ST. ALBERT'S COLLEGE (AUTONOMOUS) ERNAKULAM

CURRICULUM FOR UNDER GRADUATE PROGRAMMES IN

PHYSICS

UNDER CHOICE BASED CREDIT SYSTEM (UG CBCS) 2017

2017 ADMISSIONS ONWARDS

Members of the Board of Studies of Physics

Sl.No:	Name	Designation	Qualification
a) **Chairman:** *(Head of the Department concerned)*			
1	Dr. Nelson Rodrigues	HoD	MSc, PhD
b) Teachers: *(The entire faculty of each specialization)*			
1	Dr Nandakumar Kalarikkal	Hon. Director of International and Inte runiversity Centre for Nanoscience & Nanotechnology, and Associate Professor, School of pure and Applied Physics Mahatma Gandhi University, Kottayam -686560 , Kerala , India.	MSc, PhD.
2	Dr. Pramod Gopinath	Professor, International School of Photonics, CUSAT, Kalamassery	MSc, Ph.D
3	Dr. James Kurian	Professor, Department of Electronics, CUSAT, Kalamassery	M.Tech , Ph.D
4	Dr. Louie Frobel P.G	Asst. Professor, Department of Physics, St.Albert's College Ernakulam	M.Sc , M.Phil, Ph.D
5	Dr. Sajeesh T H	Asst. Professor, Department of Physics, St. Albert's College Ernakulam	M.Sc, Ph.D
6	Dr. Vimala George	Asst. Professor ,Department of Physics , St. Xavier's College for women Aluva	M.Sc, Ph.D
7.	Dr. Ninan Sajith Philip	Associate Professor, Department of Physics, St. Thomas College,Kozhencherri-689641..	MSc, PhD.
8	Dr. Tripti S.warrier	Assistant Professor, Department of Electronics,CUSAT, Kalamassery.	B Tech, M Tech, PhD.
c) Two Subject Experts: *(From outside the Parent University to be nominated by the Academic Council)*			
1	Dr. Anand Narayanan	Associate Professor , Department of Earth and Space Science ,	M.Sc., Ph.D

		Indian Institute of Space Science and Technology, TVM	
2	Dr. M. K. Jayaraj	Syndicate member, and Professor Department of Physics , CUSAT ,Kalamassery	M.Sc , Ph.D
d) Nominee of Vice Chancellor: (*one expert to be nominated by the Vice-Chancellor from a panel of six experts recommended by the Principal)*			
1	Dr. Issac Paul	Associate Professor, Department of Physics , S.B.College Changanassery	M.Sc , Ph.D
e) Placement Representative: *(One representative from industry/corporate sector/allied area relating to placement)*			
1	Mr G. Sivaramakrishnan	Consultant Konark Systems Pvt Ltd Kaloor, Ernakulam, Kerala	
2	Rev.Dr.George Peter Pittappillil	Director, Mithradham	
f) Meritorious alumnus: *(One postgraduate meritorious alumnus to be nominated by the Principal)*			
1	Dr. Sasikumar	Principal , Govt.College Thalasseri	M.Sc , Ph.D
g) The Chairman, Board of Studies, **may** *with the approval of the Principal of the college,* **co-opt:**			
a) Co-opted Special Experts from outside (*Experts from outside the college whenever special courses of studies are to be formulated)***:**			
1	Dr. Joe Jacob	Associate Professor and HoD Department of Physics, SB College Changanserri	M.Sc , Ph.D
2	Dr. L. Godfrey	Emeritus professor, Dept. of Physics, CUSAT	M.Sc , Ph.D
b) Other members of staff of the same faculty:			
1	Sri. Shaji Joseph	Associate Professor	M.Sc
2	Sr. Lawrel Gregory	Associate Professor	M.Sc
3	Sri. S. Charles	Associate Professor	M.Sc
4	Sri. Justin Paiva	Associate Professor	M.Sc, M.Phil
5	Sri. Augustine Sumesh C J	Assistant Professor	M.Sc, B.Ed

Term: *The term of the nominated members shall be three years.*

Meetings*: The Board of Studies shall meet at least twice a year.*

Functions*:*

The Board of Studies of a Department in the college shall:

(a) Prepare syllabi for various courses keeping in view the objectives of the college, interest of the stakeholders and national requirement for consideration and approval of the Academic Council;
(b) Suggest methodologies for innovative teaching and evaluation techniques;
(c) Suggest panel of names to the Academic Council for appointment of examiners; and
(d) Coordinate research, teaching, extension and other academic activities in the department/college.

(Chairman)

CONTENTS

ACKNOWLEDGEMENT

There are many profound personalities whose relentless support and guidance made this syllabus restructuring 2019 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 St. Albert's College (Autonomous) Ernakulam.

We express profound gratitude to the Chairman, Principal, Members of the Governing Council and Academic Council for their sincere co-operation and guidance for completion of this work. We place on record my wholehearted gratitude to the members of Board of Studies for their untiring efforts.

Special thanks are due to the staff members of various colleges and institutes, who have actively participated and contributed to the revision of syllabus through group chats and e mail conversations. The enthusiasm and sincerity shown by the teachers from various colleges in the context of syllabus restructuring is highly appreciated.

Prepared by BOS

Ernakulam

TITLE

B. Sc. PHYSICS PROGRAMME – Under Graduate Programmes under Choice Based Credit System, 2019

3. AIMS AND OBJECTIVES OF THE PROGRAMME

Aims:

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 scepticism 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 programme also aims to develop the following abilities:

1. Read, understand and interpret physical information – verbal, mathematical and graphical.

2. Impart skills required to gather information from resources and use them.

3. To give need based education in physics of the highest quality at the undergraduate level.

4. Offer courses to the choice of the students.

   Perform experiments and interpret the results of observation, including the assessment of experimental uncertainties.

6. Provide an intellectually stimulating environment to develop skills and enthusiasms of students to the best of their potential.

7. Use Information Communication Technology to gather knowledge at will.

8. Attract outstanding students from all backgrounds.

Objectives:

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 (2^{nd} 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(4^{th}semester), the students should have been introduced to powerful tools for tackling a wide range of topics in Optics, Laser, Fiber 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 (6^{th} semester)r, 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.

REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM 2017

Preamble

In 2016, St. Albert's College was granted autonomy, we adopted the curriculum and syllabus followed by the Mahatma Gandhi University, Kottayam for the year 2016. In 2017, when the Mahatma Gandhi University made a comprehensive revision of their curriculum and syllabus, it was adopted by the college as it was a better curriculum that met the needs and current demands of the culture, the society, and the expectations of the population being served.

Mahatma Gandhi University introduced Choice Based Credit and Semester and Grading System in colleges affiliated to the University from the Academic Year 2009-10, under **Direct Grading System**. Subsequently, the Kerala State Higher Education Council constituted a committee of experts headed by Prof. B Hridayakumari, to study and make recommendations for the improvement of the working of the Choice Based Credit and Semester System in colleges affiliated to the Universities in the State. The State Government accepted the recommendations of the Committee and the Syndicate and the Academic

Council of the Mahatma Gandhi University has resolved to reform the existing CBCSS regulations. Accordingly Regulations for Under Graduate Programmes under Choice Based Course-Credit-Semester System and Grading, 2013 was introduced in the University from the

Academic year 2013-14 onwards, under Indirect Grading System. The University Grants Commission, to facilitate student mobility across institutions within and across the states insisted to introduce uniform grading system in the Universities. Based on the UGC directives, various Board of Studies / Expert committees framed draft Regulations and syllabi for various UG Programmes to be made effective from 2016-17 academic year onwards. The Academic Council held on 18th July 2016 resolved to postpone the implementation of the regulations and syllabi for UG Programmes and to implement from

2017-2018 academic year after detailed discussions with the experts and other stake holders.

On the basis of the suggestions put forth by the joint meeting of Faculties and also based on the discussions and suggestions in the workshops conducted for the purpose, Chairpersons of various faculties submitted modified draft Regulations, Scheme and Syllabi and text books for various undergraduate Programmes and the Standing committee of the Academic Council at its meeting held on 5th May 2017 resolved to recommend to the Academic council to approve the modified Regulations, Scheme and Syllabi and text books for various undergraduate programmes. Hence it becomes necessary to issue modified Regulations as follows.

