SACRED HEART COLLEGE (AUTONOMOUS), THEVARA

KOCHI, KERALA, 682013

CURRICULUM AND SYLLABUS

FOR

B.Sc. PHYSICS

CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS)

INTRODUCED FROM 2023 ADMISSIONS ONWARDS

Prepared by

Board of Studies in Physics

Sacred Heart College Thevara, Kochi.

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There are many profound personalities whose relentless support and guidance made this syllabus restructuring 2023 a success. We take this opportunity to express our sincere appreciation to all those who were part of this endeavour for restructuring the syllabus of U G course in Physics under Sacred Heart College (Autonomous) Thevara.

We place on record our wholehearted gratitude to the members of Faculty of Physics and Board of Studies for their untiring efforts.

Thevara

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1. INTRODUCTION

AIMS AND OBJECTIVES OF THE PROGRAMME

The Board of Studies in Physics (UG) recognizes that curriculum, course content and assessment of scholastic achievement play complementary roles in shaping education. The committee is of the view that assessment should support and encourage the broad instructional goals such as basic knowledge of the discipline of Physics including phenomenology, theories and techniques, concepts and general principles. This should also support the ability to ask physical questions and to obtain solutions to physical questions by use of qualitative and quantitative reasoning and by experimental investigation. The important student attributes including appreciation of the physical world and the discipline of Physics, curiosity, creativity and reasoned skepticism and understanding links of Physics to other disciplines and to societal issues should gave encouragement. With this in mind, we aim to provide a firm foundation in every aspect of Physics and to explain a broad spectrum of modern trends in physics and to develop experimental, computational and mathematics skills of students.

The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of Physics by providing a more complete and logical framework in almost all areas of basic Physics.

By the end of the first year (2nd semester), the students should have attained a common level in basic mechanics, a secure foundation in mathematics, Chemistry (otherwise specified), Languages and other relevant subjects to complement the core for their future courses and developed their experimental and data analysis skills through experiments at laboratories.

By the end of the second year (4th semester), the students should have been introduced to powerful tools for tackling a wide range of topics in Optics, Laser, Fibre optics, Semiconductor devices and circuits. Along with Languages, they should have been familiar with additional

relevant techniques in mathematics, Chemistry or Electronics/Computer application and developed their experimental and data analysis skills through a wide range of experiments through practical at laboratories.

By the end of the third year (6th semester) the students should have developed their understanding of core Physics by covering a range of topics in almost all areas of physics including Classical and Quantum Mechanics, Electricity and Electrodynamics, Relativity and spectroscopy, Thermal and Statistical Physics, Nuclear and Particle physics, Solid State Physics, Digital Electronics etc. along with one choice based courses, Open course and had experience of independent work such as projects; seminars etc. and thereby developing their experimental skills through a series of experiments which also illustrate major themes of the lecture courses.

1.2 PROGRAMME OUTCOMES

PO 1	**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO 2	**Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the word by connecting people, ideas, books, media and technology.
PO 3	**Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act an informed awareness of issues and participate in civic life through volunteering.
PO 4	**Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
PO 5	**Ethics**: Recognise different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6	**Global Perspective:** Understand the economic, social and ecological connections that link the world's nations and people.

1.3 Eligibility for admission

Pass in +2 or equivalent Examination with Physics as an optional subject

2. REGULATIONS FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS) FOR UNDERGRADUATE PROGRAMMES -2023

Preamble

Sacred Heart College, Thevara became an autonomous college under Mahatma University Kottayam in 2014. Since then, academic programmes of the college are being conducted as per the curriculum and syllabus approved by the various Boards of studies and the academic council of the college. The college revised the syllabi of the undergraduate (UG) programmes in 2015-16 and 2019-20. The curriculum and syllabus under the choice based credit and semester system (CBCSS) for the undergraduate programmes effective from 2019-20 admissions offer Outcome Based Education (OBE). The new 'REGULATIONS FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS) FOR UNDERGRADUATE PROGRAMMES -2023' is a continuation of the effort of the college for providing best education to the UG students of the college.

2.1 Title

These regulations shall be called **"SACRED HEART COLLEGE THEVARA REGULATIONS FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS) FOR UNDERGRADUATE PROGRAMMES -2023**

2.2 Scope

Applicable to all undergraduate (UG) programmes of the college with effect from 2023 admissions onwards, except otherwise approved by the Academic Council of the College

2.3. Definitions

i. '**Programme**' means the entire course of study and examinations.

ii. 'Duration **of Programme'** means the period of time required for the conduct of the programme. The duration of undergraduate programmes shall be 6 semesters, post-graduate programme shall be of 4 semesters and M Phil programmes shall be 2 semesters.

iii. **'Semester'** means a term consisting of a minimum of 90 working days, inclusive of examination, distributed over a minimum of 18 weeks of 5 working days, each with 5 contact hours of one hour duration

iv. **'Course'** means a segment of subject matter to be covered in a semester. Each Course is to be designed variously under lectures / tutorials / laboratory or fieldwork / study tour /seminar / project / practical training / assignments/evaluation etc., to meet effective teaching and learning needs.

v. '**Common Course I'** means a course that comes under the category of courses for English and '**Common Course II**' means additional language, a selection of both is compulsory for all students undergoing undergraduate programmes(Model I)

vi. '**Core course'** means a course in the subject of specialization within a degree programme.

vii. '**Complementary Course**' means a course which would enrich the study of core courses.

viii. '**Open course'** means a course outside the field of his/her specialization, which can be opted by a student.

ix. '**Additional core course**' means a compulsory course for all undergraduate students (as per the UGC directive) to enrich their general awareness.

x. The U.G. programmes shall include (a) Common courses (b) Core courses (c) Complementary Courses (d) Open Course (e) Study tour and (f) Internship for selected programmes.

xi. '**Additional Course'** is a course registered by a student over and above the minimum required courses.

xii. **'Credit' (Cr)** of a course is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

xiii. '**Extra credits**' are additional credits awarded to a student over and above the minimum credits required for a programme for achievements in co-curricular activities carried out

outside the regular class hours OR curricular activities/courses completed for value addition, as directed by the College/ department. It is the numerical value assigned to Club activities, Social service, Internship, Add on courses etc. which is not added with the total academic credits of the students. Additional credit components

(a) Talent & career club activity (optional)

(b) Social service (mandatory)

(c) Internship for Commerce, Communication and Computer applications (mandatory).

(d) Internship (desirable for other programmes).

(e) Add on courses (optional)

xiv. '**Programme Credit'** means the total credits of the UG Programme.

xv. **'Programme Elective course'** Programme Elective course means a course, which can be chosen from a list of electives and a minimum number of courses is required to complete the programme.

xvi. '**Programme Project'** Programme Project means a regular project work with stated credits on which the student undergoes a project under the supervision of a teacher in the parent department / any appropriate Institute in order to submit a dissertation on the project work as specified.

xvii. '**Internship**' is on-the-job training for professional careers.

xviii. '**Plagiarism**' Plagiarism is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

xix. '**Tutorial'** Tutorial means a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

xx. '**Seminar'** seminar means a lecture by a student expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

xxi. '**Evaluation'** means every course shall be evaluated by 25% continuous (internal) assessment and 75% end course/end semester (external) assessment.

xxii. '**Repeat course'** is a course that is repeated by a student for having failed in that course in an earlier registration.

xxiii. **'Audit Course'** is a course for which no credits are awarded.

xxiv. '**Department'** means any teaching Department offering a course of study approved by the

college / Institute as per the Act or Statute of the University.

xxv. '**Parent Department'** means the Department which offers a particular UG/PG programme.

xxvi. '**Department Council'** means the body of all teachers of a Department in a College.

xxvii. **'Faculty Advisor'** is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department.

xxviii. '**College Co-ordinator** means a teacher from the college nominated by the College Council to look into the matters relating to CBCSS

xxix. **'Letter Grade'** or simply '**Grade**' in a course is a letter symbol (O, A, B, C, D, etc.) which indicates the broad level of performance of a student in a course.

xxx. Each letter grade is assigned a **'Grade point'** (GP) which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

xxxi. **'Credit point'** (CP) of a course is the value obtained by multiplying the grade point (GP) by the Credit (Cr) of the course CP=GP x Cr.

xxxii. '**Semester Grade point average'** (SGPA) is the value obtained by dividing the sum of credit points (CP) obtained by a student in the various courses taken in a semester by the total number of credits taken by him/her in that semester . The grade points shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

xxxiii. **Cumulative Grade point average'** (CGPA) is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.

xxxiv. '**Grace Marks'** means marks awarded to course/s, as per the orders issued by the college from time to time, in recognition of meritorious achievements in NCC/NSS/Sports/Arts and cultural activities.

2.4 ATTENDANCE

Being a regular college, physical presence in the regular activities, especially, classes and exams, is mandatory for the students. However, if a student secures 75% of attendance s/he is eligible to appear for the exams, provided there are no other impediments like disciplinary proceedings, malpractice record etc.

i. A maximum of 5 marks (5%) for a course is given for attendance

ii. **Absence:** A student found absent for one hour in the forenoon or afternoon session is deprived of the attendance for the entire session as far as eligibility for final exam is concerned.

iii. The hour related calculation in a course is meant for awarding marks for the course concerned.

iv. **Late entry**: A student is supposed to be in time in the class. Late arrival related treatment is left to the discretion of the individual teacher. However, as a norm, a late arriving student may be permitted to the class, if it is not inconvenient or distraction to the class as such; though attendance MAY NOT BE GIVEN. Late arrival beyond 5 minutes is treated as ABSENCE; though the teacher may consider permitting the student to sit in the class.

v. **Leave** : A student has to formally report his/her absence with reasons either in advance, or immediately after the absence for obtaining an approved leave. This applies to all sorts of leave – medical, on duty or other.

vi. The student is supposed to report in prescribed format on the very next day of the absence; however, upto a week's time is permitted. Afterwards, the leave applications will not be considered.

vii. The student has to retain a copy/section of the approved leave form and produce the same as proof, in case there is any confusion regarding the leave sanctioning. In the absence of such proof, the claims will not be entertained.

viii. **Duty Leave**: A student representing the college in sports, arts, social service or academic matters, has to get sanction from the class teacher concerned and submit the leave application form duly endorsed by teacher concerned & the class teacher, and submit it to the faculty Dean (or Vice Principal). The same will be forwarded by the Dean/Vice Principal for attendance entry. **SPORTS**: The approval of the Department of Physical

Education and the class teacher is required. The time limit for submission mentioned above is applicable in the case of duty leave as well.

ix. **CONDONATION**: a student may have the privilege of condonation of attendance shortage (upto a maximum of 10 days) on the basis of genuineness of the grounds of absence (medical reasons or college duty), duly recommended by the department. This is not a matter of right. It is a matter of privilege based on Principal's discretion and the good conduct of the student on the campus. A student of UG programme may have a maximum of two such opportunities.

x. **RE-ADMISSION** – a student whose attendance is inadequate will have to discontinue the studies. Such students, whose conduct is good, may be re-admitted with the approval of Governing Body, on the basis of recommendation from the department, and assurance from the student and the guardian regarding good conduct and compliance in academic and discipline matters. For this the prescribed re-admission fee has to be paid.

As a condition for re-admission, the student should have cleared all academic arrears, or should have appeared for the exams in which he/she is having an arrear (if the results are not out), and should have fulfilled all academic assignments prescribed by the department for compensating for his lack of attendance.

xi. **UNAUTHORISED ABSENCE & REMOVAL FROM ROLLS**: A student absent from the classes continuously for 10 consequent days without intimation or permission, shall be removed from the rolls, and the matter intimated to the student concerned. On the basis of recommendation of the department concerned, re-admission process may be permitted by the Principal.

2.5 PROGRAMME REGISTRATION

i. A student shall be permitted to register for the programme at the time of admission.

ii. A UG student who registered for the programme shall complete the same within a period of 12 continuous semesters from the date of commencement of the programme.

2.6 PROMOTION: A student who registers for the end semester examination shall be promoted to the next semester. However, in extreme circumstances, a student having sufficient attendance who could not register for the end semester examination may be allowed to register notionally by the Principal with the recommendation of the Head of the department concerned and , by paying the prescribed fee.

2.7 UNDERGRADUATE PROGRAMME STRUCTURE

Model I BA/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	22
d	Credits required from Common Course II	16
e	Credits required from Core course and Complementary courses including Project	79
f	Open Course	3
g	Minimum attendance required	75%

Model I/II B.Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	14
d	Credits required from Common Course II	8
e	Credits required from Core and Complementary/ Vocational courses including Project	95
f	Open Course	3
g	Minimum attendance required	75%

Model II BA/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	16
d	Credits required from Common Course II	8
e	Credits required from Core + Complementary + Vocational Courses including Project	93
f	Open Course	3
g	Minimum attendance required	75%

Model III BA/B.Sc./B.Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	8
d	Credits required from Core + Complementary + Vocational Courses including Project	109
e	Open Course	3
f	Minimum attendance required	75%

2.8 EXAMINATIONS

All the End Semester Examinations of the college will be conducted by the Controller of Examination. The Principal will be the Chief Controller of Examinations. An Examination committee consists of the Chief Controller of Examinations, Controller of Examinations, Additional Chief Superintendent, Deans, IQAC Coordinator and other faculty members nominated by the Principal will act as an advisory body of the matters relating to the conduct of examinations.

2.9. EVALUATION AND GRADING

The evaluation scheme for each course shall contain two parts;

a. Continuous Internal Evaluation (CIA) and
b. End Semester Examination (ESE).

The internal to external assessment ratio shall be 1:3, for both courses with or without practical except for (i) BA Animation and Graphics (ii) BA Animation and Visual effects and (iii) BBA. For courses without practical, there shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation. For courses with practical, generally external evaluation shall be for a maximum of 60 marks and internal evaluation for 20 marks. Both internal and external evaluation shall be carried out in the mark system and the marks are to be rounded to the nearest integer.

The internal to external assessment ratio for BA Animation and Graphics, BA Animation and Visual effects and BBA shall be decided by the respective Board of studies subject to a minimum of 60 marks for external examinations.

