4C

20PHP305C OPTOELECTRONICS

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

Course Objectives

Optoelectronics is the science that deals with designing devices that can detect or emit light in any part of the spectrum. It is used in a variety of different fields like communication, warfare and consumer applications. Though the market for optical sector is huge in India, there are not enough firms to cater to the whole of it. This paper gives an introduction to semiconductors and light. The application of optics in electronics, usage of optical waves in communications, optical fibers are explained in this paper.

Course Outcomes (COs)

1. The students are conversant with the application of optical properties and processes in semiconductor optical sources.
2. The students understand the operation of LEDs and lasers.
3. The students are familiar with the structures and performance of LEDs and lasers.

UNIT - I

Semiconductor Science and Light Emitting Diodes : Semiconductor energy bands - semiconductor statistics – extrinsic semiconductors – compensation doping – degenerate and non degenerate semiconductors – energy band diagrams in applied field - direct and indirect bandgap semiconductors, - p-n junction principles - open circuit- forward and reverse bias – depletion layer capacitance – recombination life time – p-n junction band diagram - open circuit - forward and reverse bias – light emitting diodes – principles - device structures - LED materials, heterojunction high intensity LEDs – double heterostructure – LED characteristics and LEDs for optical fiber communications - surface and edge emitting LEDs.

UNIT - II

Fiber Optics : Symmetric planar dielectric slab waveguide – waveguide condition – single and multimode waveguides – TE and TM modes – modal and waveguide dispersion in the planar waveguide – dispersion diagram – intermodal dispersion – intramodal dispersion – dispersion in single mode fibers – material dispersion – waveguide dispersion – chromatic dispersion – profile

and polarization dispersion – dispersion flattened fibers - bit rate and dispersion – optical and electrical bandwidth – graded index optical fiber - light absorption and scattering – attenuation in optical fibers.

UNIT - III

Laser Principles : Laser oscillation conditions - diode laser principles - heterostructure laser diode – double heterostructure – stripe geometry – buried heterostructure – gain and index guiding - laser diode characteristics – laser diode equation - single frequency solid state lasers – distributed feedback –quantum well lasers - vertical cavity surface emitting laser - optical laser amplifiers.

UNIT - IV

Photodetectors and Photovoltaics : Principle of p-n junction photodiode - Ramo's theorem and external photocurrent - absorption coefficient and photodiode materials – quantum efficiency and responsivity - PIN-photodiode – avalanche photodiode – phototransistor - photoconductive detectors and photoconductive gain – noise in photo-detectors – noise in avalanche photodiode - solar energy spectrum - photovoltaic device principles – I-V characteristics - series resistance and equivalent circuit - temperature effects - solar cell materials, device and efficiencies

UNIT - V

Optoelectronic Modulators: Optical polarization, birefringence, retardation plates, electro-optic modulators – Pockels effect - longitudinal and transverse electro-optic modulators, Kerr effect, Magneto-optic effect, acousto-optic effect – Raman Nath and Bragg-types.

Non-linear optics: Wave propagation in an anisotropic crystal - polarization response of materials to light - second order non-linear optical processes – second harmonic generation - sum and frequency generation, optical parametric oscillation - third order non-linear optical processes - third harmonic generation - intensity dependent refractive index - self-focusing - non-linear optical materials, phase matching - angle tuning - saturable absorption - optical bistability - two photon absorption.

SUGGESTED READINGS

1. Ajoy Ghatak & Thyagarajan 2nd edition,2013,Laser Fundementals and applications Laxmi Publications (P) Ltd.
2. Jasprit Singh,1st edition2014 Optoelectronics: An introduction to materials and devices, Mc Graw Hill International Edn.
3. Pallab Bhattacharya, 2nd edition Semiconductor optoelectronic devices: Pearson(2008)
4. A.Yariv and P. Yeh,1st edition 2003 Optical waves in crystals: Propagation and Control of Laser Radiation, John Wiley and Sons Pub.
5. William T. Silfvast, Laser fundamentals, CUP 2nd Edn. 2009.
6. https://nptel.ac.in/courses/115102026/
7. https://nptel.ac.in/courses/115102103/

SEMESTER – III
4H- - 2C

20PHP311 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.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To familiarize the student in introducing and exploring MATLAB softwares.
- To enable the student on how to approach for solving Engineering problems using simulation tools.
- To prepare the students to use MATLAB in their project works.

Course Outcomes (COs)

1. The course is designed to train the students so that they can efficiently handle various instruments.
2. Students will verify laws studied in the different theory course.
3. Ability to express programming & simulation for engineering problems.
4. Ability to find importance of this software for Lab Experimentation.

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 different temperatures by optical microscope.

9. Experiment on rotatory dispersion of quartz.
10. Matlab Programming-Radioactive Decay
11. Matlab Programming-Numerical Integration
12. Matlab Programming-Computer Simulation of Equations of Motion for a System of Particles
13. Matlab Programming-Computer Simulation of 1-D and 2-D Lattice Vibrations
14. Matlab 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 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. B.L Worsnop& H T Flint. Advanced Practical Physics For Students,9th revised Edition,Littlehampton Book Services Ltd.

SEMESTER – III
4H- - 2C

20PHP312 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 Objective

This course introduces the assembly language programming of 8085 Microprocessor.It gives a practical training of interfacing the peripheral devices with the 8086 microprocessor.

Course Outcomes (COs)

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

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. Microprocessor – LED interfacing and Musical tone generator interfacing
9. Microprocessor – interfacing of stepper motor and ADC wave form generation.
10. Microprocessor – Traffic light simulation
11. Microprocessor – interfacing of frequency or temperature measurement sensor

12. Microprocessor – Hexa Key Board interface.
13. Write an assembly language program (ALP) to generate 10kHz square wave.
14. Micro-controller -interfacing of stepper motor and DC motor.
15. To interface PWM based voltage regulator using PIC.

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. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Fifth edition, Oxford University Press, 2003.

SEMESTER IV

20PHP491 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 and methodology of research in Theoretical Physics and Experimental Physics. Students get the opportunity to participate in some ongoing research activity and development of a laboratory experiment.

Course Outcomes (COs)

1. Demonstrate a depth of knowledge of Physics.
2. Complete an independent research project, resulting in research outputs in terms of publications in journals and conference proceedings.
3. Demonstrate knowledge of contemporary issues in their chosen field of research.
4. Demonstrate an ability to present and defend their research work.