1. TITLE

1.1 These regulations shall be called **"ST.ALBERT'S COLLEGE (AUTONOMOUS), ERNAKULAM - REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM 2019"**

2. SCOPE

2.1. Applicable to all regular BA/ BSc /B Com /BBA courses conducted by the College with effect from 2019 admissions.

2.2. Applicable to all regular BA/ BSc /B Com /BBA courses conducted by the College with effect from 2019 admissions.

2.3. Medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.

3. DEFINITIONS

3.1. **'Academic Week'** is a unit of five working days in which the distribution of work is organised from day one to day five, with five contact hours of one hour duration on each day.

3.2. **'Choice Based Course'** means a course that enables the students to familiarize the advanced areas of core course.

3.3. ***'Common Course I'*** means a course that comes under the category of courses for English.

3.4. ***'Common Course II'*** means additional language.

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

3.6. ***'Core course'*** means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

3.7. ***'Course'*** means a portion of a subject to be taught and evaluated in a semester (similar to a

paper under annual scheme).

3.8. ***Credit'*** is the numerical value assigned to a paper according to the relative importance of the syllabus of the programme**.**

3.9. ***'Department'*** means any teaching department in a college.

3.10. ***'Examination Coordinator'*** is a teacher nominated by a Department Council to coordinate the continuous evaluation undertaken in that department.

3.11. ***'Department Council'*** means the body of all teachers of a department in a college.

3.12. ***'Class Tutor'*** means a teacher from the parent department nominated by the Department Council, who will advise the student on academic matters.

3.13. **'Grace Marks'** shall be awarded to candidates as per the University Orders issued from time to time.

3.14. **'Grade'** means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a Paper/Course/ Semester/Programme.

3.15. ***'Grade Point'*** (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

3.16. ***'Institutional Average (IA)'*** means average mark secured (Internal + external) for a course at the college level.

3.17. ***'Open Course'*** means an optional course which the student is free to take at his/her will. Open course shall be a non-major elective course offered by the Departments other than the parent Department.

3.18. **'*Parent Department'*** means the department which offers core course/courses within an undergraduate programme.

3.19. ***'Programme'*** means a three year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.

3.20. ***'Semester'*** means a term consisting of a minimum **90** working days, inclusive of tutorials, examination days and other academic activities within a period of six months**.**

3.21. ***'Vocational Course'*** **(Skill Enhancement Course)** means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

3.22. Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes of the affiliating University.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

4.1. Eligibility for admissions and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the college in this regard, from time to time.

5. DURATION

5.1. The duration of U.G. programmes shall be 6 semesters.

5.2. There shall be two Semesters in an academic year, the "ODD" semester commences in June and on completion, the "EVEN" Semester commences. There shall be two months' vacation during April/May.

6. REGISTRATION

6.1. The strength of students for each programme shall be as per the existing orders issued by the college and as approved by the affiliating University.

7. SCHEME AND SYLLABUS

7.1. The U.G. programmes shall include (a) Common Courses I and II, (b) Core Course(s), (c) Complementary/Vocational Courses, and (d) Open Course.

7.2. There shall be one Choice Based course (Elective Course) in the sixth semester. In the case of B.Com Programme there shall be an elective stream from third semester onwards.

7.3. Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one University to continue their education in another University without break.

7.4. 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. The practical examinations (external/internal) will be conducted only at the end of each semesters for all programmes

7.5. Students who complete the programme with minimum "D" grade will have one betterment chance within 12 months, immediately after the publication of the result of the whole programme. In such cases they should appear for all the papers in a particular semester.

8. 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 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%

9. EXAMINATIONS

9.1. The evaluation of each paper shall contain two parts:

(i) Internal or In-Semester Assessment (ISA)

(ii) External or End-Semester Assessment (ESA)

9.2. The internal to external assessment ratio shall be 1:4.

Both internal and external marks are to be rounded to the next integer. All papers (theory & practical), grades are given **on a 7-point scale** based on the total percentage of marks, ***(ISA+ESA)*** as given below:-

Percentage of Marks	Grade	Grade Point
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 Satisfactory	5
35 to below 45	D Pass	4
Below 35	F Failure	0
	Ab Absent	0

10. CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a paper is calculated using the formula:-

CP = C × GP, where C is the Credit and GP is the Grade point

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

SGPA = TCP/TC, where TCP is the Total Credit Point of that semester.

Cumulative Grade Point Average (CGPA) is calculated using the formula:-

CGPA = TCP/TC, where TCP is the Total Credit Point of that programme.

Grade Point Average (GPA) of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational course, Core Course is calculated using the formula:-

GPA = TCP/TC, where TCP is the Total Credit Point of a category of course.

TC is the total credit of that category of course

Grades for the different courses, semesters and overall programme are given based on

the corresponding CPA as shown below:

GPA	**Grade**
9.5 and above	**S Outstanding**
8.5 to below 9.5	**A+ Excellent**
7.5 to below 8.5	**A Very Good**
6.5 to below 7.5	**B+ Good**
5.5 to below 6.5	**B Above Average**
4.5 to below 5.5	**C Satisfactory**
3.5 to below 4.5	**D Pass**
Below 3.5	**F Failure**

11. MARKS DISTRIBUTION FOR EXTERNAL AND INTERNA EVALUATIONS

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses without practical total marks of external examination is 80 and total marks of internal evaluation is 20. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

11.1. For all courses without practical

a) Marks of external Examination : 80

b) Marks of internal evaluation : 20

Components of Internal	**Marks**

Evaluation of theory	
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test papers (2x5=10)	**10**
Total	**20**

For all courses with practical total marks for external evaluation is 60 and total marks for internal evaluation is 15.

11.2. For all courses with practical

a) Marks of external Examination : 60

b) Marks of internal evaluation : 15

Components of Internal Evaluation	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**2**
Test papers (2 x 4)	**8**
Total	**15**

(c) For practical examinations total marks for external evaluation is 40 for internal evaluation is 10

Components Internal evaluation of Practical	**Marks**
Attendance	2
Test paper (1 x 4)	4
Record*	4
Total	10

*Marks awarded for Record should be related to number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are mandatory.

11.3. For projects

a) Marks of external evaluation: 80

b) Marks of internal evaluation: 20

c)

Components of External Evaluation of Project	Marks
Dissertation (External)	50
Viva-Voce (External)	30
Total	**80**

*****Marks for dissertation may include study tour report if proposed in the syllabus.

Components of internal Evaluation of Project	Marks
Punctuality	5
Experimentation/data collection	5
Knowledge	5
Report	5
Total	**20**

Attendance Evaluation for all papers

% of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

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

12. ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester for all courses.

13. SEMINAR/VIVA

A student shall present a seminar in the 5th semester for each paper and appear for

Viva-voce in the 6th semester for each course.

14. INTERNAL ASSESSMENT TEST PAPERS

At-least two test papers are to be conducted in each semester for each course.

14.1. **Grievances regarding internal evaluation** : There is provision for grievance redressal regarding internal evaluation which operates at four levels. Complaints regarding the internal evaluation shall be brought to the notice of the teacher concerned in the first instance. If the student is not satisfied with the decision of the teacher concerned, he may appeal to the Departmental Grievance Redressal Committee which shall have the Head of the department, the class Tutor and the teacher against whom the complaint is made, as members. The student will also have the freedom to make further appeal to the College Level Grievance Redressal Committee which shall have the Principal, the COE and the concerned Head of the department, as members. If the student is not satisfied, he may appeal to the Governing Council.

14.2. The COE shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester.

14.3. The internal evaluation marks/grades in the prescribed format should reach the office of Controller of Examinations, St. Albert's College before the commencement of study leave in each semester.

14.4. Students can register for end semester examination only if they pass internal evaluation.

15. External Examination (End Semester Examination)

The external examination of all semesters shall be conducted by the College at the end of each semester.

15.1. Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the college on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on

production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the Department. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance will not be readmitted.

15.2. All students are to do a project in the area of core course. This project can be done individually or in groups (not more than five students) for all subjects which may be carried out in or outside the campus. The projects are to be identified during the II 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 college. External Project evaluation and Viva / Presentation are compulsory for all subjects and will be conducted at the end of the programme.

15.3. There shall be supplementary exams only for fifth semester. For reappearance improvement for other semesters the students can appear along with the next batch.