2.9.1. Continuous Internal Assessment (CIA)/ Continuous Assessment: The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars/viva/field survey and attendance in respect of theory courses and based on written tests, lab skill/records/viva and attendance in respect of practical courses. The marks assigned to various components for internal evaluation as follows.

Components of Internal Evaluation (for theory without practical)

	Components	Marks
i.	Assignments	5
ii	Seminar/Quiz/Field survey /Viva etc.	5
iii	Attendance	5
iv	Two Test papers(2x5)	10
	Total	25

i. **Assignments**: Every student shall submit one assignment as an internal component for every course.

Components	Marks
Punctuality	1
Content	2
Conclusion	1
Reference/Review	1
Total	**5**

ii. **Seminar**: The seminar lecture is expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

Components	Marks
Content	2
Presentation	2
Reference/Review	1
Total	**5**

iii. **Evaluation of Attendance**

The attendance of students for each course shall be another component of internal assessment.

% of attendance	Mark
Above 90%	5
Between 85 and below 90	4
Between 80 and below 85	3
Between 76 and below 80	2
Between 75 and below 76	1

Components of Internal Evaluation (for theory with practical)

Components of Theory – Internal Evaluation	**Marks**
Attendance	5
Seminar/ Assignment (Written assignments, preparation of models, charts, posters etc., field survey, field work)	5
Test paper(s)	10
Total	20

Components of Practical- Continuous internal assessment

Components	**Marks**
Attendance and Lab involvement	2
Record	2
Viva/Model Exam	1
Total	5

iv. **Class Tests:** Every student shall undergo **two class tests** as an internal component for every course.

2.9.2 End Semester Examination (ESE): The End Semester Examination in theory courses shall be conducted by the college with question papers set by external experts/ question bank. The evaluation of the answer scripts shall be done by the examiners based on a well-defined scheme of evaluation given by the question paper setters/Prepared as per the direction of the Chairman, Board of Examiners. The evaluation of the End Semester Examinations shall be done immediately after the examination preferably through the centralised valuation.

2.9.3 Project

Project work is a part of the syllabus of most of the programmes offered by the college. The guidelines for doing projects are as follows:

i. Project work shall be completed by working outside the regular teaching hours.

ii. Project work shall be carried out under the supervision of a teacher in the concerned department or an external supervisor.

iii. A candidate may, however, in certain cases be permitted to work on the project in an industrial / Research Organization/ Institute on the recommendation of the Supervisor.

iv. There should be an internal assessment and external assessment for the project work in the ratio 1:3

v. The external evaluation of the project work consists of valuation of the dissertation (project report) followed by presentation of the work and viva voce.

vi. The mark and credit with grade awarded for the program project should be entered in the grade card issued by the college.

Components of Internal Evaluation for Projects

Components	**Marks**
Topic/Area selected	2
Experimentation/Data collection	5
Punctuality-Regularity	3
Compilation	5
Content	5
Presentation	5
Total	**25**

2.9.4 Comprehensive Viva-voce

Comprehensive Viva-voce shall be conducted at the end of the programme, which covers questions from all courses in the programme as per the syllabus.

2.10. Grade and Grade Points

For all courses (theory & practical), Letter grades and grade point are given on a 10-point scale based on the total percentage of marks, (CIA+ESE) as given below:-

Percentage of Marks	Grade	Grade Point (GP)
95 and above	S Outstanding	10
85 to below 95	A^+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B^+ Good	7
55 to below 65	B Above Average	6
45 to below 55	C Average	5
35 to below 45	D Pass	4
Below 35	F Fail	0
	Ab Absent	0

Grades for the different semesters and overall programme are given based on the corresponding SGPA/CGPA as shown below:

SGPA/CGPA	Grade
Equal to 9.5 and above	***S Outstanding***
Equal to 8.5 and below 9.5	***A+ Excellent***
Equal to 7.5 and below 8.5	***A Very Good***
Equal to 6.5 and below 7.5	***B+ Good***
Equal to 5.5 and below 6.5	***B Above Average***
Equal to 4.5 and below 5.5	***C Average***
Equal to 4.0 and below 4.5	***D Pass***
Below 4.0	***F Failure***

A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course. A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the end semester examination for the same semester, subsequently. A student who fails to secure a minimum marks/grade for a pass in a course can be permitted to write the examination along with the next batch.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of semester, a student should pass all courses and score at least the minimum CGPA grade **'D'**. However, a student is permitted to move to the next semester irrespective of her/his SGPA.

Credit Point (CP) of a course is calculated using the formula

CP = Cr x GP, where Cr = Credit; GP = Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula

SGPA = TCP/TCr, where

TCP = Total Credit Point of that semester $= \sum_1^n \mathrm{CPi}$**;**

TCr = Total Credit of that semester $= \sum_1^n \mathrm{Cri}$

Where n is the number of courses in that semester

Cumulative Grade Point Average (CGPA) of a Programme is calculated using the formula

CGPA $= \sum(\mathrm{SGPA} \times \mathrm{TCr}) \Big/ \sum \mathrm{TCr}$

SGPA/CGPA shall be round off to two decimal places

To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board/website at least one week before the commencement of external examination. There shall not be any chance for improvement for internal mark.

The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course which shall be forwarded to the controller of examinations through the Head of the Department and a copy should be kept in the department for at least two years for verification.

2.11. Registration for the examination

a. All students admitted in a programme with remittance of prescribed fee are eligible for the forthcoming semester examinations.

b. Online application for registration to the various End Semester Examinations shall be forwarded to the CE along with prescribed fee for each course in prescribed format.

c. The eligible candidates who secure the prescribed minimum attendance of the total duration of the course and possess other minimum qualification prescribed in the regulations for each course shall be issued the hall tickets. The hall ticket shall be downloaded by the students from the college website.

d. The mode of fee remittance shall be through the prescribed bank.

2.12. Supplementary Examinations

Candidates who failed in an examination can write the supplementary examination conducted by the College along with regular examinations.

2.13. Improvement of Examination

A candidate can improve his/her marks once by appearing again for the examination with the subsequent batch with the remittance of prescribed fee. In such cases the better of the two marks shall be taken as the marks awarded to him.

Internal assessment marks shall be carried over to the subsequent semester examination. There shall not be any provision for improving internal assessment marks.

2.14. Promotion to the Next Higher Semester

A candidate shall be eligible for promotion from one semester to the next higher semester if,

a. He / she secures a minimum 75 % attendance and registered for the End Semester Examination of the programme for which he/she is studying.

b. His / her progress of study and conduct are satisfactory during the semester completed, as per the assessments recorded by the course teachers and the Head of the Department concerned.

2.15 Certificates

1. Degree certificates are issued by the Mahatma Gandhi University, Kottayam as per the act and statues of the University on the submission of the consolidated mark / score cards of the students by the College.
2. A consolidated mark / scored card shall be issued to the candidates after the publication of the results of the final semester examination taken by the candidate.

3. A Course Completion Certificate with classification shall be issued to students till the provisional certificate is issued by the university.

2.16. Award of Degree

The successful completion of all the courses with 'D' grade shall be the minimum requirement for the award of the degree.

2.17. Monitoring

There shall be a Monitoring Committee constituted by the principal consisting of faculty advisors, HoD, a member from teaching learning evaluation committee (TLE) and the Deans to monitor the internal evaluations conducted by college. The Course teacher, Class teacher and the Deans should keep all the records of the internal evaluation, for at least a period of two years, for verification.

Every Programme conducted under Choice Based Credit System shall be monitored by the College Council under the guidance of IQAC Coordinator, Controller of Exams, academic deans and HoDs.

2.18. Grievance Redressal Mechanism

In order to address the grievance of students regarding Continuous internal assessment (CIA) a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: At the level of the concerned course teacher

Level 2: At the level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

Level 3: A committee with the Principal as Chairman, Dean of the Faculty concerned, HOD of the department concerned and one member of the Academic council nominated by the principal every year as members.

3. PROGRAMME STRUCTURE FOR B.Sc. PHYSICS

COURSE DESIGN

The U.G. programme in Physics must include (a) Common courses, (b) Core courses, (c) Complementary courses, (d) Choice based courses, (e) Open courses and (f) Project. No course shall carry more than 4 credits. The student shall select any one Open course in Semester 5 offered by the various Departments which offers the core courses or physical education department, depending on the availability of infrastructure facilities, in the institution. The number of Courses for the restructured programme should contain 12 compulsory core courses, 1 open course, 1 choice based course from the frontier area of the core courses, 6 core practicals, 1 project in the area of core, 8 complementary courses, 2 complementary practicals otherwise specified, from the relevant subjects for complementing the core of study. There should be 10 common courses, or otherwise specified, which includes the first and second language of study.

3.1. *Course-wise Distribution of Credits:*

The B. Sc. Physics programme consists of common courses with 38 credits, core course, Choice based course and complementary courses with 79 credits and open course with 3 credits.

The number and credits of different types of courses of the programme are listed below.

Type of the Course	No. of Courses	No. of Credits
Common Course I (*English*)	6	22
Common Course II (*Second Language*)	4	16
Total	10	38
Core Courses – *Theory*	12	34
Core Courses – *Practical*	6	12
Choice Based Course	1	3
Project & Viva – Voce	1	2
Total	20	51
Complementary Courses – *Theory*	8	24
Complementary Courses – *Practical*	2	4
Total	10	28
Open Course	1	3
Grand Total	41	120

3.2. Extra-Credit Courses:

The list of extra-credit courses and their corresponding credits are given below:

Course	No. of Credits
Service-Learning (*Mandatory*)	1
Courses offered by talent clubs	1

3.3. *Semester-wise Distribution of Credits and Instructional Hours*:

	Sem I		Sem II		Sem III		Sem IV		Sem V		Sem VI	
	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week
Common Course I (*English*)	7	9	7	9	4	5	4	5	-	-	-	-
Common Course II (*Second Language*)	4	4	4	4	4	5	4	5	-	-	-	-
Core Course - *Theory*	2	2	2	2	3	3	3	3	13	13	12	14
Core Course - *Practical*	-	2	2	2	-	2	2	2	-	8	8	8
Complementary Course – I Chemistry- *Theory*	2	2	2	2	3	3	3	3	-	-	-	-
Complementary Course – I *Chemistry - Practical*	-	2	2	2	-	2	2	2	-	-	-	-
Complementary Course – II *Maths - Theory*	3	4	3	4	4	5	4	5	-	-	-	-
Project	-	-	-	-	-	-	-	-	-	-	1	-
Open Course	-	-	-	-	-	-	-	-	3	4	-	-
Choice Based Core Course	-	-	-	-	-	-	-	-	-	-	3	3
Total	18	25	22	25	18	25	22	25	16	25	24	25

SEMESTER	No. of Credits	No. of Instructional Hours
I	18	25
II	22	25
III	18	25
IV	22	25
V	15	25
VI	25	25
Total	120	150

3.4 MARK DISTRIBUTION FOR PROJECT AND INDUSTRIAL VISIT (23U6PJPHY1)

All students have to do a project in the area of core course. This project can be done individually or in groups (not more than three students). The projects are to be identified and its work must be started during the V semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the University. External Project evaluation and Viva / Presentation are compulsory for all subjects and will be conducted at the end of the programme.

An industrial visit is also included in the program. The entire students must visit an industry during 5 th or 6th semester and submit a report in duplicate along with the project report. This industrial visit and the report will be evaluated internally and externally along with the project evaluation.

a) Marks of External Examination : 75

Components of Evaluation (External)	Marks
Dissertation - Project (External)	45
Viva-Voce– Project(External)	25
Industrial Visit Report	3
Viva-Voce – Industrial Visit	2
Total	75

b) Marks of internal evaluation: 25 (All the five components of the internal assessments are mandatory)

Components of Internal Evaluation	Marks
Punctuality	5
Experimentation/Data Collection	5
Knowledge	5
Report	5
Industrial Visit	5
Total	25

(a) Marks of Practical exam – (only in even semesters) – 30

(b) Marks of Practical Internal evaluation – 10 (odd and even semesters combined annually)

Components of Practical internal Evaluation	Marks
Attendance	3
Record	4
Lab involvement	3
Total	10

Division of internal marks for record (5 marks maximum)

No. of Experiments	Marks
14 and above	4
12&13	3
10&11	2
8&9	1
Less than 8	0

Attendance Evaluation

For all Practical lab sessions

% of attendance	Marks
90 and above	3
80 – 89	2
75-79	1

(Decimals are to be rounded to the next higher whole number)

4. CONSOLIDATED SCHEME FOR I TO VI SEMESTERS

4.1. B. Sc. Physics Programme – (Physics Alone)

Semester	Title of the course	Hrs/week	Credits	Total Hrs	End Exam Duration	Internal Marks	External Marks
1	Methodology and Perspectives of Physics	2	2	36	3	20	60
	Core Practical I – Mechanics and Properties of Matter	2	-	36	-	-	-
2	Mechanics and Properties of Matter	2	2	36	3	20	60
	Core Practical 1- Mechanics and Properties of Matter	2	2	36	3	10	30
3	Optics, Laser and Fiber Optics	3	3	54	3	20	60
	Core Practical II - Optics and Semiconductor Physics	2	-	36	-	-	-
4	Semiconductor Physics	3	3	54	3	20	60
	Core Practical II - Optics and Semiconductor Physics	2	2	36	3	10	30

5	Electricity and Electrodynamics	3	3	54	3	20	60
	Classical and Quantum Mechanics	3	3	54	3	20	60
	Digital Electronics and Programming	3	3	54	3	20	60
	Energy and Environmental Physics	4	4	72	3	25	75
	Open Course- Physics in Daily Life	4	3	72	3	25	75
	Core Practical III – Electricity, Magnetism and Laser	2	-	36	-		
	Core Practical IV – Digital Electronics	2	-	36	-		
	Core Practical V – Thermal Physics, Spectroscopy and C^{++} Programming	2	-	36	-		
	Core Practical VI – Acoustics, Photonics and Advanced Semiconductor Physics	2	-	36	-		
6	Thermal and Statistical Physics	3	3	54	3	20	60
	Relativity and Spectroscopy	4	3	72	3	20	60
	Nuclear, Particle and Astrophysics	3	3	54	3	20	60
	Solid State Physics	4	3	72	3	20	60
	Choice based Course – Computational Physics OR Materials Science	3	3	54	3	25	75
	Core Practical III – Electricity, Magnetism and Laser	2	2	36	3	10	30
	Core Practical IV – Digital Electronics	2	2	36	3	10	30
	Core Practical V – Thermal Physics, Spectroscopy and C^{++} Programming	2	2	36	3	10	30
	Core Practical VI – Acoustics, Photonics and Advanced Semiconductor Physics	2	2	36	3	10	30
	Project and Industrial Visit	-	1	-	-	25	75