15.4. A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.

16. **All courses shall have unique alphanumeric code.**

17. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. She/he shall also upload a detailed scheme of evaluation along with the questions. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions and to be generated from the question bank. **RANK CERTIFICATE**

The college publishes rank list of top 10 candidates for each programme after the publication of 6th semester results. Rank certificate shall be issued to candidates

who secure positions from 1st to 3rd in the rank list. Candidates who secure positions from fourth to tenth in the rank list shall be issued position certificate indicating their position in the rank list. Candidates shall be ranked in the order of merit based on the CGPA scored by them. Grace marks awarded to the students should not be counted fixing the rank/position. Rank certificate and position certificate shall be signed by the Controller of Examinations.

18.1 Pattern of questions Papers

(a) Without practical

Sl. No	Pattern	Marks	Choice of questions	Total marks
1	Short Answer/problem type	2	10/12	20
2	Short essay/problem	5	6/9	30
3	Essay/problem	15	2/4	30
Total				80

(b) With practical

Sl. No	Pattern	Marks	Choice of questions	Total marks
1	Short Answer/problem type	1	10/12	10
2	Short essay/problem	5	6/9	30
3	Essay/problem	10	2/4	20
Total				60

Each BOS shall specify the length of the answers in terms of number of words.

Pattern of questions for external examination of practical papers will decided by the concerned Board of Studies/Expert Committees.

18.2 MARK CUM GRADE CARD

The College under its seal shall issue to the students a MARK CUM GRADE CARD on completion of each programme, which shall contain the following information:

a) Name of the College

(b) Title & Model of the Undergraduate Programme

(c) Name of the Semester

(d) Name and Register Number of the student

(e) Date of publication of result

(f) Code, Title, Credits and Maximum Marks (Internal, External & Total) of each course opted in the semester.

(g) Internal, External and Total Marks awarded, Grade, Grade point and Credit point in each course opted in the semester.

(h) The total credits and total credit points in the semester.

(i) Semester Grade Point Average (SGPA) and corresponding Grade.

(j) Cumulative Grade Point Average (CGPA), GPA corresponding to Common Courses I and II, Core Course, Complementary Courses, Vocational Courses and Open Course.

(k) The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the final semester examination and shall include the final Grade(SGPA) scored by the candidate from 1st to 5th semesters, and the overall Grade for the total programme

There shall be 3 level monitoring committees for the successful conduct of the scheme. They are -

19. There shall be 3 level monitoring committees for the successful conduct of the scheme. They are -

19.1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior most teachers as members.

19.2. College Level Monitoring Committee (CLMC), comprising Principal, Controller of Examinations and A.O/Superintendent as members.

19.3. Governing Council.

20. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Governing Council shall, for a period of one year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

21. The Governing Council is authorized to make necessary criteria for eligibility for higher education in the grading scheme, if necessary, in consultation with affiliating University & other Universities. The Governing Council is also authorized to issue orders for the perfect realization of the Regulations.

Annexure I: Model Mark Cum Grade Card

St Albert's College (Autonomous) Ernakulam

Section: Banerjee Road, Ernakulam.

Student ID: Date:

MARK CUM GRADE CARD

Name of Candidate:

Name of College:

Permanent Register Number (PRN):

Name of the Programme: Degree:

Name of Examination : First Semester Examination Month and Year

Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Percentage of total marks	Grade awarded (G)	Grade point (GP	Credit point (Cx GP)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (I)	Maximum	Awarded (E + I)	Maximum					
	Common Course I												
	Common Course II												
	Core Course												
	Complementary Course I												
	Complementary Course II/ Vocational Course												
	Total												
	Total credit points (TCP)												
	Total credit (TC)												
	SGPA:												
	Grade:												

Annexure II: Model Mark cum Grade Card (VI Semester)

St Albert's College (Autonomous) Ernakulam

Section: Banerjee Road, Ernakulam.

Student ID: Date:

MARK CUM GRADE CARD

Name of Candidate:

Name of College:

Permanent Register Number (PRN):

Name of the Programme: Degree:

Name of the Examination:

Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Percentage of total marks	Grade awarded (G)	Grade point (GP	Credit point (Cx GP)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (I)	Maximum	Awarded (E + I)	Maximum					
	Core 9 Core 10 Core 11 Core 12 Choice Based Course Project SGPA Grade												

		Credit	GPA	Grade	Month & Year	Result
	Semester I Semester II Semester III Semester IV Semester V Semester VI					
	Common Course I Common Course II Complementary Course I Complementary Course II Core Course Open Course					
	Overall programme CGPA:					

Annexure III:

Reverse side of the mark cum Grade Card (Common to all Semesters)

Description of the Evaluation Process

Grade and Grade Point

The Evaluation of each course comprises of internal and external components in the ratio 1:4 for all courses

Grades and Grade points are given on a 7 point scale based on the percentage of total marks

(Internal + External) as given in Table 1.

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

Credit point and Credit point Average.

Grades for the different semesters are and the overall programme is given based on the corresponding CPA.

Table 1

% of marks	Grade	GP
Equal to 95 and above	S Outstanding	10
Equal to 85 and < 95	A^+ Excellent	9
Equal to75 and < 85	A Very Good	8
Equal to 65 and < 75	B+ Good	7
Equal to 55 and < 65	B Above Average	6
Equal to 45 and < 55	C Satisfactory	5
Equal to 35 and < 45	D Pass	4
Below 35	F Failure	
	Ab Absent	

Credit point **(CP)** of a paper is calculated using the formula CP = C x GP,

where C is the Credit; GP is the Grade Point

Grade Point Average (GPA) of a Course/ Semester or Programme (cumulative) etc. is calculated using the formula $\mathbf{GPA} = \frac{\mathrm{TCP}}{\mathrm{TC}}$

where TCP is the Total Credit Point; TC is the Total Credit

CPA	
Equal to 9.5 and above	**S Outstanding**
Equal to 8.5 and < 9.5	**A+ Excellent**
Equal to7.5 and < 8.5	**A Very Good**
Equal to 6.5 and < 7.5	**B+ Good**

Equal to4.5 and < 5.5	**C Satisfactory**
Equal to 3.5 and < 4.5	**D Pass**
Below 3.5	**F Failure**

Note: A separate minimum of 30 % Marks each for internal and External (For both Theory and Practical) and aggregate minimum of 35 % are required for pass for a paper. For a pass in a programme, a seperate minimum of grade D is required for all the individual papers. If a candidate secure F Grade for any one of the paper offered in a semster/ programme until he or she improves this to D Grade or above within the permitted period.A separate minimum of 75% of attendance is needed for OJT/HOT.

COURSE DESIGN - B. Sc. PROGRAMMES IN PHYSICS

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.

PROGRAMME STRUCTURE		
	Programme structure	
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 (including Project) and Complementarycourses	79
F	Open course	3
G	Minimum attendance required	75%
	Scheme of Courses:	
The different types of courses and its number are as the following:		
	Course	No
	Common Courses	10
	Core Courses	12
	Project	1
	Core Practicals	6
	Open Course	1

	Choice based Course	1
	Complementary Courses	8
	Complementary Practicals	2
	Total	**41**

Course Code:

Every course is coded using an eleven-digit alpha numeric code that gives a brief description on the following details.

A. Subject Code (3 characters)

Composed of three characters, which gives a meaningful abbreviation of the subject to which the paper belongs to. Here PHY stands for Physics.

B. Semester to which course belongs to (1 digit)

Composed of single digit number which indicates the semester to which the paper belongs to (1to 6). In case of Practicals the number indicates the semester in which the exam in conducted.

C. Course type as per syllabus (2 characters)

Composed of two characters which give meaningful abbreviation of type of the course. The abbreviations used here are CM – Complementary Course, CB – Choice Based Core, CR – Core Course, PR – Project, and CO – Open Course.

D. Whether 'Theory' or 'Practical' or Project

Letter 'T' is used to denote Theory papers, the letter 'P' for Practical papers.

For project the code is CPR.

E. Serial number of the course in continuous series (2 digits)

Composed of two digits to indicate the paper's relative position in the programme.

Eg. 01 indicates 1st paper, 05 indicates 5th paper, etc.

F. Syllabus year (2 digits)

Composed of two digits to indicate the year from which the syllabus is effective.

Sample Course Code

The course code PHY1CRT0119 indicates that the paper is Physics Ist semester core theory 1st paper and the syllabus is effective from 2019 onwards.

5.4. Courses with Credits:

Courses with Credits of different courses and scheme of examinations of the programme is the following.

Courses	Credits	Total
Core Courses	47	
Open Course	3	
Choice Based Core	3	

Project & Industrial visit	1	
Vocational Courses	Nil	
2nd Core Courses	Nil	
Total		**54**
Complementary Courses I	14	
Complementary Courses II	14	
Total		**28**
Common Courses	38	
Total		**38**
Grand Total		**120**

5.5. Scheme of Distribution of Instructional hours for the core courses

Curriculum and syllabus 2017 admissions onwards

Semester	Model I	
	Theory	**Practical**
First semester	2	2
Second semester	2	2
Third semester	3	2
Fourth semester	3	2
Fifth semester	17	8
Sixth Semester	17	8

6. MARKS DISTRIBUTION FOR PROJECT AND INDUSTRIAL VISIT

All students are 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 student must visit an industry during 5th 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		**80**	
	Components of Evaluation (External)		**Marks**
	Dissertation - Project (External)		45
	Viva-Voce– Project(External)		27
	Industrial Visit Report		5
	Viva-Voce – Industrial Visit		3
	Total		**80**

b) Marks of internal evaluation: 20(All the five components of the internal assessment are mandatory)

Components of Internal Evaluation	**Marks**
Punctuality	4
Experimentation/Data Collection	5
Knowledge	5
Report	4

Industrial Visit	2
Total	**20**

B. Sc. Physics Programme – (Model I)

Semester	Title of the Course	Hours/ week	Credits	Total hrs	University Exam duration	Marks	
						IA	EA
1	English I	5	4	90	3	20	80
	English II/ Common Course I	4	3	72	3	20	80
	Second Language I	4	4	72	3	20	80
	PHY1CRT0117 - Methodology and Perspectives of Physics	2	2	36	3	15	60
	Complementary I: Mathematics I	4	3	72	3	20	80
	Complementary II: Chemistry I	2	2	36	3	15	60
	Core Practical I: PHY1CRP0117 Mechanics and Properties of Matter	2	-	36	-	-	-
	Complementary II Practical I	2	-	36	-	-	-
2	English II	5	4	90	3	20	80
	English III/ Common Course II	4	3	72	3	20	80
	Second Language II	4	4	72	3	20	80
	PHY2CRT0117 – Mechanics and	2	2	36	3	15	60

	Properties of Matter						
	Complementary I: Mathematics II	**4**	**3**	**72**	**3**	**20**	**80**
	Complementary II: Chemistry II	**2**	**2**	**36**	**3**	**15**	**60**
	Core Practical I: PHY2CRP0117 Mechanics and Properties of Matter	**2**	**2**	**36**	**3**	**10**	**40**
	Complementary II Practical I	**2**	**2**	**36**	**3**	**10**	**40**
3	**English III**	**5**	**4**	**90**	**3**	**20**	**80**
	II Lang/Common Course I	**5**	**4**	**90**	**3**	**20**	**80**
	PHY3CRT0117 – Optics, Laser and Fiber Optics	**3**	**3**	**54**	**3**	**15**	**60**
	Complementary I: Mathematics III	**5**	**4**	**90**	**3**	**20**	**80**
	Complementary II: Chemistry III	**3**	**3**	**54**	**3**	**15**	**60**
	Core Practical II: PHY3CRP0117 Optics and Semiconductor Physics	**2**	**-**	**36**	**-**	**-**	**-**
	Complementary II Practical II	**2**	**-**	**36**	**-**	**-**	**-**
4	**English IV**	**5**	**4**	**90**	**3**	**20**	**80**
	II Lang/ Common Course II	**5**	**4**	**90**	**3**	**20**	**80**
	PHY4CRT0117- Semiconductor Physics	**3**	**3**	**54**	**3**	**15**	**60**
	Complementary I: Mathematics IV	**5**	**4**	**90**	**3**	**20**	**80**
	Complementary II: Chemistry IV	**3**	**3**	**54**	**3**	**15**	**60**
	Core Practical II: PHY4CRP0117 Optics and Semiconductor Physics	**2**	**2**	**36**	**3**	**10**	**40**
	Complementary II Practical II	**2**	**2**	**36**	**3**	**10**	**40**
5	**PHY5CRT0117 – Electricity and Electrodynamics**	**3**	**3**	**54**	**3**	**15**	**60**
	PHY5CRT0217 – Classical and Quantum Mechanics	**3**	**3**	**54**	**3**	**15**	**60**
	PHY5CRT0317 –Digital Electronics and Programming	**3**	**3**	**54**	**3**	**15**	**60**
	PHY5CRT0417 – Environmental Physics and Human Rights	**4**	**4**	**72**	**3**	**15**	**60**
	PHY5COT0X* -Open Course	**4**	**3**	**72**	**3**	**20**	**80**
	Core Practical III: PHY5CRP0117 Electricity, Magnetism and Laser	**2**	**-**	**36**	**-**	**-**	**-**
	Core Practical IV: PHY5CRP0217 Digital Electronics	**2**	**-**	**36**	**-**	**-**	**-**

	Core Practical V: PHY5CRP0317 Thermal Physics, Spectroscopy and Python programming	**2**	**-**	**36**	**-**	**-**	**-**
	Core Practical VI: PHY5CRP0417 Acoustics, Photonics and Advanced Semiconductor Physics	**2**	**-**	**36**	**-**	**-**	**-**
6	**PHY6CRT0117- Thermal and Statistical Physics**	**3**	**3**	**54**	**3**	**15**	**60**
	PHY6CRT0217 --Relativity and Spectroscopy	**4**	**3**	**72**	**3**	**15**	**60**
	PHY6CRT0317 – Nuclear, Particle and Astrophysics	**3**	**3**	**54**	**3**	**15**	**60**
	PHY6CRT0417- Solid State Physics	**4**	**3**	**72**	**3**	**15**	**60**
	PHY6CRT0X *17-Choice BasedCourse	**3**	**3**	**54**	**3**	**20**	**80**
	Core Practical III: PHY6CRP0117 Electricity, Magnetism and Laser	**2**	**2**	**36**	**3**	**10**	**40**
	Core Practical IV: PHY6CRP0217 Digital Electronics	**2**	**2**	**36**	**3**	**10**	**40**
	Core Practical V: PHY6CRP0317 Thermal Physics, Spectroscopy and Python programming	**2**	**2**	**36**	**3**	**10**	**40**
	Core Practical VI: PHY6CRP0417 Acoustics, Photonics and Advanced Semiconductor Physics	**2**	**2**	**36**	**3**	**10**	**40**
	PHY6PR0117 – Project & Industrial Visit	**-**	**1**	**-**	**-**	**20**	**80**

***- X Stands for 01, 02, 3, … for Open course and 5,6,7,…. For Choice based course**

Choice Based Course

Sl. No.	Paper Code	Semester	Paper Title
1	PHY6CRT0517	VI	Computational Physics
2	PHY6CRT0617	VI	Material Science
3	PHY6CRT0717	VI	IT
4	PHY6CRT0817	VI	Instrumentation

5	**PHY6CRT0917**	**VI**	**Astronomy & Astrophysics**

Open Course

Sl. No.	Paper Code	Semester	Paper Title
1	**PHY5COT0117**	**V**	**Physics in Daily Life**
2	**PHY5COT0217**	**V**	**Our Universe**
3	**PHY5COT0317**	**V**	**Computer Hardware and Networking**

Semester-I

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

PHY1CRT0117: METHODOLOGY AND PERSPECTIVES OF PHYSICS

Learning Outcome:

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

- introduced with the pursuit of physics, its history and methodology.
- understand the analytical approach to modeling of physical phenomena.
- understand the impact of physics and science on society.
- understand the Importance of measurements which is central to Physics.