4.2 <u>Complementary Physics for B.Sc Mathematics</u>

Semester	Title of the course	Hrs/week	Credits	Total Hrs	Internal Marks	External Marks
1	Properties of Matter and Error Analysis	2	2	36	20	60
	Complementary Physics Practical I	2	-	36	-	-
2	Mechanics and Astrophysics	2	2	36	20	60
	Complementary Physics Practical I	2	2	36	10	30
3	Modern Physics and Electronics	3	3	54	20	60
	Complementary Physics Practical II	2	-	36	-	-
4	Optics and Electricity	3	3	54	20	60
	Complementary Physics Practical II	2	2	36	10	30

4.3 Complementary Physics for Chemistry

Semester	Title of the course	Hrs/week	Credits	Total Hrs	Internal Marks	External Marks
1	Properties of Matter and Thermodynamics	2	2	36	20	60
	Complementary Physics Practical I	2	-	36	-	-
2	Mechanics and Superconductivity	2	2	36	20	60
	Complementary Physics Practical I	2	2	36	10	30
3	Modern Physics and Magnetism	3	3	54	20	60
	Complementary Physics Practical II	2	-	36	-	-
4	Optics and Soli d State Physics	3	3	54	20	60
	Complementary Physics Practical II	2	2	36	10	30

5. SYLLABUS CORE PHYSICS

B.Sc. Physics Programme

Semester-I

Core Course: I **Credit – 2 (36 hours)**

23U1CRPHY01: METHODOLOGY AND PERSPECTIVES OF PHYSICS

Course Outcomes

CO 1: Understand and appreciate the structured development of Physics from the period of Galileo and Newton by analyzing the scientific contributions by great scientists.

CO 2: Understand the basics of digital electronics and mathematical tools like vector differentiation, integration, coordinates systems etc.

CO 3: Understand the basics of experimental methods and errors so as to make the student aware of the possible errors that might creep in while carrying out experiments and explore the methods that may be taken to eliminate or minimize the same.

Module I

Concepts and Development Physics: (8 hours)

Development of physics in the last century and the birth of new scientific concepts with reference to scientific contributions of Galileo, Newton, Einstein, J J Thomson, Curies, Rayleigh, Max Plank, Heisenberg and Schrodinger (qualitative understanding). Contributions of Indian physicists -C V Raman, H J Babha, J C Bose, S N Bose, M Saha, S Chandrasekhar, Vikram Sarabhai, (Topics in this part require qualitative study only)

1. Feynman lectures of Physics
2. Concepts of Modern Physics: ArtherBeisser,
3. Modern Physics: Kenneth Krane
4. Modern Physics: R Murugeshan
5. https://www.nobelprize.org/nobel_prizes/physics/laureates/

Module II **(18 hours)**

Number systems- Decimal, hexadecimal and Binary, Conversions, Binary arithmetic addition, subtraction and multiplication. 1's and 2's complement subtraction –signed binary numbers. Signed binary arithmetic, BCD code, ASCII code, Significance of binary number system in digital electronics, microprocessors and in computers.
Introductory Vector Analysis - Applications of vectors in Physics. Differential and integral vector calculus: – The operator - physical significance of Gradient, Divergence and Curl, Line integral, surface integral and volume integral of vectors

Co-ordinate systems: Cartesian Co-ordinate system, plane polar and spherical polar coordinates, cylindrical coordinates (Basic ideas with examples in physics).

References:

1. Introduction to Electrodynamics, David J. Griffiths, Prentice Hall India Pvt. Ltd., Chapter 1
2. Mathematical Physics: Charlie Harper
3. University Physics, Roger A Freedman, Hugh D Young 14th edition
4. Digital electronics: Albert Paul Malvino
5. Digital logic and computer design – M. Morris Mano, PHI.

Module III

Experimental methods and error analysis **(10 hrs)**

Experimental methods, least count of instruments, Instruments for measuring mass, length, time, angle , current, voltage. Fundamental units. Precision and accuracy of measurements, source of error in measurements, necessity of estimating errors , types of errors, reading error of instrument, calibration error, random error, systematic error, significant digits, order of magnitude and rounding of numbers, rounding error, absolute and relative errors, Errors of computation - addition, subtraction, multiplication, division, error in power and roots, Propagation of errors, analysis of data, standard deviation, calculation of mean value.

References:

1. Text book: Advanced course in Practical Physics by D Chattopadhyay- Chapter-1
2. Practical Physics, G L Squires, Third edn. Cambridge University Press.
3. The theory of Errors in Physical Measurements- J C Pal- New Central Book Agency- 2010

Semester-II

Core Course: II **Credit – 2 (36 hours)**

23U2CRPHY02: MECHANICS AND PROPERTIES OF MATTER

CO 1: Understand and revise the basic concepts in waves and oscillatory motions so as to equip them to use the knowledge in other papers like wave-mechanics, acoustics etc and experimentation.

CO 2: Understand the basics of Rotational Dynamics and principles moment of inertia.

CO 3: Understand the basics of elasticity and hydrodynamics.

Module I

Wave motion **(4 hours)**

General equation of wave motion, plane progressive harmonic wave, energy density, intensity of a wave, superposition of waves, beats, transverse waves in stretched strings, modes.

Text Book: Mechanics by D.S. Mathur – Chapter 9.

Oscillations **(8 hours)**

Periodic motion, simple harmonic motion and harmonic oscillator, energy of a harmonic oscillator, examples of harmonic oscillator – simple and compound pendulum.Theory of Damped harmonic oscillator.Theory of forced oscillator, resonance, applications.

Text Book: Mechanics by D.S. Mathur – Chapter 7, 8.

Module II

Rotational Dynamics **(7 hours)**

Angular velocity- angular acceleration- angular momentum- conservation- torque-moment of inertia- Parallel and perpendicular axes theorems - calculation of moment of inertia- (rod, ring, disc, cylinder, and sphere). Theory of flywheel.

Text Book: Mechanics by D.S. Mathur – Chapter 10.

Module III

Elasticity **(10 hours)**

Basic ideas on elasticity – Young's modulus, bulk modulus, rigidity modulus, Poisson's ratio, relations connecting various elastic constants. Work done per unit volume in a strain. Bending of beams, bending moment, flexural rigidity.Young's modulus – uniform and non-uniform bending, cantilever.I –section girders.Determination of rigidity modulus using Static and Dynamic methods.

Text Book: Mechanics by D.S. Mathur – Chapter 12, 13.

Module IV

Hydrodynamics **(7 hours)**

Streamline and turbulent flows, coefficient of Viscosity – Determination of viscosity by Poiseuille's method.Equation of continuity, energy possessed by a liquid, Bernoulli's theorem. Surface tension, surface energy, excess pressure in a liquid drop and bubble, factors affecting surface tension, applications.

Text Book: Mechanics by D.S. Mathur – Chapter 14.

Text books:

1. Mechanics by J.C. Upadhayaya, Ramprasad Pub.

2. Mechanics -D.S.Mathur, S.Chand.
3. Advanced course in Practical Physics by D Chattopadhyay, Central Book
4. Properties of Matter and Acoustics by Murugeshan and K. Sivaprasath, S. Chand

References:

1. Mechanics- Hans and Puri, TMH
2. Classical Mechanics by J.C. Upadhyaya, Himalaya Pub.
3. Classical Mechanics-Takwale and Puranik, TMH.
4. Classical mechanics- K.SankaraRao, PHI.
5. Properties of Matter by Mathur, S. Chand,
6. Mechanics by SomnathDatta, Pearson
7. Mechanics by H.D Young and R.A Freedman, Pearson.

Semester-III

Core Course: III **Credit – 3 (54 hours)**

23U3CRPHY03: OPTICS, LASER AND FIBER OPTICS

CO1: Understand the basic concepts of interference, thin films, Haidinger fringes, Michelson interferometer
CO2: Understand the basic concepts of diffraction and polarisation
CO3: Understand the principle behind lasers, different types of lasers and its applications, and basic concepts of optic fibres and applications of fibres.

Module I

Interference **(13 hours)**

Review of basic ideas of interference, Coherent waves -Optical path and phase change-superposition of waves-theory of interference-intensity distribution. Young's double slit experiment, Coherence-Conditions for interference.

Thin films-plane parallel film- interference due to reflected light-conditions for brightness and darkness-interference due to transmitted light-Haidinger fringes-interference in wedge shaped film-colours in thin films-Newton's rings-applications. Michelson interferometer-construction, working and just mention the applications.

Text book: Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu-Chapter 14 and 15.

Module II

Diffraction **(10 hours)**

Fresnel Diffraction – Huygens- Fresnel theory –zone plate –Difference between zone plate and convex lens. Comparison between interference and diffraction –diffraction pattern due to a straight edge, single silt. Fraunhoffer diffraction at a single slit, double slit,N slits, theory of plane transmission grating. Dispersive power and resolving power of grating.

Text book: Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu-Chapter 17, 18 and 19.

Polarization **(12hours)**

Concept of polarization – plane of polarization- Types of polarized light-production of plane polarized light by reflection -refraction. Malu's law-Polarization by double refraction-calcite crystal.Anisotropic crystals-optic axis-Double refraction-Huygens explanation of double refraction. Retarders - Quarter wave plate and Half wave plate. Production and Detection of plane, elliptically and circularly polarized light-Optical Activity- specific rotation.

Text book:Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu-Chapter 20

Module III

Laser **(10 hours)**

Absorption and emission of light-Absorption-spontaneous emission and stimulated emission, Einstein relations, Population inversion- Active medium-Pumping, different pumping methods, Resonators – plane mirror and confocal resonators – Metastable state, Three level and Four level Laser systems. Ruby Laser, He-Ne laser, Semiconductor Laser, Laser beam Characteristics, coherence.Applications of Laser, Holography (qualitative study only).

Text book: Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu-Chapter 22 and 23.

Fibre Optics: **(9 hours)**

Propagation of light in a fiber -acceptance angle, numerical aperture, V-number, single mode and multimode step index fiber –graded index fiber- attenuation- application of fiber-optical fiber communication – advantages.

Text book: Semiconductor physics and optoelectronics- V.Rajendran, J.Hemaletha and M.S.M.Gibson, Unit IV-Chapter 1.

References:

1. Optics, E Hecht and AR Ganesan, Pearson
2. Optics, 3rd edition, AjoyGhatak, TMH
3. Optical Electronics, AjoyGhatak and K Thyagarajan, Cambridge
4. Optics and Atomic Physics, D P Khandelwal, Himalaya Pub. House
5. Optics, S K Srivastava, CBS Pub. N Delhi
6. A Text book of Optics, S L Kakani, K L Bhandari, S Chand.
7. Optics N.Subramanayam, Brijlal, M.N Avadhanulu S Chand.
8. Semiconductor optoelectronic devices: Pallab Bhattacharya, PHI 2009.
9. Lasers and Non linear Optics, BB Laud, New Age Int Pub. 2013
10. Laser Fundamentals, William T Silfvast, Cambridge Univ Press. 2012.
11. Optoelectronics an Introduction, J Wilson & JFB Hawkes, PHI 1999.
12. Fiber Optics and Optoelectronics, R P Khare, Oxford 2012..
13. Introduction to Optics, Frank L Pedrotti, Leno M Pedrotti& Leno S Pefrotti, Pearson 2014.
14. Optical fiber and fiber optic communication system (4th edition) Subir Kumar Sarkar, S. Chand.

Semester-IV **Credit – 3**
Core Course: IV **(54 hours)**
23U4CRPHY04: SEMICONDUCTOR PHYSICS

CO1: Understand the basic concepts of semiconductors and its applications and analyse the
CO2: Understand the basic concepts of transistors, amplifiers and oscillators
CO3: Understand the basic concepts of FET, Operational Amplifier & Modulation

Module I

Semiconducting diodes and applications **(14 hours)**

PN Junction, Depletion layer, Barrier potential, Biasing- forward and reverse, Reverse breakdown, Junction capacitance and diffusion capacitance- PN Junction diode – V-I characteristics–Diode parameters, Diode current Equation, Diode testing, Ideal diode. Zener diode and its reverse characteristics.Thermistors.

Rectification - Half wave, Full wave, Centre tapped, Bridge rectifier circuits - Nature of rectified output, Efficiency & Ripple factor-Filter circuits – Inductor Filter, Capacitor Filter, LC Filter, π Filter-Regulated Power supplies - Zener diode voltage regulator- Voltage multipliers – Doubler & Tripler- Wave Shaping circuits - Clipper-Positive, negative and biased – Clampers- Positive, negative and biased.

Text Book: Basic Electronics- B.L.Theraja Chapters 13,14,15,17

A Text Book of Applied Electronics- R.S.Sedha Chapters-11, 12, 19, 20, 33

Module II

Transistors Configurations and Feed back **(12 hours)**

Bipolar junction transistors, Transistor biasing, CB, CC, CE configurations and their characteristics- Active, saturation and cut-off regions. Current gain α, β, γ and their relationships. Leakage currents- Thermal runaway. DC operating point and AC and DC Load line, Q-Point.

Basic principles of feedback, positive & negative feedback, Advantages of negative feedback, negative feedback circuits – voltage series & shunt, current series & shunt.

Amplifiers and Oscillators (12 hours)

Need for biasing-Stabilization- Voltage divider bias. Single stage transistor Amplifiers-CE amplifier - amplification factors. Decibel system, Variations in Amplifier gain with frequency.