Module I

Concepts and Development Physics: (8hours)

Development of physics in the last century and the birth of new scientific concepts with reference to s*cientific 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)

References:

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, cylindricalcoordinates (Basic ideas with examples in physics),

References:

6. Introduction to Electrodynamics, David J. Griffiths, Prentice Hall India Pvt. Ltd., Chapter 1
7. Mathematical Physics: Charlie Harper
8. University Physics, Roger A Freedman, Hugh D Young 14th edition
9. Digital electronics: Albert Paul Malvino
10. 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- common balance; length-vernier, screw gauge, travelling microscope, and sonar; time- pendulum clock and atomic clock; angle- spectrometer and stellar parallax; current- ammeter and conversion of galvanometer to ammeter; voltage- voltmeter and conversion of galvanometer to voltmeter. 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:

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

Semester-II

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

PHY2CRT0117 : MECHANICS AND PROPERTIES OF MATTER

Learning outcome

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

- aquire engineering skills and practical knowledge which enable the student in the day today life.
- develop deep understanding of the basics of subjects like mechanics and properties of matter so that they can pursue higher studies.

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 mechanics (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.

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 Somnath Datta, Pearson
7. Mechanics by H.D Young and R.A Freedman, Pearson.

Semester-III

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

PHY3CRT0117: OPTICS, LASER AND FIBER OPTICS

Learning Outcome

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

- Comphrehend the fascinating area of interference
- Compare Fresnel's and Fraunhofer diffraction.
- Identify polarization by reflection, refraction and scattering.
- Classify different types of lasers, its principle and properties, application.
- Understrand structure and principle of optic 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 stimulatedemission, 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.

Fiber 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 1799.

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 (4^{th} edition) Subir Kumar Sarkar, S Chand.

Semester-IV

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

PHY4CRT0117: SEMICONDUCTOR PHYSICS

Learning Outcome.

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

- Understand basic concept of doping, junction, and VI charecteristics.
- Understand biasing techniques for diodes and transistors.
- Design basic amplifiers and oscillators.

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 monostable multivibrator (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: Basic Electronics-B. L. Theraja - Chapters 26, 30, 31

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

References:

1. Principles of electronics, VK Mehta, S Chand
2. Basic Electronics(7^{th}Edition), 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, Santiram Kal, PHI 2010

Semester-V

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

PHY5CRT0117: ELECTRICITY AND ELECTRODYNAMICS

Learning Outcome.

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

- Define choke coil and transcformers
- Explain thermocouple effects
- Comphrehend Maxwell's equations ans Poynting theorem.

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- Pragati Prakashan*
5. *Classical Electromagnetism, Jerrold Franklin- Pearson*
6. *Electromagnetic Fields and Waves, KD Prasad- Satya Prakashan*
7. *Field and wave Electromagnetics, David K Cheng- Pearson.*

Semester-V

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

PHY5CRT0217: CLASSICAL AND QUANTUM MECHANICS

Learning Outcome.

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

- Distinguish various types of constraints in a mechanical problem.
- Understand different analytical mechanics for solving problems.
- Explain photoelectric effect and Compton effect.
- Evaluate eigen values and eigen functions
- Solve Schrodinger equation for particle in a box.

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,John Wiely*
7. *Quantum Mechanics- Griffith, Pearson*

Semester-V

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

PHY5CRT0317: DIGITAL ELECTRONICS AND PROGRAMMING

Learning Outcome.

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

- Explain basic logic operations.
- Understand Boolean algebra
- Understand the fundamentals of Digital circuits.

Module I

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

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).

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. Floyed (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*

References:

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)**

PHY5CRT0417: 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.

Learning Outcome.

Upon completion of this course, the students will be able 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.
- 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.
- develop the sense of awareness 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.
- acquire the basic knowledge about environment and the social norms that provides unity with environmental characteristics and create positive attitude about the environment.

Module I

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

Definition, scope and importance

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
- Hot-sports of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts
- Endangered and endemic species of India

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 **(8 hours)**

Unit 1- Human Rights– An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Unit-2 Human Rights and United Nations – contributions, main human rights related organs - UNESCO, UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Unit-3 Environment andHuman Rights - Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment

Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western ghats- mention Gadgil committee report, Kasthurirengan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

Internal: **Field study**

- Visit to a local area to document environmental grassland/ hill /mountain
- Visit a local polluted site – Urban/Rural/Industrial/Agricultural Study of common plants, insects, birds etc
- Study of simple ecosystem-pond, river, hill slopes, etc

(Field work Equal to 5 lecture hours)

REFERENCES

1. Bharucha Erach, 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. Singal Rakesh Ranjan - 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.

Human Rights

1. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.
2. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)
3. Law Relating to Human Rights, Asia Law House, 2001.
4. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,
5. S.K.Khanna, Children andthe Human Rights, Common Wealth Publishers, 1998. 2011.
6. Sudhir Kapoor, Human Rights in 21st Century, Mangal Deep Publications, Jaipur, 2001.
7. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004.

Semester-V

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

PHY5COT0117: Physics in Daily Life

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

- Understand the ideas regarding sensible units and measurements which is the counterstone of physics.
- Apply laws of optics in daily life
- Understand rotational and translational motion
- Do basic service of electrical appliances.
- Get basic idea of various forms of energy.

Module I

Unit 1 **(8 hours)**

Fundamental and derived quantities. Units and dimensions, dimensional analysis, order of magnitude, significant figures, errors.

Unit 2 Light **(12 Hours)**

Reflection, refraction, diffraction,interference, scattering(elementary ideas only) – examples from daily life – apparent depth, blue color of sky, twinkling of stars.

Total internal reflection, mirage, sparkling of diamond, primary and secondary rainbow – optical fibers. Concave and convex mirrors, lenses – focal length, power of a lens, refractive index, prism, dispersion. Human eye, defects of the eye – myopia, hypermetropia, presbyopia and astigmatism and their correction by lens.

Module II

Unit 3 Motion **(12 Hours)**

Velocity, acceleration, momentum, Idea of inertia, force - laws of motion. Newton's law of gravitation, acceleration due to gravity, mass and weight, apparent weight, weightlessness.

Rotational motion, Moment of inertia, torque, centripetal and centrifugal acceleration- examples- banking of curves, centrifugal pump, roller coasters.

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, moon- faces of moon, lunar and solar eclipses, constellations, Different types of stars, Galaxies, black hole. Satellites, Artificial satellites, Global positioning system. Geo stationary satellite.

Reference Texts

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

Semester-V

OPEN COURSE: Credit-3 (72hours)

PHY5COT0217: Our Universe

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

- *comprehend the cosmos and its origin and to developscientific attitude and aptitude*.

Module I

Our universe (10 hours)

Early models of universe- Geo centric model- Ptolemy-Aristotle. Copernican model - Sun at the centre. Galileo and his observations. Planetary paths-Kepler's laws(**No need of derivation**).

Galaxies-Hubble's classification – Spiral, elliptical & irregular galaxies. Milky way galaxy (**qualitative**).

Module II

Cosmology (14 hours)

Origin of the universe - Big bang theory – expansion of the universe – Hubble's law, age of the universe. Doppler effect and red shift(**qualitative**).

Stellar evolution – birth - red giant- death of a star. White dwarf- Chandrasekhar limit. Super novae- neutron star- black hole.

Text Books

1. Architecture of the universe. (cha 3,4,8 and 9) Necia H.Apfel and Allen Hynek-Benjamin Cummins Publishing Company.
2. Astronomy A Beginners guide to the universe sixth edition(Ch.12)-Chaisson Mc Millan
3. Cosmic vistas-A popular history of astronomy(chap 4,5,6,7,8) Biman Basu-national book trust,India
4. Astronomy; A Self Teaching Guide (cha 5&6)-Dinah L Moche
5. The Great Universe (cha 4,5,6,7) G.K Sasidharan-S.Chand

Module III

Observational Astronomy (24 hours)

Celestial sphere- cardinal points, celestial equator, ecliptic, equinoxes. Celestial co-ordinate systems-equatorial co-ordinate system-Right ascension & declination, Ecliptic and galactic co-ordinate systems. Diurnal motion of sun - Summer solstice and winter solstice. Time - apparent and mean solar time, International date line. Constellations-zodiacal constellations. Astronomical distance scales – AU, Parsec and light year. Stellar Parallax and distance to stars from parallax.

Optical Telescopes - Light gathering power, visual angle, angular magnification, Types of telescopes-refracting and reflecting – Newtonian and Cassegrain telescopes **(No need ofderivation of magnification**). HST, Radio telescopes, GMRT (India).

Text Books:

1. Astronomy A beginner's guide to the universe sixth edition(ch-1)-Chaisson Mc Millan
2. Astrophysics stars and galaxies (chap 2,4,20)K D Abhayankar
3. Joy of Star watching (**ch**- 3, 8 &10)- Biman Basu- National Book Trust, India
4. A textbook of Optics(ch-10) N.Subrahmanyan, Brijlal and M.N Avadhanulu
5. Astronomy; A Self Teaching Guide (cha 2&3)-Dinah L Moche
6. www.gmrt.ncra.tifr.in

Module IV

Solar system (24 hours)

The sun- solar atmosphere - Photosphere, chromospheres and corona. Sun spots. Definition of a planet- terrestrial planets & Jovian planets, Comparison of planets. Minor members of solar system- Asteroids, comets, meteors.

Universal law of gravitation. Earth's orbital motion-day to day changes-seasonal changes.

Text Books:

1. Architecture of the Universe (**ch**- 2, 14, 15, 17, 18, 19, 20)- Necia H. Apfel & Allen Hynek- The Benjamin Cummings publishing company, Inc.
2. Astronomy A beginner's guide to the universe sixth edition(ch-1)-Chaisson Mc Millan
3. Astronomy; A Self Teaching Guide (cha 4,9,10,11)-Dinah L Moche
4. The great Universe – G.K Sasidharan-S.Chand

Semester-V

OPEN COURSE: Credit-3 (72hours)

PHY5COT0319: COMPUTER HARDWARE AND NETWORKING

Module I (24 hours)

Microprocessors – Basic concepts of Intel 80186, 80286, 80386, 80486 and Pentium processors. Motherboard, Expansion buses, Memory, upgrading / adding memory, BIOS Motherboard – removing, installing / configuring motherboards, BIOS set up, troubleshooting memory.

Module II (24 hours)

Data storage devices, IDE and SCSI controllers, hard disk, installing / upgrading CD ROM drives, DVD, Optical storage, Tape back – ups. Printers, Keyboards, pointing and positioning devices, digital camera, Scanners, Monitors, Hard disks- installing / upgrading, troubleshooting, formatting, Error codes, BIOS disk routines

MODULE III (24 hours)

Multimedia, Graphical accelerators, audio, modems, I/E add on, Networks, Power supplies, UPS

Printer installation, Software installation – DOS, Windows 95, 98, Linux, WindowsNT – installation,

Administration, Installing PASCAL, C, ORACLE, VISUAL BASIC, Software diagnostics –

PC tools, Norton utilities, XT/AT diagnostics, Viruses and anti-viruses.

References:

1. *IBM PC and CLONES- Hardware, troubleshooting and maintenance – B Govindarajalu*
2. *PC Hardware, a beginners guide – Ron Gilster*
3. *All about Motherboard: - Manahar Lotia, Pradeep Nair*

Semester-VI

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

PHY6CRT0117: THERMAL AND STATISTICAL PHYSICS

Learning Outcome

On satisfying the requirements of this course, students will have the knowledge and skills to:

- Identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, partition functions.
- Use the statistical physics methods, such as Boltzmann distribution, Gibbs distribution,
- Apply Fermi-Dirac and Bose-Einstein distributions to solve problems in some physical systems.
- Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.
- Apply the concepts and laws of thermodynamics to solve problems in thermodynamic
- Understand systems such as gases, heat engines and refrigerators etc.
- Analyze phase equilibrium condition and identify types of phase transitions of physical systems.

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 and6

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 (8hours)

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 Brij Lal, 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)**

PHY6CRT0217: RELATIVITY AND SPECTROSCOPY

Learning Outcome

On satisfying the requirements of this course, students will have the knowledge and skills to:

- Understand Special Theory of Relativity
- Analyze Lorentz transformnation equations
- Apply relativistic variations in mass, length and time
- Describe various atom models
- Explain Zeeman effect
- Familiarize the various regions of electromagnetic spectra and the spectroscopic technique outlaying in each region.
- Classify molecule based on the principle moment of inertia

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

Molecular Spectroscopy (21 hours)

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 (Pragathi Prakash)*
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)**

PHY6CRT0317: NUCLEAR, PARTICLE PHYSICS AND ASTROPHYSICS

Learning Outcomes

On completion of the course, the student should be able to:

- explain the different forms of radioactivity and account for their occurrence
- describe the astrophysical processes leading to nuclear synthesis
- account for the fission and fusion processes
- classify elementary particles according to their quantum numbers and draw simple reaction diagrams
- classify different kinds of reactions between elementary particles

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 Subhra Kakani -Viva Books 2008*
3. *Elements of Nuclear Physics, M L Pandya and R P S Yadav, Kedar Nath Ram Nath*
4. *Modern Physics, Kennth Krane, 2nd Edition, Wiley India (Pvt) Ltd.*
5. *Modern Physics , G. Aruldhas and P. Rajagopal, Prentice-Hall India*
6. *An Introduction to Astrophysics, Baidyanath Basu, 2nd Edition, Prentice-Hall India*

Semester-VI

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

PHY6CRT0417: SOLID STATE PHYSICS

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 **(12 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.

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 and tunneling- 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 – XIV-1 **Credit – 3 (54 hours)**

PHY6CRT0517 : COMPUTATIONAL PHYSICS

Learning Outcome:

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

- *Discuss and compare the methods to solve algebraic and transcendental equations*
- *Solve non linear problems using numerical methods*
- *Explain curve fitting and interpolation*
- *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- Runge Kutta methods for 1st and 2nd order

***Text Books**:*

1. *Numerical Methods, Balagurusamy, TMH*
2. *Numerical Methods for Scientists and Engineers- K Sankara Rao- PHI*
3. *Introductory Numerical Methods, S S Sastry, PHI.*

Semester-VI

Choice Based Course – XIV-2 **Credit-3 (54 hours)**

PHY6CRT0617: MATERIAL SCIENCE

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 5

Text Books:

1. *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., Vikas 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, Baldev Raj,BB Rath and J Murday- Universities Press-IIM*

Semester-VI

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

PHY6CRT0717: INFORMATION TECHNOLOGY

Learnng Outcome

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

- learn about the fascinating world of information technology and
- to use the tools available in Internet and the World Wide Web for a deep study of the subjects related to physics in better way by the students themselves.

Module I **(20 hours)**

Information and its Use : Information Technology – Quality of information – Message transmission – Electronic Office – E mail – Document storage – Computers in Industry – Different types – Graphical user interface

Text book: "Information Technology – The Breaking Wave", D.Curtin, K.Sen and K.Morin, Tata McGraw Hill, 1999. Chapter – 1, 2

Computer Networks: Importance of Networks. Components of Networks. Classification of Networks: Broad cast networks-Switched networks. Switching Techniques. Types of Networks – LAN – MAN – WAN. Networking Models – OSI reference model – TCP/IP reference model-Comparison between the OSI and TCP/IP models. Network Topology – Bus- Star-Ring-Tree-Mesh-Cellular.

Text book: Computer Networks, A.S. Tanenbaum - Prentice Hall of India, Chapter - 1

Computer Fundamentals, P.K. Sinha 3rd Edn. BPB Publications, Chapter – 17

THE INTERNET: Internet Protocols – Internet Protocol (IP)-Transmission Control Protocol (TCP) -Internet Address – Structure of Internet Servers Address-Address Space- Services on Internet – Domain Name System-SMTP and Electronic mail – Http and World Wide Web-Usenet and News groups-FTP-Telnet-Network Security

-Digital Signature-E-mail Privacy-Internet Tools – Search Engines-Web browsers-Internet explorer, Netscape Navigator, Mozilla Firefox(Working Knowledge)

Text book: Computer Networks, A.S.Tanenbaum - Prentice Hall of India, Chapter –5, 6, 7

Computer Fundamentals, P.K. Sinha 3rd Edn. BPB Publications, Chapter – 18

Module – II **(20 hours)**

THE HTML: What is HTML? Basic Tags of HTML – HTML-TITLE-BODY - Starting an HTML document – The <!DOCTYPE>declaration-setting boundaries with <HTML>-the HEAD element-the BODY element-the STYLE element and the SCRIPT element. - Formatting of text– Headers-Formatting Tags-PRE tag-FONT tag-Special Characters. Working with Images- META tag -Links – Anchor Tag -Lists – Unordered Lists-Ordered Lists-Definition Lists -Tables –TABLE, TR and TD Tags-Cell Spacing and Cell Padding-Colspan and Rowspan -Frames –Frameset-FRAME Tag-NOFRAMES Tag - Forms – FORM and INPUT Tag-Text Box-Radio Button-Checkbox-SELECT Tag and Pull Down Lists-Hidden-Submit and Reset

Text book: HTML4 – 2nd Edn. Rick Darnell, Techmedia, Chapter – 1, 2,3,4,5

Module – III **(14 hours)**

Basic Idea of DBMS: Need for Data Base – Database Systems versus File systems - View of Data - Data Abstraction-Instances and Schemas - Data Models – ER Model-Relational Model- Network Model-Hierarchical Model (general ideas) -Basic ideas about Structured Query Language.