Oscillatory Circuits, LC oscillators – Hartley Oscillator, Colpit's Oscillator, RC oscillators - Phase shift Oscillator. Astable and monostablemultivibrator (basic idea only)

Text Book: Basic Electronics-B.L.Theraja-Chapters 18, 19, 20, 22, 24, 25, 28, 29.

A Text Book of Applied Electronics-R.S.Sedha Chapters 14, 15, 22,24, 29, 31, 32 Module III

FET, Operational Amplifier & Modulation (16 hours)

FET -characteristics, FET- Parameters. Comparison between FET and BJT. MOSFET (basic idea only)

OP-amp- Symbol and terminals.Characteristics of ideal OP-amp, CMRR, Applications - inverting, Non-inverting, Unity follower and Summing amplifiers.

Types of modulation – AM, FM, Pulse modulation and Phase modulation (qualitative study only). Amplitude modulation- modulation index - Analysis of AM wave – Sidebands –bandwidth- AM Demodulation.

Text Book: 1.Basic Electronics-B. L. Theraja - Chapters 26, 30, 31

2. A Text Book of Applied Electronics-R.S.Sedha-Chapter-16, 35

References:

1. Principles of electronics, VK Mehta, S Chand
2. Basic Electronics(7thEdition), Malvino and Bates, TMH
3. Electronics Fundamentals and Applications- D. Chattopadhyay and P.G.Rakshit, New Age International Publishers.
4. Electronics: Fundamentals of Analog circuits, Thomas L. Floyd, David Buchla, Prentice Hall
5. Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky, Prentice Hall
6. Basic Electronics, Debashis De , Pearson 2010
7. Basic Electronics, SantiramKal, PHI 2010

Semester-V

Core Course: V **Credit – 3 (54 hours)**

23U5CRPHY05: ELECTRICITY AND ELECTRODYNAMICS

Course Outcomes

CO 1: Understand basics of alternating currents and network theorems.
CO 2: Develop elementary ideas of transient currents and thermo electricity.
CO 3: Develop fundamental ideas of electrostatics and magnetostatics.

Module I

Alternating Current and Network Theorems (15 hours)

EMF induced in a coil rotating in a magnetic field - AC applied to resistive, inductive and capacitance circuits - AC applied to LR and RC circuits - Analysis of LCR series circuits - LCR parallel resonant circuit – comparison - Power in ac circuits - Wattless current - choke coil - transformer on no load- skin effect.

Ideal voltage source and current source - Superposition theorem - Reciprocity theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem.

Text Book:Electricity and Magnetism, R. Murugeshan- Chapters 13, 30 and 18

Module II

Transient Current and Thermo electricity (8 hours)

Growth and decay of current in an LR circuit- Charging and discharging of a capacitor through a resistor - Growth and decay of charge in an LCR circuit.

Seebeck effect - Laws of thermo emf - Peltier effect- Thomson effect- Thermoelectric diagrams - Thermocouple (qualitative study) - Explanation of thermoelectric effects based on electron theory.

Text Book: Electricity and Magnetism, R. Murugeshan- Chapters 12, 8 and 32.

Module III

Electrostatics and Magnetostatics (20 hours)

Fundamental theorems of divergence and curl (physical concepts) - Electric field - Continuous charge distribution- Divergence and curl of electrostatic field- Gauss's law and applications: solid sphere, infinite wire, infinite plane sheet - Electric potential - Poisson's and Laplace's equations - Potential of a localized charge distribution – Electrostatic boundary conditions- work and energy in electrostatics – The work done to move a charge – Energy of a point charge distribution and continuous charge distribution-Basic properties a conductor .

Lorentz Force law- Biot- Savart law- Divergence and curl of B- Applications of Amperes' law: long straight wire, infinite plane, solenoid – Comparison of electrostatics and magnetostatics- Magnetic vector potential – Magnetostatics boundary conditions

Electromagnetic induction- Faraday's law

Text Book:Introduction to Electrodynamics, David J Griffiths, Chapters 1, 2, 5 and 7

Module IV

Maxwell's Equations and Electromagnetic wave propagation (11 hours)

Maxwell's equations - Boundary conditions for free space - Continuity equations-Poynting's theorem

Wave equations (general idea on reflection at boundary and polarization) - Electromagnetic wave in vacuum - Wave equation for E and B - Monochromatic plane waves- Energy of electromagnetic waves

Text Book: Introduction to Electrodynamics, David J Griffiths-Chapters 7,8 and 9

References:

1. Fundamentals of Magnetism and Electricity, D.N Vasudeva - S Chand
2. Principles of Electromagnetics, Mathew N.O Sadiku- 4th Ed. , Oxford
3. Electricity and Magnetism, KK Tewari- S Chand
4. Electricity and Electronics, Saxena, Arora and Prakash- PragatiPrakashan
5. Classical Electromagnetism, Jerrold Franklin- Pearson
6. Electromagnetic Fields and Waves, KD Prasad- SatyaPrakashan
7. Field and wave Electromagnetics, David K Cheng- Pearson.

Semester-V

Core Course: VI **Credit – 3 (54 hours)**

23U5CRPHY06: CLASSICAL AND QUANTUM MECHANICS

Course Outcomes:
CO 1 - Understand basic formulations of Classical Mechanics.
CO 2 - Understand about the basics in the formulation of a new branch of Physics - namely Quantum Mechanics.
CO 3 - Analysis of basic principles of Quantum Mechanics.

Module I

Lagrangian and Hamiltonian Formulations of Classical Mechanics (15 hours)

Constraints, degrees of freedom, generalized co-ordinates, principle of virtual work, D'Alembert's principle, Lagrange's equations(no derivation required), Application of Lagrangian (Linear Harmonic oscillator, Planetary motion and Simple Pendulum only), Hamilton's Canonical equations of motion, Advantages of Hamilton's method, Applications of Hamilton's method (Linear Harmonic oscillator and Simple pendulum only).Hamilton's Principle of Least Action. Derivation of Lagrange's equation from Hamilton's Principle.

Text book: Classical Mechanics by J.C. Upadhyaya-Chapter 2 & 3.

Classical Mechanics by G. Aruldhas

Module II

Historical development and origin of quantum theory (9 hours)

Failure of classical physics- Black Body radiation-Planck's radiation law, Photoelectric effect-Einstein's explanation, Compton effect, Bohr's correspondence principle-Wave particle Dualism, Dual nature of matter- De Broglie hypothesis, Davisson-Germer Experiment, De Broglie waves, Wave packet, Group and phase velocities

Text Book: A Textbook of Quantum Mechanics- G Aruldhas-Chapter 1

General Formalism of Quantum Mechanics (15 hours)

Linear vector space- Hilbert space - Orthogonality- Linear operator-Eigen functions and eigen values- Hermitian operator- Postulates of Quantum Mechanics- wave function, Operators, Expectation value, Eigen value, Time development- Simultaneous measurability- General uncertainty relation.

Text Book: A Textbook of Quantum Mechanics- G Aruldhas-Chapter 3 and 8

Module III

Schrödinger equation and its applications (15 hours)

Time dependent Schrödinger equation- interpretation of wave function, Probability density, Probability current density, Ehrenfest theorem- Extension to three dimensions-Time independent Schrödinger equation- Stationary states- Admissibility conditions of wave function-general properties of one dimensional Schrödinger equation, particle in a box, one dimensional barrier problem- square potential barrier.

Text Book: A Textbook of Quantum Mechanics- G Aruldhas.

Text Book:

1. Classical Mechanics by J.C. Upadhyaya. Himalaya Pub.
2. Concepts of Modern Physics- Arthur Beiser, TMH

References:

1. Concepts of Modern Physics- Arthur Beiser, TMH
2. A Textbook of Quantum Mechanics- G Aruldhas- (2nd Edition)- PHI
3. Classical Mechanics-Takwale and Puranik, TMH.
4. Classical mechanics- K.SankaraRao, PHI.
5. Introductory Quantum Mechanics- RI Liboff, Pearson
6. Quantum Physics- Gasiorowicz,JohnWiely
7. Quantum Mechanics- Griffith, Pearson

Semester-V

Core Course: VII

23U5CRPHY07: DIGITAL ELECTRONICS AND PROGRAMMING Credit – 3 (54 hours)

CO1: Analyzing Basic gates and to simplify circuits and Boolean expressions using the Boolean laws
CO2: Explain the logic behind the operation of registers and counters and to design basic combinational and sequential logic circuits
CO3: Outline the basic concepts of Object Oriented Programming (OOP) and to design OOPs concepts through C++ programs for solving simple problems

Module I (9 Hrs)

Boolean algebra and logic gates (9 hours)

Basic gates NOT, OR, AND. Universal Logic Gates- NOR, NAND. XOR and XNOR Gates. Rules and Laws of Boolean algebra. Duality theorem -De Morgan's Theorems. analysis and simplification of logic circuits. Boolean equation and truth table - SOP and POS. Minterms and Maxterms. Standard SOP and Standard POS- Conversion between Standard SOP & Standard POS. Karnaugh Map (up to four variables). K map SOP minimization.

Module II (18 Hrs)

Combinational logic (6 hours)

Half Adder and Full Adder, Half and Full subtractor, 4-bit parallel Adder/Subtractor. Multiplexer, De-multiplexer, Encoder & Decoder.

Sequential logic (13 hours)

Flip-flops, RS, Clocked RS, Master Slave JK FF, DFF, T Flip-flop, Buffer registers- Shift register-SISO and SIPO, Counters- Binary ripple counter. D/A converters (Ladder type), A/D Converter (Counter type).

Module III (26 Hrs)

Programming in C++ (26 hours)

Basic C++ program structure –comments-data types-variable types-constants-operators(arithmetic, relational, logical and assignment operators)- if, if-else and else if, do while - case – loops(while, do-while, and for)-nested loops- arrays(Defining Arrays, Accessing Array

Elements, Initializing Arrays)- basic ideas of functions(qualitative idea), object and classes. Programs using loops.

Text book: Object oriented programming in Turbo C++ - Robert Lafore (Galgotia Pub.) Chapter 2, 3 and 7.

Text books:

1. Digital fundamentals, Thomas L. Floyd (10th edition), Pearson
2. Digital principles and applications, Malvino, Leach and Saha (6th Edition) TMH
3. Digital electronics, S Salivahanan& S Arivazhagan VPH (2010)
4. Digital design, M Morris Mano, PHI

1. Digital logic and computer design - M Morris Mano, PHI
2. Digital Electronics- William H Gothmann, PHI
3. Digital circuits and design- S Salivahanan and S Arivazhakan, PHI
4. Digital Electronics- Sedha, S Chand
5. Digital computer electronics- Malvino, Brown, TMH
6. Object oriented programming in Turbo C++ - Robert Lafore (Galgotia Pub.)

Semester-V

Core Course: VIII **Credit-4 (72 hours)**

23U5CRPHY08:

ENERGY AND ENVIRONMENTAL PHYSICS AND HUMAN RIGHTS

VISION

The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, solid waste disposal, degradation of environment, issues like economic productivity and national security, Global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and World Summit on Sustainable Development at Johannesburg in 2002 have drawn the attention of people around the globe to the deteriorating condition of our environment. It is clear that no citizen of the earth can afford to be ignorant of environment issues.

India is rich in biodiversity which provides various resources for people. Only about 1.7 million living organisms have been described and named globally. Still many more remain to be identified and described. Attempts are made to conserve them in ex-situ and in-situ situations. Intellectual property rights (IPRs) have become important in a biodiversity-rich country like India to protect microbes, plants and animals that have useful genetic properties. Destruction of habitats, over-use of energy resource and environmental pollution has been found to be responsible for the loss of a large number of life-forms. It is feared that a large proportion of life on earth may get wiped out in the near future.

In spite of the deteriorating status of the environment, study of environment has so far not received adequate attention in our academic programme. Recognizing this, the Hon'ble Supreme Court directed the UGC to introduce a basic course on environment at every level in college education. Accordingly, the matter was considered by UGC and it was decided that a six months compulsory core module course in environmental studies may be prepared and compulsorily implemented in all the University/Colleges of India.

The syllabus of environmental studies includes five modules including human rights. The first two modules are purely environmental studies according to the UGC directions. The second two modules are strictly related with the core subject and fifth module is for human rights.

Objectives

Environmental Education encourages students to research, investigate how and why things happen, and make their own decisions about complex environmental issues by developing and enhancing critical and creative thinking skills. It helps to foster a new generation of informed consumers, workers, as well as policy or decision makers.

Environmental Education helps students to understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future. It encourages character building and develops positive attitudes and values.
To develop the sense of awareness among the students about the environment and its various problems and to help the students in realizing the inter-relationship between man and environment and helps to protect the nature and natural resources.

To help the students in acquiring the basic knowledge about environment and the social norms that provides unity with environmental characteristics and create positive attitude about the environment.

Course Outcomes:

CO1 -Analyse the need for environment protection and understand the significance of sustainable development.
CO2 -Understand the significance of natural resources and ill-effects of its over exploitation.
CO3-Understand the role of an individual in prevention of pollution and disaster management.
CO4- Understand the environmental Issues, environmental laws, acts and possible solutions.

CO5- Understand solar energy based devices, analyse the environmental impact and assess home power consumption.

Module I

Unit 1: Multidisciplinary nature of environmental studies (2 hours)

Definition, scope and importance, Sustainable development

Need for public awareness.

Unit 2: Natural Resources: (10 hours)

Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies.

Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water,

floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and

using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy

sources, use of alternate energy sources, Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosionand desertification Role of individual in conservation of natural resources. Equitable use of resources for sustainable life styles.

Unit 3: Ecosystems (6 hours)

Concept of an ecosystem

Structure and function of an ecosystem

Producers, consumers and decomposers

Energy flow in the ecosystem

Ecological succession

Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the given

ecosystem:- Forest ecosystem

Module II

Unit 1: Biodiversity and its conservation (8 hours)

Introduction

Biogeograhical classification of India

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

India as a mega-diversity nation

Importance of biodiversity-hotspots

in India

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts

Endangered and endemic species of India and its protection

Unit 2: Environmental Pollution (8 hours)

Definition, Causes, effects and control measures of: -

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution

Pollution case studies

Disaster management: floods, earthquake, cyclone and landslides.

Unit 3: Social Issues and the Environment (10 hours)

Urban problems related to energy

Water conservation, rain water harvesting, watershed management

Resettlement and rehabilitation of people: its problems and concerns, Case studies

Environmental ethics: Issues and possible solutions

Climate change, global warming, acid rain, ozone layer depletion , nuclear accidents and holocaust, Case studies

Consumerism and waste products

Environment Protection Act

Air (Prevention and Control of Pollution) Act

Water (Prevention and control of Pollution) Act

Wildlife Protection Act

Forest Conservation Act

Issues involved in enforcement of environmental legislation

Public awareness

Module III

Non-renewable and Renewable Energy Sources (10 hours)

Non-renewable energy sources:-Coal, Oil, Natural gas; Nuclear fission energy; Merits and demerits of non-renewable energy.

Renewable energy sources: Biomass energy- Biogas plant - Fixed dome type and moving dome type; Wind energy; Wave energy; Tidal energy; Hydroelectricity; Geothermal energy conversion; Ocean thermal energy conversion; Fusion energy; Hydrogen energy- Production (electrolysis) and storage; Merits and demerits of each renewable energy sources; Storage of intermittently generated renewable energy (qualitative); Fuel cell.

Module IV

Solar energy (10 hours)

Sun as a source of energy- Solar radiation, Solar Constant, Spectral distribution; Solar pond - Convective and salt gradient types; Flat plate collector; Solar water heater - Direct and indirect systems- Passive and active systems; Optical concentrator - Parabolic trough reflector - Mirror strip reflector - Fresnel lens collector; Solar desalination; Solar dryer - Direct and indirect type; Solar cooker; Solar heating of buildings; Solar green houses; Need and characteristics of photovoltaic (PV) systems; Solar cells - Principle, Equivalent circuits, V-I characteristics, fill factor, conversion efficiency; PV Sun tracking systems; Merits and demerits of solar energy.

Module – V

Environmental Impact Assessment and Home Energy Audit (8 hours)

Basic Ideas of environmental impact assessment – environmental laws and constitutional provisions to control pollution in India: Air Act, Water Act & Environmental Protection Acts. Introduction to energy audit (basic ideas only): power in electrical circuits, consumption by home appliances and assessment of home power consumption.

REFERENCES

1. BharuchaErach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB)
2. Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)
3. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001 Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p .(Ref)
4. Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)
5. Down to Earth, Centre for Science and Environment (Ref)
6. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)
7. Jadhav.H&Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)
8. Mekinney, M.L &Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)
9. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)
11. Rao.M.N&Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)
12. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
13. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)
14. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)
15. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)
16. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)

17. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

(Ref) (M) Magazine (R) Reference (TB) Textbook

18. Renewable Energy Sources and Emerging Technologies: Edition 2, D.P. Kothari K. C. SingalRakeshRanjan - PHI Learning Pvt. Ltd, 2011.
19. Solar energy - M P Agarwal - S Chand and Co. Ltd.
20. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
21. Environmental Science: Principles and Practices by R C Das and D K Behera
22. Principles of Physics, 10th edition, 2017 byJearl Walker, David Halliday and Robert Resnick-Wiley.
23. Sears and Zemansky's University Physics with modern physics, 14th edition, 2018 byHugh D Young and Roger A Freedman- Pearson.

Semester-V

Open Course: **Credits-3 (72 Hrs)**

23U5OCPHY01: Physics in Daily Life

CO 1: Understand and appreciate beauty in Physics as a science of nature and science of physical quantities.

CO 2: Understand basics of mechanics and electricity.

CO 3: Understand and appreciate various branches of Physics like optics, hydrostatics, heat, space physics and their implications in day to day life.

Module I

Unit 1 **(8 hours)**

Estimation by order of magnitudes.Need of unit for measurement (qualitative discussion) Fundamental and derived quantities and their units and basic definitions. Common Units of length, mass and time. Subunits and multipliers.CGS, FPS, MKS and SI System of units.Guidelines for writing the units. Basics of dimensional analysis and its uses, order of magnitude, significant figures, errors.

Reference: 1. Young and Freedman, University Physics with Modern Physics, Pearson Education

Unit 2 Light **(12 Hours)**

Scattering of light. Rayleigh scattering, Blue color of sky and whiteness of cloud, Color of sky and sunrise and sunset, Reflection of light, Plane mirror and curved mirrors. Laws of reflection, Ray diagrams for locating images for objects in different positions in front of curved mirrors. Refraction, Snell's law, Absolute and relative refractive indices, Path of light through glass slab and lateral displacement. Path of light through prism and i-d curve.Equation for

refractive index of prism (derivation included).Dispersion and spectrum. Examples from daily life – apparent depth, twinkling of stars. Total internal reflection, mirage, sparkling of diamond, primary and secondary rainbow – optical fibers (qualitative). Concave and Convex lenses – focal length, power of a lens. Human eye, defects of the eye – myopia, hypermetropia, presbyopia and astigmatism and their correction by lens. Diffraction, Interference basic ideas only.

Reference: i) N. Subrahmanyam and Brijlal, A text book of optics, S. Chand Publishers

2. Young and Freedman, University Physics with Modern Physics, Pearson Education

Module II

Unit 3 Motion (12 Hours)

Mechanics and branches. Velocity, acceleration, Equations of motion.Graphical treatment.momentum, Idea of inertia, force - laws of motion. Impulse and impulsive force.law of conservation of linear momentum. Kinetic and Potential energies.

Newton's law of gravitation, acceleration due to gravity, mass and weight, apparent weight, weightlessness.

Rotational motion, centre of mass and radius of gyration.Comparison between linear and rotational dynamics.Equations for rotational dynamics. Rotational kinetic energy and Moment of inertia, Angular momentum and torque, Law of conservation of angular momentum and examples.

Reference: 1. Young and Freedman, University Physics with Modern Physics, Pearson Education

Unit 4 Electricity 10 Hours)

Voltage and current, ohms law. Electric energy, electric power, calculation of energy requirement of electric appliances – transformer, generator, hydroelectric power generation – wind power – solar power – nuclear power

Module III

Unit 5 Matter and energy (18 Hours)

Different phases of matter, fluids - surface tension, viscosity- capillary rise, Bernoulli's theorem and applications.

Heat energy, temperature, different temperature scales – degree Celsius, Fahrenheit and Kelvin.

Waves – transverse and longitudinal waves, sound waves, Doppler Effect.

Lasers, fluorescence, phosphorescence, electromagnetic waves – applications microwave oven, radar, super conductivity.

Unit 6 Universe (12 hours)

Planets-Solar System-Sun and its basic properties- Terrestrial and Jovian Planets- Asteroids , Comets and Meteoroids- Moon-Chandrayaan Mission-phases of moon-Lunar and Solar Eclipses-Constellations-Different types of Stars-Galaxies-Black hole-Satellites-Artificial Satellites-Global Positioning System-Geostationary Satellite

Reference Texts

1. Fundamentals of Physics with Applications by Arthur Beiser
2. Conceptual Physics by Paul G Hewitt

Semester-VI

Core Course: IX

23U6CRPHY09: THERMAL AND STATISTICAL PHYSICS **Credit-3 (54 hours)**

CO 1: Understand thermodynamic systems with special reference to ideal gas and laws of thermodynamics.

CO 2: Understand the formulation and importance of Maxwell's thermodynamic relations and applications.

CO 3: Learn the introductory concepts in statistical mechanics.

Module I

Equation of state for gases (5 hours)

Equation of an ideal gas, behavior of real gases, Andrew's experiment on carbon dioxide, critical state, two phase region, intermolecular forces, van der Waals equation of state, van der Waals isotherms, critical constants, limitation of van der Waals equation.

Zeroth law of thermodynamics (4 hours)

Thermodynamic system, surroundings, variables, thermal equilibrium: zeroth law, thermodynamic equilibrium, thermodynamic processes, reversible and irreversible processes, equation of state, expansivity and compressibility.

First laws of thermodynamics (7 hours)

Internal energy, heat, work, cyclic processes, first law, heat capacity, energy equation and difference of specific heat capacities, indicator diagram work done in reversible isothermal expansion of ideal gas, work done in reversible adiabatic expansion of ideal gas.

Heat engines and second law of thermodynamics (5 hours)

Second law statements, heat engine, efficiency, Carnot's ideal heat engine, work done by the engine per cycle, reversibility, Carnot refrigerator, heat pump, Carnot theorem, absolute scale of temperature, Clausius- Clapeyron latent heat equation.

Text Book: Thermal and Statistical Physics, R.B. Singh, part-1 chapter 3, 4, 5 and 6

Module II

Entropy (5 hours)

Definition of entropy, principle of increase of entropy, entropy and unavailable energy, change in entropy in heat conduction, change in entropy in reversible and irreversible process, efficiency of Carnot cycle from TS diagram, entropy of an ideal gas, entropy and disorder.

Thermodynamic relations (8 hours)

Maxwell's thermodynamic relations, TdS equations, energy equation, heat capacity equations, thermodynamic functions, third law of thermodynamics. Conduction and radiation (4 hours)

Conduction, thermal conductivity, thermal conductivity of bad conductor Lee's disc experiment - thermal resistance, thermal radiation and its properties, fundamental definitions of energy flux, intensity and radiant emittance, Stefan's law, Stefan-Boltzmann law.

Text Book: Thermal and Statistical Physics, R.B. Singh, part-1 chapter7, 8, 10 and 11.

Module III

Statistical mechanics (8 hours)

Microstates and macrostates, Phase space, density of states, mu space and Gamma space, principle of equal a priori probability, ergodic hypothesis, statistical equilibrium, ensemble,ensemble formulation of statistical mechanics, microcanonical, canonical and grand canonical ensemble, partition function, average energy of particle, equipartition theorem.

Statistical distributions (8 hours)

Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics, distribution laws, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution.

Text Book: Thermal and Statistical Physics, R.B. Singh, part-2, Chapters 2, 3,4 and 5.

Text Book:

1. Thermal and Statistical Physics, R.B. Singh, New Age Pub. (2010)

References:

1. An introduction to thermodynamics by Y.V.C. Rao (New Age Pub.)
2. An introduction to Thermal Physics by D.V. Schroeder (Pearson Pub.)
3. Heat and thermodynamics by Mark W Zemansky, Richard H Dittman&Amit K Chattopadhyay. MCH New Delhi.
4. Thermodynamics and Statistical physics BrijLal, N.Subrahmanyam and P S Hemne (S. Chand &Co, Multi colour edition 2007).
5. Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif. McGraw Hill
6. Statistical Mechanics, R.K. Pathria, Pergamon press, Oxford

Semester-VI

Core Course: X **Credit-3 (72 hours)**

23U6CRPHY10: RELATIVITY AND SPECTROSCOPY

Course Outcomes:

CO 1 -Understand the basic concepts of Special theory of relarivity.

CO 2 - Understand the basics of atomic spectroscopy to analyse various magneto optic effects.

CO 3 - Understand the basics of molecular spectroscopy.

CO 4 - Get an introduction to Resonance Spectroscopic techniques like NMR and ESR.

Module I

Special Theory of Relativity (18 hours)

Inertial and non inertial frames of reference- Galilean transformation, Significance of Michelson-Morley experiment, Postulates of Special Theory of Relativity, Lorentz transformation, Spatial contraction, Time dilation, composition of velocities, mass of moving particle, Equivalence of mass and energy. Introductory concept of general theory of relativity.

Text Book: Modern Physics, Kenneth S Krane.

Concepts of modern Physics, Arthur Beiser

Module II

Atomic Spectroscopy (21 hours)

Historical introduction. Electrostatic spectrum. Types of spectra. Absorption and emission of light by atoms, quantum theory, early atom models – Bohr model, electron spin and magnetic moment, Exclusion principle, Stern- Gerlach experiment, Vector atom model, quantum numbers associated with vector atom models, Total angular momentum and LS coupling, fine structure of Sodium D lines, Zeeman effect, quantum mechanical explanation for anomalous Zeeman effect, Paschen-Back effect.

Text Book: Molecular structure and Spectroscopy, G Aruldas.

Concepts of modern Physics, Arthur Beiser

Module III (21 hours)

Molecular Spectroscopy

Molecular energy levels. Electronic, rotational and vibrational energies, rotational spectra, explanation in terms of rigid rotator model, vibrational energy levels, explanation in terms of harmonic oscillator.

Electronic energy levels of atoms, Fluorescence and phosphorescence, Raman effect – experimental arrangement and result, classical theory and its failure, quantum theory of Raman effect.

IR and Microwave spectroscopes.

Text Book: Fundamentals olf Molecular Spectroscopy, C.Banwell and E. Mccash.

Molecular structure and Spectroscopy, G Aruldas.

NMR and ESR Spectroscopy (12 hours)

NMR Spectroscopy- Basic principles and instrumentation- Medical applications of NMR. Text Book: Molecular structure and Spectroscopy, G Aruldas – Chapter 10 (Sections 10.1, 10.2,10.3 and 10.19).

ESR Spectroscopy- Basic principles and instrumentation.

Text Book: Molecular structure and Spectroscopy, G Aruldas – Chapter 11 (Sections 11.1, 11.2 and 11.3).

Text Books:

1. Molecular structure and spectroscopy, Aruldas 2nd ed. EEE.
2. Modern Physics, Kenneth S Krane (2nd Edition) -Wiley.
3. Concepts of modern Physics, Arthur Beiser (6th Edition) - SIE.

References:

1. Spectroscopy: Straughan and Walker –(Vol.1) John Wiley
2. Fundamentals of Molecular Spectroscopy: CN Banwell–(4th edition) TMH .
3. Introduction to Atomic Spectra, HE White, TMH
4. Elements of spectroscopy, Guptha, Kumar and Sharma (PragathiPrakash)
5. Special Relativity- Resnick, (Wiley)
6. Mechanics – D.S.Mathur (S.Chand).
7. Mechanics by J.C. Upadhayaya (Ramprasad)
8. Semiconductor physics and optoelectronics- V Rajendran, J Hemaletha and M S M Gibson.