Text book: Fundaments of Database System – Elmasri, Ramez and Navathe Shamkant B. 4th Edn.Person Education, India, 2004. Chapter – 1

MS – OFFICE/OPEN OFFICE (Working Knowledge): Word processors – PowerPoint - Spreadsheets – Databases

(No specific text book is preferred. MS office (97, 98, 2000, /Open Office which is installed in the lab can be used. Working practice must be given)

References

1. "Information Technology – The Breaking Wave", D.Curtin, K.Sen and K.Morin,Tata McGraw Hill, 1999.
2. Computer Networks – A.S. Tanenbaum - Prentice Hall of India
3. Computer Fundamentals – P.K. Sinha 3rd Edn. BPB Publications
4. Internet and World Wide Web – Deitel
5. HTML4 – 2nd Edn. Rick Darnell, Techmedia
6. Database System Concepts – Silberschatz-Korth-Sudarshan 4th Edn – TataMac Graw Hill
7. "Information Technology and systems", Green, B.C., Longman Scientific

&Technical Publishers, England, 1994.

8. Networks – Tirothy S. Ramteke – 2nd Edn. Pearson Edn – New Delhi, 2004
9. Data and Computer Communucation, William Stalling, PHI, New Delhi.
10. Mastering HTML4 – Ray D.S. and Ray E.J. – BPB
11. HTML – The Complete Reference – Tata Mc Graw Hill
12. Fundaments of Database System – Elmasri, Ramez and Navathe Shamkant B. 4thEdn.v Pearson Education, India, 2004.

Semester-VI

Choice Based Course – XIV-IV **Credit – 3 (54 hours)**

PHY6CRT0817: INSTRUMENTATION

Module I **(10 hours)**

Measurements and Measurement Systems

Measurements-Method of measurement-Instruments and measurement systems-Mechanical, Electrical and Electronic instruments-Classification of Instruments-Applications of Measurement Systems - Elements of generalized measurement systems

Text book: A Course in Electrical and Electronics Measurements and Instrumentation, Sawhney. A.K- Chapter 1

Module II **(18 hours)**

Primary Sensing Elements and Transducers

Mechanical Devices as Primary Detectors – Mechanical Spring Devices – Pressure Sensitive Primary Devices – Flow Rate Sensing Elements - Transducers-Classification– Characteristics (Static and Dynamic) and Choice of Transducers – Characterization

Text book: Sensors and Transducers, Patranabis D., Chapter 1

A Course in Electrical and Electronics Measurements and Instrumentation, Sawhney. A.K- Chapter 25

Module III **(18 hours)**

Resistive,Inductive and Capacitive Transducers

Potentiometers –Strain gauges (Theory, types) - Rosettes – Resistance thermometer – Thermistors (materials, Constructions, Characteristics) – Thermocouples-Self inductive transducer – Mutual inductive transducers – Linear Variable Differential Transformer – LVDT Accelerometer – RVDT – Synchros – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.

Miscellaneous Transducers **(8 hours)**

Light transducers (photo-conductive, photo emissive, photo-voltaic, semiconductor, LDR)–Piezoelectric transducer – Hall Effect transducers – Digital Encoding transducers

Text book: A Course in Electrical and Electronics Measurements and Instrumentation, Sawhney. A.K- Chapter 1 and 25

Text books:

1. *A Course in Electrical and Electronics Measurements and Instrumentation, Sawhney A.K, 18th Edition, Dhanpat Rai & Company Private Limited, 2007.*
2. *Sensors and Transducers, Patranabis D., 2nd edition, PHI, 2015.*

References:

1. *Measurement Systems-Applications and Design, Doebelin. E.A, Tata McGraw Hill*
2. *Sensors and Transducers, Patranabis. D, Prentice Hall of India*
3. *Principles of Measurement Systems John. P, Bentley,, III Edition, Pearson*
4. *Transducers and Instrumentation, Murthy.D.V.S,, Prentice Hall of India*
5. *Instrumentation- Devices and Systems, Rangan, Sarma, and Mani, Tata-McGrawHill*
6. *Electronic Instrumentation by H.S Kalsi, McGrawHill*
7. *Instrumentation measurements and analysis, Nakra & Choudhary, Tata-McGrawHill*
8. *Mechanical and industrial measurement by R.K. Jain, Khanna Publishers, New Delhi*

Semester-VI

Choice Based Course – XIV-V **Credit – 3 (54 hours)**

PHY6CRT0917: Astronomy and Astrophysics

Module I

Observational astronomy **(12 Hours)**

Astronomical distance scales – AU, Parsec and light year. Stellar Parallax and distance to stars from parallax. Magnitude scale - Apparent and absolute magnitudes. Variable stars as distance indicators. Cepheid variables. Astronomy in different bands of electromagnetic radiation- Optical, radio and X-ray astronomies, Radiation Laws.

Optical Telescopes. Types of telescopes-refracting and reflecting – Newtonian and Cassegrain telescopes. Magnification and f number. Resolving Power, Telescope mounts – alt-azimuth and equatorial mounts.

Text Book **:** K D Abhyankar Section 3.1 & 4.3, Ian Morison Chapter 5, Dinah L. Moché, Chapter 2 &3.

Module II

Celestial sphere **(8 Hours)**

Concept of celestial sphere - cardinal points, celestial equator, ecliptic, equinoxes. Diurnal motion of sun - summer solstice and winter solstice. Celestial co-ordinate systems: – Horizon system – Azimuth & Altitude, Equatorial system-Right ascension & declination, Ecliptic coordinate system.

Time - apparent and mean solar time, sidereal time. Twilight, Seasons- causes of seasons (qualitative ideas). International Date Line.

*Text Book***:**K D Abhyankar, Chapter 2 & Dinah L. Moché, Chapter 1

Sun (**5 Hours)**

Sun - solar atmosphere and internal structure – Photosphere, chromosphere and corona. Radiation zone & Convection Zone. Sun spots, Activity Cycles, flares, prominences, coronal holes, Solar wind.

*Text Book***:** Dinah L. Moché, Chapter 4, Ian Morison Chapter 2

Galaxies **(3 hours)**

Galaxies - our galaxy, galaxy types & turning fork diagram. Structure on the largest scale-clusters, super clusters and voids.

*Text Book***:** Dinah L. Moché, Chapter 6

Module III

Astrophysics (14 hours)

Gravitational contraction - Virial theorem, Jeans mass. Energy production inside stars. Thermonuclear fusion. Hydrogen burning. p-p chain. CNO cycle. Evolution of stars – birth – protostar, hydrostatic equilibrium, red giant, late stages of evolution - white dwarfs & Chandrasekhar limit, Neutron stars, Supernovae, Pulsars, Black holes. Stellar Classification, H-R diagram - Main sequence stars

*Text Book***:** K D Abhyankar, Chapter 10, Dinah L. Moché Chapter 5

Cosmology (12 hours)

Large scale structure of the universe – isotropy and homogeneity. Cosmological principle.

Standard big bang model - GUT, Planck Epoch, Inflation, Nucleosynthesis, Recombination & CMBR. Expanding universe - red shift. Hubble's law and Hubble parameter. Age of universe and its determination. Dark energy and Dark Matter (qualitative idea).

*Text Book***:** Dinah L. Moché Chapter 7 & Ian Morison Chapter 9

References:

1. A short history of the Universe – Joseph Silk
2. Introduction to Astronomy and Cosmology, Ian Morison, John Wiley & Sons, Inc.
3. ASTRONOMY, A Self-Teaching Guide, Dinah L. Moché, John Wiley & Sons, Inc.
4. Introduction to cosmology- J V Narlikar
5. http://www.astro.cornell.edu/academics/courses/astro201/topics.html
6. http://www.ualberta.ca/~pogosyan/teaching/ASTRO_122/lectures/lectures.html
7. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
8. Astrophysics: Stars and Galaxies- K D Abhyankar

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.

Division of internal marks for record (maximum 4 marks)

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

SEMESTER	PAPER	PAPER CODE	TITLE
1 & 2	01	PHY2CRP0117	Mechanics and Properties of Matter

3 & 4	02	PHY4CRP0117	Optics and Semiconductor Physics
5 & 6	03	PHY6CRP0117	Electricity, Magnetism and LASER
5 & 6	04	PHY6CRP0217	Digital Electronics
5 & 6	05	PHY6CRP0317	Thermal Physics, Spectroscopy and C++ Programming
5 & 6	06	PHY6CRP0417	Acoustics, Photonics and Advanced Semiconductor Physics

SEMESTER 1&2 (First Year)

Core Practical 1: PHY2CRP0117 – 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 / venier calipers 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: PHY4CRP0117 –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: PHY6CRP0117 – 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 B_h
11. Searle's vibration magnetometer – magnetic moment
12. Deflection and vibration magnetometer – m and B_h
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: PHY6CRP0217 – 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. Astable Multivibrator using Transistor
8. Astable Multivibrator using IC 555
9. Monostable Multivibrator using Transistor
10. Monostable Multivibrator 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. Bistable multivibrator 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: PHY6CRP0319 – Thermal Physics, Spectroscopy and C++ Programming

1. Thermistor – Resistance - Temperature characteristics and temperature co-efficient of resistance
2. Newton's law of cooling – Specific heat capacity of a liquid
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
17. Computer programming in C++ – Simple Pendulum – Calculation of 'g' from experimental data
18. Computer programming in C++ – Resistance colour code to numerical value conversion
19. Computer programming in C++ – For different initial velocity and angle of projection, find out time of flight, horizontal range, Maximum height of a Projectile
20. Computer programming in C++ – sorting the numbers in ascending and descending order
21. Computer programming in C++ – multiplication of two matrices

SEMESTER 5&6 (Third Year)

Core Practical 06: PHY6CRP0417 – 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 A Navas.*
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.*

COMPLEMENTARY PHYSICS FOR MATHEMATICS AND STATISTICS

Semester I **2 credits (36 hours)**

PHY1CMT0117: PROPERTIES OF MATTER & ERROR ANALYSIS

LEARNING OUTCOMES

Upon the successful completion of the the course the strudent will be able to

- Illustrate the different examples of elasticity
- Explain the molecular theory of surface tension
- Categorize the factors affecting the surface tension
- Discuss the theories related to viscosity
- List different types of errors
- Interpret the errors in instruments

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.

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)**

PHY2CMT0117 : MECHANICS AND ASTROPHYSICS

LEARNING OUTCOMES :

Upon the successful completion of the course the student will be able to

- Recall the basic ideas of gravity
- illustrate the experiments related to gravity
- Recognize the ideas of rotational dynamics
- Determine the moment of inertia of different bodies
- Differentiate periodic and oscillatory motion
- Explain the theories related to progressive waves
- Explain various physical parameters that affecting the star.
- Discuss various theories of evolution of stars

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. (Tata McGraw-Hill)*
2. *Mechanics, D S Mathur*
3. *Modern Physics- R. Murugeshan, Er. Kirthiga Sivaprasad*
4. *A text book on oscillations waves and acoustics, M.Ghosh , D Bhattacharya*
5. *Introduction to Astrophysics-Baidyanath Basu.*
6. *Mechanics by D.S. Mathur and P.S. Hemne, S. Chand.*
7. *Waves, Mechanics & Oscillations- S B Puri*

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

PHY3CMT0117: MODERN PHYSICS AND ELECTRONICS

LEARNING OUTCOMES:

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

- Explain the different atom models
- Compute the binding energy of nucleus
- Interprets the theory of radioactivity
- Explain the physical concepts of quantum mechanics
- Summarise the Schrödinger equation (time dependent and time independent) for a particle in a potential box.
- Explain the quantum theory of Raman Effect
- Explain the physics of semiconductors
- Evaluate the working of diodes and rectifiers
- Recognize different types of number systems as they relate to computers
- Describe the operation of the logic gates
- Construct and understand the working principles of half adder and full adder

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. Kirthiga Sivaprasad*
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)**

PHY4CMT0117: OPTICS & ELECTRICITY

LEARNING OUTCOMES:

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

- Explain the phenomenon of interference
- Analyze Newton‟s ring experiment
- Differentiates the different types of Diffraction
- Compute the resolving power of grating
- Explains the concept of Polarization
- State and analyze Brewster‟s law
- Explains the e-ray and o-ray
- Describe the different types of lasers, its principle, properties An
- Recognize and classify the structures of Optical fiber and types
- Explain the electrical behaviour of dielectric materials
- Illustrate the theory related to Gauss‟s law in dielectrics
- DescribeRC, LC, LR and LCR Series Circuits at resonance
- Explain the significance of the resonant frequency

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 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*

COMPLEMENTARY PHYSICS FOR CHEMISTRY AND GEOLOGY

Semester 1

PHY1CMT0217: PROPERTIES OF MATTER AND THERMODYNAMICS

LEARNING OUTCOMES

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

- Illustrate the different examples of elasticity
- Explain the molecular theory of surface tension
- Categorize the factors affecting the surface tension
- Discuss the theories related to viscosity
- Classify different thermodynamic systems
- Explain the theories 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

PHY2CMT0217: MECHANICS AND SUPERCONDUCTIVITY

LEARNING OUTCOMES :

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

- Recall the basic ideas of gravity
- illustrate the experiments related to gravity
- Recognize the ideas of rotational dynamics
- Determine the moment of inertia of different bodies
- Differentiate periodic and oscillatory motion
- Explain the theories related to progressive waves
- Describe different theories related to superconductivity
- Explain types of superconductivity and their applications

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

PHY3CMT0217: MODERN PHYSICS AND MAGNETISM

LEARNING OUTCOMES:

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

- Explain the different atom models
- Compute the binding energy of nucleus
- Interprets the theory of radioactivity
- Explain the physical concepts of quantum mechanics
- Summarise the Schrödinger equation (time dependent and time independent) for a particle in a potential box.
- Explain the quantum theory of Raman Effect
- Explain the physics of semiconductors
- Evaluate the working of diodes and rectifiers
- Discuss about magnetism, different magnetic materials and its properties

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. Kirthiga Sivaprasad . 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

PHY4CMT0217: OPTICS AND SOLID STATE PHYSICS

LEARNING OUTCOMES:

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

- Explain the phenomenon of interference
- Analyze Newton‟s ring experiment
- Differentiates the different types of Diffraction
- Compute the resolving power of grating
- Explains the concept of Polarization
- State and analyze Brewster‟s law
- Explains the e-ray and o-ray
- Describe the different types of lasers, its principle, properties An
- Recognize and classify the structures of Optical fiber and types
- Explain about the crystal structure and Bragg‟s law of xray diffraction
- Illustrate the theory related to Gauss‟s law in dielectrics

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

Semester I & II

Complementary Physics Practical 1: PHY2CMP0117

1. Vernier Calipers -- 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: PHY4CMP0117

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 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
17. Static Torsion - Rigidity modulus
18. Deflection and Vibration Magnetometer-m & Bh
19. Field along the axis of circular coil- determination of Bh
20. Searle's Vibration Magnetometer - magnetic moment
21. Gates – AND, OR, NOT- verification of truth tables

References

1. *Practical Physics – C L Arora- S Chand*
2. *Properties of Matter -D.S. Mathur*
3. *Optics -Subrahmanyam& Brijlal*
4. *Electricity &Magnetism -Sreevastava*
5. *Electronics Lab Manual (Vol.1) -K. A. Navas*
6. *Laboratory manual for electronic devices and circuits-David A Bell*
7. *Practical Physics- Joseph Ittiavirah, Premnath and Abraham*