Semester-VI

Core Course: XI **Credit - 3 (54 hours)**

23U6CRPHY11: NUCLEAR, PARTICLE PHYSICS AND ASTROPHYSICS

Course Outcomes

CO 1: Understand basics of nuclear structure, radiations and detectors.

CO 2: Develop elementary ideas of nuclear transformations and cosmic rays.

CO 3: Develop fundamental ideas of particle and astrophysics.

Module I

Nuclear structure (10 hours)

Nuclear composition – Discovery of neutron – Nuclear electrons - Nuclear properties: Nuclear radii – Spin and magnetic moment - Stable nuclei - Binding energy- Binding energy curve, Liquid drop model - Semi empirical binding energy formula with correction factors - Shell model - Nuclear forces- Meson theory of nuclear forces – Discovery of pion – Virtual Photons

Nuclear Radiation Detectors, Counters and Particle Accelerators (8 Hours)

Interactions between energetic particles and matter (basic concepts only) - Ionization chamber - Solid state detectors - Proportional counter - Geiger-Muller counter - The Wilson cloud chamber - Bubble chamber - Scintillation counters - Van de Graaff

generator - Linear accelerator - Cyclotron - Betatron

Module II

Nuclear Transformations (15 hours)

Radioactive decay – Radiation hazards – Half life – Radiometric dating – Radioactive series - Alpha decay, tunnel theory of alpha decay, derivation for alpha decay constant - Beta decay, positron emission, electron capture, inverse beta decay – Gamma decay - The concept of interaction cross section, reaction rate – Nuclear reactions, Resonance, Center of mass coordinate system, Q value of nuclear reaction – Nuclear fission – Nuclear reactors – Breeder reactors - Nuclear fusion in stars – Formation of heavier elements – Fusion reactors – Confinement methods

Cosmic rays (4 hours)

Latitude effect – Azimuth effect – Altitude effect - Primary cosmic rays – Secondary cosmic rays –

Cosmic ray showers – Discovery of Positron – Mesons Van Allen belts – Origin of cosmic rays

Module III

Particle Physics (10 hours)

Interactions and Particles – Leptons – Neutrinos and Antineutrinos, other leptons – Hadrons – Resonance particles – Elementary particle quantum numbers – Basic concepts of symmetries and conservation principles – Basic concepts of Quarks – color, flavor, Quark confinement –Higgs boson

Astrophysics (7 hours)

Classification of stars – Hertzsprung - Russel diagram – Luminosity of a star – Stellar evolution - White Dwarfs - Chandrasekhar limit - Neutron stars - Black holes - Supernova explosion – Photon diffusion time.

Text Book:

1. Concepts of Modern Physics, Arthur Beiser, 6th Edition, Tata McGraw-Hill publishing company
2. Modern Physics, R Murugeshan and K. Sivaprasath, 15th Edition (Revised) (2010), S.Chand

References:

1. Atomic and Nuclear Physics, S N Ghoshal, S.Chand.
2. Nuclear and Particle Physics S L Kakani and SubhraKakani -Viva Books 2008
3. Elements of Nuclear Physics, M L Pandya and R P S Yadav, KedarNath Ram Nath
4. Modern Physics, KennthKrane, 2nd Edition, Wiley India (Pvt) Ltd.
5. Modern Physics , G. Aruldhas and P. Rajagopal, Prentice-Hall India
6. An Introduction to Astrophysics, BaidyanathBasu, 2nd Edition, Prentice-Hall India

Semester-VI

Core Course: XII **Credit-3 (72 hours)**

23U6CRPHY12: SOLID STATE PHYSICS
Course Outcomes

CO 1:Understand basics of Crystal Physics, bonding in Solids and Interpret Bragg's equation
CO 2:Develop elementary ideas of Free electron theory and band theory in solids
CO 3: Explain the properties of semiconductors
CO 4: Understand the dielectric, magnetic and superconducting properties in solids and apply the knowledge to solve problems

Module I

Crystal structure (18 hours)

Solid state, crystalline, polycrystalline and amorphous materials, crystal lattice, periodicity, translation vectors, unit cell, basis, symmetry operations, bravais lattice in two and three dimensions, miller indices, interplanar spacing, simple crystal structures-hcp, fcc, bcc and simple cubic, Structures of NaCl, Diamond and ZnS, X-ray diffraction from crystals- Bragg's law, powder method, reciprocal lattice -properties, reciprocal lattice to sc, bcc and fcc, Bragg's law in reciprocal lattice.

Text book: Solid State Physics by Puri and Babbar- Chapter 1 & 2

Module II

Bonding in solids (7 hours)

Inter-atomic forces, ionic bonding, bond dissociation and cohesive energy, madelung energy, covalent bonding, metallic bonding, hydrogen bonding, van derwaals bonding (basic ideas only).

Text book: Solid State Physics by Puri and Babbar

Free electron theory and elementary band theory (13 hours)

Free electron gas in one dimension, three dimension, electronic specific heat, band theory, Bloch theorem, Kronig-Penney model (derivation not expected), energy-wave vector relations, different zone schemes, velocity and effective mass of electron, distinction between metals, insulators and semiconductors.

Semiconducting properties of materials (12 hours)

Intrinsic and extrinsic semiconductors, drift velocity, mobility and conductivity of intrinsic semiconductors, carrier concentration and Fermi level for intrinsic semiconductor, carrier concentration, conductivity and Fermi level for extrinsic semiconductor. Hall Effect, Direct and Indirect band gap, Principles of LED and Photodiodes.

Text book: Solid State Physics by Puri and Babbar Chapter 5, 6 and 7

Module III

Dielectric properties of materials (5 hours)

Polarization and susceptibility, local filed, dielectric constant and polarizability, sources of polarizability, Clausius-Mossoti relation, piezoelectricity.

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Magnetic properties of materials (7 hours)

Response of materials to magnetic field, classification of magnetic materials, Langevin's classical theory of diamagnetism and paramagnetism, ferromagnetism, Weiss theory, domain theory, antiferromagnetism and ferrimagnetism.

Superconductivity (10 hours)

Origin of superconductivity, response of magnetic field, Meissner effect, super current and penetration depth, critical field and critical temperature, type-I and type –II superconductors, thermodynamic and optical properties, isotope effect, Josephson effect andtunneling- SQUID BCS theory-Cooper pairs-Existence of bandgap.

Text book: Solid State Physics by Puri and Babbar Chapter 5, 6 and 7

Text book:

1. Solid State Physics by Puri and Babbar (S.Chand)

References :

1. Solid State Physics, M.A. Wahab, (2nd Edition), Narosa
2. Introduction to Solid State Physics, Charles Kittel, (7th Edition), Wiley
3. Crystallography applied to solid state Physics, AR Verma, ON Srivastava, New age
4. Solid State Physics, AJ Dekker- Macmillian.
5. Solid State Physics, NW Ashcroft, ND Mermin – Cengage Learning.
6. Elementary Solid State Physics, M. Ali Omer, Pearson.
7. Solid state physics, R L Singal, KNRN &Co.
8. Solid state physics, S O Pillai, New age

Semester-VI

Choice Based Course – XIII-1 **Credit-3 (54 hours)**

23U6CRPHY13: COMPUTATIONAL PHYSICS

CO1: Discuss the methods to solve linear and nonlinear equations by numerical methods
CO2: Explain the methods for curve –fitting and interpolation
CO3: Discuss various numerical integration and differentiation methods

Algorithms of all methods required

Module I (18 hours)

Solutions of Nonlinear Equations

Bisection Method - Newton Raphson method (two equation solution) – Regula-Falsi Method, Secant method - Fixed point iteration method - Rate of convergence and comparisons of these Methods

Solution of system of linear algebraic equations

Gauss elimination method with pivoting strategies-Gauss-Jordan method-LU Factorization, Iterative methods (Jacobi method, Gauss-Seidel method)

Module II (18 hours)

Curve fitting: Regression and interpolation

Least squares Regression- fitting a straight line, parabola, polynomial and exponential curve

Finite difference operators-forward differences, divided difference; shift, average and differential operators- Newton's forward difference interpolation formulae- Lagrange interpolation polynomial- Newton's divided difference interpolation polynomial

Module III (18 hours)

Numerical Differentiation and Integration
Numerical Differentiation formulae - Maxima and minima of a tabulated function- Newton-Cote general quadrature formula - Trapezoidal, Simpson's 1/3, 3/8 rule –

Solution of ordinary differential equations

Taylor Series Method, Picard's method-Euler's and modified Euler's method –Heun's method-

RungeKutta methods for 1st and 2nd order

Text Books:

1. Numerical Methods, Balagurusamy, TMH
2. Numerical Methods for Scientists and Engineers- K SankaraRao- PHI
3. Introductory Numerical Methods, S SSastry, PHI.

Semester-VI
Choice Based Course – XIII-2 **Credit-3 (54 hours)**
23U6CRPHY13:
MATERIAL SCIENCE

CO1: Understand various terms involved in the understanding of the structure and properties of materials.
CO2: Understand the optical properties of materials and modern engineering materials.
CO3: Understanding the key terms used in the field of Nanoscience

Module I (18 hours)

Structure and Properties of Materials

Classification of materials- Advance materials- Level of structures, Microstructure and Macrostructure, Structure-Property relationships, Physical properties of materials- Imperfections in solids- Point defects, imperfections, dislocations- interfacial and bulk defects. Diffusion Mechanisms- Fick's first and second laws. Mechanical Properties- Stress strain relationship, Basic ideas of anelasticity, plastic deformation, tensile properties, ductility, malleability, brittleness, toughness, resilience, hardness, stiffness, endurance, creep and impact strength- Basic Thermal properties, Thermal cracking- Electrical and Magnetic properties- Dielectric strength and dielectric constant- Basic ideas of Chemical properties

Text Book: Callister's Material Science and Engineering-Adapted by R Balasubramaniam, Wiley

Module II (18 hours)

Optical Properties of Materials

Absorption processes- Fundamental absorption -Exciton absorption- Free –carrier absorption- Photoconductivity-photoelectric effect-Photovoltaic effect

Photoluminescence-colour centres-Generation of colour centres

Text Book: Solid State Physics, M.A. Wahab, Chapter-15

Modern Engineering Materials

Display devices- active and passive-Liquid crystals- Types of Liquid crystals- Nematic liquid crystals- Cholesteric liquid crystals- Smectic liquid crystals-General features of liquid crystals- Numeric display using LCD

Metallic glasses; Shape memory alloy; lead free solders

Text Book: Semiconductor Physics and Optoelectronics, V.Rajendran et al. Unit-II

Module III (18 hours)

Nanoscience

Metal nanoclusters-magic numbers, theoretical modelling, geometric and electronic structure, magnetic clusters; Semiconducting nano particles- Rare gas and molecular clusters- carbon nanostructures- Carbon clusters, CNT preparation, properties and applications; Quantum wells, wires and dots – preparation, Size and dimensionality effects, applications .

Text Book: Modern Physics by Murugeshan
Material Characterization Techniques

Qualitative study of Powder XRD, SEM, SPM, TEM, STM, AFM, PES and Raman spectroscopy.

Text Book: Nanotechnology-The science of small- MA Shah and KA Shah, Chapter

Text Books:

1. Nanoscience and Nanotechnology : Fundamentals to Frontiers by M.S. RamachandranRao, Shubra Singh , Wiley 2013
2. Text Book: Callister's Material Science and Engineering-Adapted by R Balasubramaniam, Wiley
2. Solid State Physics (2nd ed.), M.A. Wahab, Narosa pub.
3. Nanotechnology-The science of small, MA Shah and KA Shah, Wiley.
4. Text Book: Modern Physics by Murugeshan
5. Semiconductor Physics and Optoelectronics, V.Rajendran et al., PublishingHouse.

References:

1. Crystallography applied to solid state Physics, A.R Verma, O.N Srivastava, New age
2. Nanotechnology, L.E Foster, Pearson.
3. Nanotechnology: Principles and Practices, 2nd edition, Sulabha K Kulkarni, Springer.
4. Introduction to Nanotechnology, C.P Poole, F.J Owens –Wiley
5. Textbook of Nanoscience and Nanotechnology, BS Murthy, P Shankar, BaldevRaj,BBRath and J Murday- Universities Press-IIM

B. Sc. PHYSICS PRACTICAL

Minimum of experiments to be done in each paper is 14. Minimum number of experiments for appearing practical examination is 8. Maximum possible number of repetitions must be done to reduce error in a measuring quantity.

Do calculation of percentage error for all experiments.

The S.I. units must be specified along with the results.

SEMESTER 1&2 (First Year)

Core Practical 1: 23U2PRPHY01– Mechanics and Properties of Matter

1. Symmetric Compound Pendulum – Determination of acceleration due to gravity (g), radius of gyration(K) and moment of inertia (I)
2. Asymmetric Compound Pendulum – Determination of acceleration due to gravity (g), radius of gyration(K) and moment of inertia (I)
3. Kater's pendulum – Determination of acceleration due to gravity (g)
4. Torsion Pendulum – Determination of rigidity modulus (n) and moment of inertia (I)
5. Torsion Pendulum (Method of equal masses) – Determination of rigidity modulus (n) and moment of inertia (I)
6. Measurement of density of a solid – Sensibility method to find mass using beam balance and screw gauge / veniercalipers for dimension measurements
7. Uniform bending – Pin and Microscope – Determination of Young's modulus
8. Non Uniform bending – Pin and Microscope – Determination of Young's modulus
9. Uniform bending – Optic Lever – Determination of Young's modulus
10. Non Uniform bending – Optic Lever – Determination of Young's modulus
11. Cantilever – Scale and telescope – Determination of Young's modulus
12. Cantilever – Pin and Microscope – Determination of Young's modulus
13. Vertical oscillations of a spring – Determination of Young's modulus

14. One dimensional elastic collision – Hanging sphere method – Law of conservation of energy and momentum
15. Static Torsion – Determination of rigidity modulus
16. Flywheel – Determination of moment of inertia
17. Constant pressure head – Determination of viscosity of a liquid
18. Variable pressure head – Determination of viscosity of a liquid
19. Stokes's method – Determination of viscosity of a liquid
20. Capillary rise method – Determination of surface tension
21. Quincke's method – Determination of surface tension

SEMESTER 3&4 (Second Year)

Core Practical 02: 23U4PRPHY02–Optics and Semiconductor Physics

1. Liquid Lens – Determination of optical constants of a convex lens – water and mercury given
2. Liquid Lens – Determination of refractive index of a liquid – water and unknown liquid
3. Spectrometer – Prism – Determination of refractive index of material of the prism
4. Spectrometer – Hollow Prism – Determination of refractive index of liquid
5. Spectrometer – Small angled prism – Normal incidence – Determination of refractive index of material of the prism
6. Spectrometer – i – d curve – Determination of refractive index of material of the prism
7. Newton's rings – Determination of wavelength of sodium light
8. The air wedge – Determination of diameter of thin wire
9. Zener characteristics – forward and reverse – Study of dynamic and static properties
10. Transistor characteristics – Common Emitter Configuration
11. Half wave rectifier – Study of ripple factor and load regulation with and without filter circuit
12. Full wave rectifier – (center tap) – Study of ripple factor and load regulation with and without filter circuit
13. Full wave rectifier – (bridge) – Study of ripple factor and load regulation with and without filter circuit
14. FET – characteristics – Determination of parameters
15. Voltage regulator using zener diode – Study of line and load regulations
16. Clippers – positive, negative and biased – Study of output waveforms
17. Clampers – positive, negative and biased – Study of output waveforms
18. OPAMP characteristics – Study of CMRR and open loop gain
19. OPAMP – inverter, non inverter and buffer – Study of gain
20. LC Oscillator – Colpit's /Hartley – using transistor
21. Phase shift oscillator – using transistor

SEMESTER 5&6 (Third Year)

Core Practical 03: 23U6PRPHY03– Electricity, Magnetism and LASER

1. Potentiometer – Measurement of resistance of wire
2. Potentiometer – Calibration of low range voltmeter
3. Potentiometer – Calibration of high range voltmeter
4. Potentiometer – Calibration of ammeter
5. Tangent galvanometer – Calibration of ammeter
6. Moving coil galvanometer – figure of merit
7. Conversion of galvanometer into voltmeter
8. Conversion of galvanometer into ammeter
9. Field along the axis of a circular coil – magnetic flux variation
10. Field along the axis of a circular coil – m and Bh
11. Searle's vibration magnetometer – magnetic moment
12. Deflection and vibration magnetometer – m and Bh
13. Carey Foster's bridge – Measurement of resistivity of wire
14. LCR seriesand parallel resonant circuit analysis
15. Verification of Thevenin's and Norton's theorems
16. Verification of Superposition and Maximum power transfer theorems.
17. Laser – Grating – Determination of wavelength
18. Laser – Determination of spot size and divergence
19. Optical fiber – Determination of numerical aperture
20. Single slit diffraction using laser – Determination of slit width
21. e/m – Thomson's apparatus – Bar magnet/magnetic focusing
22. Determination of Dielectric constant of a thin sheet/ a liquid

SEMESTER 5&6 (Third Year)

Core Practical 04: 23U6PRPHY04– Digital Electronics

1. Realization of logic gates – AND, OR and NOT – Using diodes, transistors etc.
2. Realization of logic gates – AND, OR and NOT – Using universal gates
3. Verification of truth table of NAND, NOR, XOR and XNOR gates
4. Verification of De Morgan's theorems – Using IC 7400
5. BCD to 7 segment decoder
6. Realization of Half adder/ Full adder using gates – Verification of truth table
7. AstableMultivibrator using Transistor
8. AstableMultivibrator using IC 555
9. MonostableMultivibrator using Transistor
10. MonostableMultivibrator using IC 555
11. D/A converter using IC 741 – Using binary weighed resistor / R – 2R ladder type
12. A/D converter using IC 741
13. SR Flip Flops using IC 7400 – Verification of truth table
14. JK Flip Flops using IC 7400 & 7410 – Verification of truth table
15. Digital counter using IC 7490 / 7495 / 74194 / 74151 – Verification of truth table
16. Schmitt trigger using IC 741
17. Bistablemultivibrator using IC 555
18. Multiplexer using gates
19. Demultiplexer using gates
20. Shift register – SISO
21. Shift register – SIPO
22. 4-Bit Binary to Gray conversion
23. 4-Bit Gray to Binary conversion

SEMESTER 5&6 (Third Year)

Core Practical 05: 23U6PRPHY05– Thermal Physics, Spectroscopy and C++ Programming

1. Thermistor– Resistance- Temperature characteristics and temperature co-
2. efficient of resistance– Specific heat capacity of a liquid Newton's law of cooling
3. Thermal conductivity of bad conductor – Lee's disc
4. Carey Foster's bridge – Temperature co-efficient of resistance
5. Study of Seeback effect/Peltier effect
6. Electrochemical equivalent of Copper
7. To determine e/k using transistor
8. Spectrometer – Cauchy's constants
9. Spectrometer – Resolving power of a prism.
10. Spectrometer – Resolving power of grating.
11. Spectrometer – Dispersive power of grating
12. Spectrometer – Dispersive power of prism
13. Computer programming in C++ – Conversion of temperature scale
14. Computer programming in C++ – Solving a quadratic equation
15. Computer programming in C++ – Generation of Fibonacci series
16. Computer programming in C++ – Conversion of a decimal number into binary number in C++ –Simple Pendulum– Calculation of 'g' from
17. Computer programming experimental data
18. Computer programming in C++ – Resistance colour code to numerical value conversion
19. programming in C++ – For different initial velocity and angle of Computer
20. projection, find out time of flight, horizontal range, Maximum height of a Projectile
21. Computer programming in C++ – sorting the numbers in ascending and descending order
22. Computer programming in C++ – multiplication of two matrices

SEMESTER 5&6 (Third Year)

Core Practical 06: 23U6PRPHY06– Acoustics, Photonics and Advanced Semiconductor Physics

1. Melde's string – Determination of frequency of given tuning fork
2. Sonometer – Determination of frequency of AC
3. Sonometer – Determination of frequency of given tuning fork, unknown mass and verification of laws of strings
4. Kundt's tube – Determination of velocity of sound
5. Spectrometer – Quartz prism – Refractive indices of quartz for the ordinary and extra –ordinary rays
6. Characteristics of LED – V- I characteristic for different colors
7. Characteristics of solar cell / photodiode – V- I characteristics
8. Characteristics of Light Depend Resistors
9. Planck's constant using LED's of at least 3 different colours
10. Weinbridge Oscillator using IC 741
11. Realization of XOR and Ex NOR using transistor
12. Sweep wave generator using transistor
13. Regulated power supply using zener diode and IC 741 – Study of line and load regulations
14. Regulated power supply using IC 78XX/79XX etc – Study of line and load regulations
15. Voltage regulator using zener diode and transistor – Study of line and load regulations
16. RC coupled common emitter amplifier – Study of frequency response and bandwidth
17. Voltage multipliers – doubler &tripler
18. Wave shaping R C circuits – Integrator and differentiator
19. OPAMP – adder and subtractor
20. Amplitude modulation using transistor
21. Pulse Width Modulation using IC 555

References:

1. Advanced course in Practical Physics by D Chattopadhyay
2. Practical Physics – Joseph Ittiavirah, Premnath and Abraham(2005)
3. Practical Physics, CL Arora, S.Chand
4. Practical Physics, Harnam Singh , S Chand
5. Electronics lab manual Vol 1 & 2, K ANavas.
6. A course of Experiments with He –Ne Laser – R.S Sirohi (2nd Edition) Wiley Eastern Ltd.
7. Electronics lab manual Vol 1 & 2, Kuryachan T D and Shyam Mohan S, Ayodhya pub.

11. COMPLEMENTARY PHYSICS FOR MATHEMATICS

Semester I 2 credits (36 hours)

23U1CPPHY01: PROPERTIES OF MATTER & ERROR ANALYSIS

CO 1: Understand the basics of elasticity.

CO 2: Develop elementary ideas of surface tension and hydrodynamics.

CO 3: Understand different kinds of errors and its propagation involved in experiments.

Module I

Elasticity (13 hours)

Stress- strain- determination Hooke's law- Elastic moduli- Poisson's ratio- twisting couple- of rigidity modulus- static and dynamic methods- static torsion- torsion pendulum, bending of beams- cantilever, uniform and non-uniform bending, I section girder.

Module II

Surface tension (3 hours)

Molecular theory of surface tension - surface energy - excess pressure in a liquid drop, factors affecting surface tension - applications

Hydrodynamics (7 hours)

Streamline and turbulent flow - critical velocity - Coefficient of viscosity - Derivation of Poiseuille's equation, Stokes equation-Determination of viscosity by Poiseuille's method - Brownian motion – Viscosity of gases – Bernoulli's theorem.

Module III (13 hours)

Error Analysis

Basic ideas – uncertainties of measurement – importance of estimating errors – dominant errors – random errors – systematic errors - rejection of spurious measurements. Estimating and reporting errors – errors with reading scales, errors of digital instruments – number of significant digits –absolute and relative errors – standard deviation. Propagation of errors – sum and differences – products and quotients – multiplying by constants – powers

References:

1. Elements of properties of matter, D S Mathur
2. Advanced course in Practical Physics by D Chattopadhyay
3. Properties of Matter - Brijlal and N. Subrahmanyam (S. Chand and Co.)
4. Concepts of Modern Physics- A. Beiser (Tata McGraw -Hill, 5th Edn.)
5. Modern Physics- G. Aruldas and P. Rajagopal (PHI Pub)
6. Physics- Resnick and Halliday
7. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, John R. Taylor - Univ. Science Books

Semester II 2 credits (36 hours)

23U2CPPHY03: MECHANICS AND ASTROPHYSICS

Course Outcomes

CO 1: Understand the basics of motion under gravity and rotational dynamics.

CO 2: Develop elementary ideas of oscillations and waves.

CO 3: Develop fundamental ideas of Astrophysics

Module I

Motion under Gravity (5 hours)

Velocity- acceleration- force – acceleration due to gravity - compound pendulum (symmetric and asymmetric) radius of gyration – Kater's Pendulum- centripetal acceleration and force - centrifugal force

Rotational Dynamics (10 hours)

Angular velocity- angular momentum- torque- conservation of angular momentum- angular acceleration- moment of inertia- parallel and perpendicular axes theorems-

moment of inertia of rod, ring, disc, cylinder and sphere- flywheel

Module II

Oscillations (9 hours)

Periodic and oscillatory motion- simple harmonic motion- differential equation, expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion - damped oscillation - forced oscillation and resonance.

Waves (4 hours)

Waves-classifications- progressive wave- energy of progressive wave- superposition of

waves-theory of beats- Doppler Effect.

Module III

Astrophysics (8 hours)

Temperature and color of a star- elements present in a stellar atmosphere- mass of star-life time

of a star- main sequence stars-HR diagram- evolution of stars- white dwarf-supernova explosion-

neutron star- black hole- (all topics to be treated qualitatively)

References

1. Elements of properties of matter, D S Mathur Mechanics- H.S.Hans and S.P.Puri. (TMH)
2. Mechanics, D S Mathur
3. Modern Physics- R. Murugeshan, Er. KirthigaSivaprasad
4. A text book on oscillations waves and acoustics, M.Ghosh , D Bhattacharya
5. Introduction to Astrophysics-BaidyanathBasu.
6. Mechanics by D.S. Mathur and P.S. Hemne, S. Chand.
7. Waves, Mechanics & Oscillations- S B Puri

Semester III

23U3CPPHY05 : Modern Physics and Electronics 3 Credits (54 Hours)

Course Outcomes

CO 1:Understand basics of Vector atom model and nuclear physics

CO 2:Develop elementary ideas of Quantum mechanics and spectroscopy

CO 3: Explain the working of Diode and transistor and develop fundamental ideas of digital electronics

Module I

Modern Physics (18 hours)

Basic features of Bohr atom model-formula for energy- vector atom model- various quantum numbers-coupling schemes – LS & JJ-Pauli's exclusion principle- magnetic moments of orbital electrons

Atomic nucleus-classification-basic properties of nucleus-charge, mass, spin, magnetic moment binding energy and packing fraction-nuclear forces-salient features Radioactivity- properties of alpha, beta and gamma-Soddy Fajan's displacement law, law of radioactive disintegration-decay constant -half life and mean life-radioactive equilibrium - measurement of radioactivity-radio carbon dating

Module II

Quantum Mechanics (12 hours)

Inadequacies of classical physics-experimental evidences-evidences for quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function & probability density- Schrödinger equation-time dependent and time independent particle in a potential box.

Spectroscopy (6 hours)

Optical spectra- spectral terms, selection rules, hyperfine structure; molecular spectra-rotational, vibrational and electronic spectra; Raman effect- experimental study, quantum theory; fluorescence and phosphorescence; comparison of Raman, fluorescence and IR spectra;

NMR

Module III

Electronics (8 hours) Current-voltage characteristics of a diode -forward and reverse bias-breakdown mechanism of p-n junction diode-Zener diode and its characteristics-half wave and full wave rectifiers- bridge rectifier-ripple factor, efficiency.Bipolar junction transistor-Construction and operation.

Module IV

Digital Electronics (10 hours)

Different number systems – decimal, binary, octal, hexa decimal number systems-conversion between different number systems- binary mathematics – addition, subtraction (1's compliment and 2's compliment methods) - basic theorems of Boolean algebra- de Morgan's theorems – Simplification of Boolean equations - AND, OR, NOT,

NAND, NOR, XOR gates- truth tables- half adder- full adder

References

1. Modern Physics- R. Murugeshan, Er. KirthigaSivaprasad
2. Principles of electronics, V K Mehta
3. Digital principles and applications- A. P. Malvino and P. Leach
4. Concepts of Modern Physics: Arthur Beiser (TMH).
5. Basic Electronics , B L Thereja (S. Chand)

Semester IV **3 credits (54 hours)**

23U4CPPHY07: OPTICS & Electricity

Course Outcomes

CO 1:Understand basics theories concerning Interference, Diffraction and Polarization
CO 2:Apply the basic knowledge of optics in advanced fields such as Laser and Fiber optics
CO 3: Explain the basic nature of varying currents after developing the fundamental concepts

Light waves- phase difference and coherence, optical path and phase change, principle of superposition, Analytical treatment of interference-young's double slit experiment, conditions for interference, bandwidth - Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness. Newton's rings-reflected system -measurement of wavelength.

Fresnel and Fraunhofer diffractions.Fresnel's theory of approximate rectilinear propagation of light-.Fraunhofer diffraction.Theory of Plane transmission grating-determination of wavelength-dispersive power of grating. Prism and grating spectra, resolving power, Rayleigh criterion, resolving power of grating,

Polarization, types of polarization, Brewster's law, dichroism, birefringence – e ray and o-ray,

polarizer and analyser, Malu's law, optical activity

Module II

Laser and Fiber Optics (10 hours)

Principle of operation of laser-population inversion, metastable states, optical resonator-components of laser- active medium, pump, optical resonant cavity- principal pumping schemes- three level and four level- laser beam characteristics applications of lasers.

Light propagation in optical fibers, acceptance angle, numerical aperture-step index fiber

- graded index fiber.

Module III

Dielectrics (10 hours)

Dielectrics- polar and non-polar dielectrics- polarization- sources of polarization-Gauss's law in dielectrics- permittivity- dielectric displacement vector- dielectric constant-

susceptibility-ferro-electricity.

Module IV

Varying Currents (12 hours)

Transient currents – Growth and decay of current in an inductive circuit – charging and discharging of a capacitor through a resistance - Peak, mean, rms and effective values of a.c, Ac circuits-AC through RC, LC, LR and LCR series circuits resonance-sharpness of resonance-power factor.

References:

1. Optics - Brijlal and N. Subrahmanyam, S Chand-2015
2. Electricity and Magnetism , D C Tayal
3. Electricity and Magnetism- J. H. Fewkes& John Yarwood
4. Electricity and Magnetism – R. Murugeshan
5. Nuclear physics –Irvin Kaplan
6. Lasers – theory & applications- Thyagarajan&Ghatak
7. Concepts of Modern Physics- A. Beiser
8. Laser Physics and Applications, V K Jain (Narosa Publication)
9. Optical Fiber Communications, John M Senior

12. COMPLEMENTARY PHYSICS FOR CHEMISTRY

Semester 1

23U1CPPHY02: PROPERTIES OF MATTER AND THERMODYNAMICS

Course Outcomes

CO 1: Understand the basics of elasticity.
CO 2: Develop elementary ideas of surface tension and hydrodynamics.
CO 3: Develop fundamental ideas of thermodynamics.

Module I

Elasticity (13 hours)

Stress- strain- Hooke's law- Elastic moduli- Poisson's ratio- twisting couple-determination of rigidity modulus- static and dynamic methods- static torsion- torsion pendulum, bending of beams- cantilever, uniform and non-uniform bending, I section girder.

Module II

Surface tension (3 hours)

Molecular theory of surface tension - surface energy - excess pressure in a liquid drop, factors affecting surface tension - applications

Hydrodynamics (7 hours)

Streamline and turbulent flow - critical velocity - Coefficient of viscosity - Derivation of Poiseuille's equation, Stokes equation-Determination of viscosity by Poiseuille's method - Brownian motion – Viscosity of gases- Bernoulli's theorem.

Text Book: Elements of properties of matter, D S Mathur, Chapter- 14

Module III

Thermodynamics (13 hours)

Thermodynamic systems- thermodynamic equilibrium- thermodynamic processes- isothermal process- adiabatic process- zeroth law of thermodynamics, first law of thermodynamics- heat engine- the Carnot engine- refrigerator, concept of entropy- second law of thermodynamics- third law of thermodynamics- Maxwell's thermodynamic relations

Text Books:

1. Elements of properties of matter, D S Mathur- S Chand
2. Heat and Thermodynamics-Brijlal&Subrahmanyam (S.Chand)

References

1. Mechanics - H.S.Hans and S.P.Puri. (Tata McGraw-Hill)
2. Properties of Matter - Brijlal and N. Subrahmanyam (S. Chand and Co.)
3. Mechanics - J.C. Upadhyaya (Ram Prasad and sons)
4. Heat and Thermodynamics – Mark W Zemanski (Tata McGraw-Hill)

Semester 2

23U2CPPHY04: MECHANICS AND SUPERCONDUCTIVITY

Course Outcomes

CO 1: Understand the basics of motion under gravity and rotational dynamics.

CO 2: Develop elementary ideas of oscillations and waves.

CO 3: Develop fundamental ideas of superconductivity.

Module I

Motion under gravity (5 hours)

Velocity- acceleration- force – acceleration due to gravity - compound pendulum (symmetric and asymmetric) radius of gyration –centripetal acceleration and force - centrifugal force

Rotational dynamics (10 hours)

Angular velocity- angular momentum- torque- conservation of angular momentum- angular acceleration- moment of inertia- parallel and perpendicular axes theorems-

moment of inertia of rod, ring, disc, cylinder and sphere- flywheel

Module II

Oscillations (9 hours)

Periodic and oscillatory motion- simple harmonic motion- differential equation, expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion damped oscillation- forced oscillation and resonance.

Waves (4 hours)

Waves-classifications- progressive wave- energy of progressive wave- superposition of waves-

theory of beats- Doppler effect.

Module III

Superconductivity (8 hours)

Super conducting phenomenon- Occurrence- BCS theory (qualitative) Meissner Effect- Type I and Type II superconductors- Josephson effects (qualitative) - High temperature superconductors- Applications of Superconductivity

Text Books:

1. Elements of properties of matter, D S Mathur- S Chand
2. Mechanics- D S Mathur- S Chand
3. Solid State Physics- P K Palanisamy- Scitech

References

1. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
2. A text book on oscillations waves and acoustics, M.Ghosh , D Bhattacharya
3. Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)
4. Elementary Solid State Physics,Ali Omar
5. Modern Physics- Murugeshan- S Chand

Semester III

23U3CPPHY06: MODERN PHYSICS AND MAGNETISM

Course Outcomes

CO 1: Understand basics of Vector atom model and nuclear physics

CO 2: Develop elementary ideas of quantum mechanics and spectroscopy

CO 3: Explain the working of diode and transistor and develop fundamental ideas of magnetism

Module I

Modern Physics (18 hours) Basic features of Bohr atom model-formula for energy-vector atom model- various quantum numbers- Coupling schemes-LS and JJ coupling-Pauli's exclusion principle-magnetic moment of orbital electrons,

Atomic nucleus classification-basic properties of nucleus-charge, mass, spin, magnetic moment binding energy and packing fraction-nuclear forces-salient features Radioactivity- properties of alpha, beta and gamma- Soddy Fajan's displacement law, law of radioactive disintegration -decay constant-half life and mean life- radioactive equilibrium - measurement of radioactivity-.Radio carbon dating

Module II

Quantum Mechanics (12 hours)

Inadequacies of classical physics-experimental evidences-evidences for quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function & probability density- Schrödinger equation-time dependent and time independent particle in a potential box.

Spectroscopy (6 hours)

Optical spectra- spectral terms, selection rules, hyperfine structure; molecular spectra-rotational, vibrational and electronic spectra; Raman effect- experimental study, quantum theory; fluorescence and phosphorescence; comparison of Raman, fluorescence and IR

spectra; NMR

Module III

Electronics (8 hours)

Current-voltage characteristics of a diode -forward and reverse bias-breakdown

mechanism of p-n junction diode-Zener diode and its characteristics-half wave and full wave rectifiers- bridge rectifier-ripple factor, efficiency. Construction and operation of a

bipolar junction transistor

Module IV

Magnetism (10 hours)

Properties of magnetic materials, Paramagnetism, Diamagnetism, Ferromagnetism, Hysteresis, Ferrites, Magnetostriction, Earth's magnetism-elements of earth's magnetism-dip, declination, horizontal and vertical components-magnetic maps-magnetographs-cause of earth's magnetism

Text Books:

1. Modern Physics- R. Murugeshan, Er. KirthigaSivaprasad . S Chand
2. Principles of electronics, V K Mehta, S Chand
3. Electricity and magnetism, D C Tayal,

References

1. Functional Electronics, Ramanan (Tata McGraw-Hill)
2. Electricity and magnetism - Brijlal and N. Subrahmanyam (S. Chand and Co.)

Semester IV

23U4CPPHY08: OPTICS AND SOLID STATE PHYSICS

Course Outcomes

CO 1: Understand basics theories concerning interference, diffraction and polarization
CO 2: Apply the basic knowledge of optics in advanced fields such as laser and fiber optics
CO 3: Understand the basic concepts of electric polarization, materials and crystallography

Module I

Interference, Diffraction and Polarization (22 hours)

Light waves- phase difference and coherence, optical path and phase change, principle of superposition, Analytical treatment of interference-- young's double slit experiment, conditions for interference, bandwidth Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness. Newton's rings-reflected system-measurement of wavelength

Fresnel and Fraunhofer diffractions.Fresnel's theory of approximate rectilinear propagation of light.Fraunhofer diffraction.Theory of Plane transmission grating-determination of wavelength-dispersive power of grating. Prism and grating spectra, resolving power, Rayleigh criterion, resolving power of grating,

Polarization, types of polarization, Brewster's law, dichroism, birefringence – e ray and o-ray,

polarizer and analyzer, Malu's law, optical activity

Module II

Laser and Fiber Optics (10 hours)

Principle of operation of laser-population inversion, metastable states, optical resonator-components of laser- active medium, pump, optical resonant cavity- principal pumping schemes- three level and four level- laser beam characteristics, applications of lasers.
Light propagation in optical fibers, acceptance angle, numerical aperture-step index fiber

- graded index fiber.

Module III

Dielectrics (10 hours)

Dielectrics- polar and non-polar dielectrics- polarization- sources of polarization-Gauss's law in dielectrics- permittivity- dielectric displacement vector- dielectric constant-susceptibility- ferro-electricity. Peak, mean, rms and effective values of A.C

Module IV

Crystallography (12 hours) Crystal structure-crystal lattice and translation vectors-unit cell-types of lattices- Miller indices- lattice directions and planes interplanar spacing-simple crystal structures- sc, fcc, bcc, hcp close packed structures- -sodium chloride structure. X-ray crystallography-diffraction of x-rays-Bragg's law

Text Books:

1. Optics - Brijlal and N. Subrahmanyam - S Chand-2015
2. Electricity and Magnetism , D C Tayal
3. Solid State Physics, S O Pillai

References:

1. A text book of Applied Physics – A .K Jha
2. Electricity and Magnetism – R. Murugeshan (S Chand & Co.)
3. Solid state physics, P. K Palanisami
4. Lasers – theory & applications- Thyagarajan&Ghatak

COMPLEMENTARY PHYSICS PRACTICALS

COMPLIMENTARY PHYSICS LAB: Minimum of experiments to be done in each paper is 14. Minimum number of experiments for appearing practical examination is 8. Maximum possible number of repetitions must be done to reduce error in a measuring quantity.

Do calculation of percentage error for all experiments.

The S.I. units must be specified along with the results.

Semester I&II
Complementary Physics Practical 1: (for Maths:23U2PCPHY01 ; for Chemistry : 23U2PCPHY02)

1. VernierCalipers -- Volume of cylinder (solid and hollow), sphere and beaker
2. Screw gauge – Radius of wire, volume of sphere and glass piece
3. Beam balance - Mass of a solid (sensibility method)
4. Spectrometer - Refractive Index of material of prism.
5. Diode characteristics- ac and dc resistance
6. Coefficient of viscosity of the liquid – Constant OR Variable pressure head method
7. Surface Tension – Capillary rise method
8. Determination of Young's Modulus- Cantilever (Scale and Telescope)
   OR - Uniform bending (Optic lever method)
   OR- Non-uniform bending (Pin and Microscope method)
9. Acceleration due to gravity (g)- Symmetric Compound Pendulum
   OR Kater's pendulum
10. Symmetric Compound Pendulum - Determination of Radius of gyration and moment of inertia
11. Fly wheel – Moment of Inertia
12. Torsion pendulum -Rigidity modulus

13. Determination of moment of inertia of rotationally symmetric body (solid sphere OR cylinder OR disc) from their period of oscillation on a torsion axle
14. Spring constant - Hooke's law - oscillation
15. Resistivity of the material of the wire- Ohm's law and verification by multimeter
16. Construction of half wave rectifier with and without filter – Ripple factor
17. Laser- Transmission OR Reflection Grating- Determination of wavelength
18. Liquid lens - Refractive Index of glass using a liquid of known refractive index
19. Poisson's ratio of rubber
20. Temperature dependence of capacitance- polymer and ceramic capacitors
21. Resistance of a galvanometer and its figure of merit.

Semester III & IV:
Complementary Physics Practical 2: (for Maths:23U4PCPHY03 ;
for Chemistry : 23U4PCPHY04)

1. Determination of Young's Modulus- Cantilever (Pin & Microscope)OR Uniform bending (pin and microscope)OR Non-uniform bending (optic lever)
2. Asymmetric Compound Pendulum- Determination of moment of inertia and Acceleration due to gravity (g)
3. Torsion pendulum (Equal mass method) - Rigidity modulus and Moment of Inertia
4. Spectrometer – Dispersive power of prism
5. Spectrometer – Dispersive power of a Grating
6. Newton's rings -Wave lengthNewton's rings -Wave length
7. Characteristics of Zener diode- ac and dc resistance
8. Conversion of Galvanometer into voltmeter
9. Carey Foster's Bridge - Measurement of resistivity
10. Tangent Galvanometer – Ammeter calibration
11. Potentiometer-Calibration of low range ammeter OR voltmeter
12. Construction of full wave rectifier (center-tap OR bridge) with and without filter – Ripple factor
13. Construction of regulated power supply using Zener diode- line and load regulation

14. Laser diffraction- width of single slit OR thickness of wire
15. Refractive index of liquid- Liquid Lens OR Spectrometer and Hollow Prism
16. Air wedge-thickness of wire
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