SACRED HEART COLLEGE (AUTONOMOUS) THEVARA, KOCHI – 682013 KERALA

CURRICULUM AND SYLLABUS

FOR

B. Sc. Physics

(CHOICE BASED COURSE CREDIT SEMESTER SYSTEM)

Prepared By

Board of Studies in Physics
Sacred Heart College (Autonomous)
Thevara, Kochi

2019

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1. 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 Sacred Heart College (Autonomous) Thevara.

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

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Thevara
29-06-2018

2. TITLE

B. Sc. PHYSICS PROGRAMME – Under Graduate Programmes under Choice Based Credit System, 2019 (UG CBCS 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 skepticism and understanding links of Physics to other disciplines and to societal issues should gave encouragement. With this in mind, we aim to provide a firm foundation in every aspect of Physics and to explain a broad spectrum of modern trends in physics and to develop experimental, computational and mathematics skills of students.

The 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.**
5. **Perform experiments and interpret the results of observation, including making an**

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 amore complete and logical framework in almost all areas of basic Physics.

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

By the end of the second year(4th semester), the students should have been introduced to powerful tools for tackling a wide range of topics in Optics, Laser, 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 (6th 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.

UndergraduateProgramme Outcomes (POs)

PO1 Critical Thinking& Deep Domain Knowledge

PO2 Effective Communication

PO3 Contribute to Nation Building

PO4 Care for the Environment

PO5 Ethical Values

PO6 Global Perspective

Programme Specific Outcomes (PSOs)

At the end of the programme a student should be able to:

PSO1

Understand concepts relating to properties of matter, thermodynamics, classical mechanics, relativity and energy and environmental physics, incorporating the contributions of relevant physicists in these fields.

PSO2

Apply and analyse the concepts of electricity, magnetism, electrodynamics, optics, spectroscopy and optoelectronics; with special emphasis on the contributions by eminent scientists in these fields.

PSO3

Apply and analyse the concepts of semiconductor physics, digital electronics and computational physics; with special emphasis on the contributions by eminent scientists in these fields.

PSO4

Apply and analyse the concepts of statistical mechanics, quantum mechanics, nuclear physics, particle physics, astrophysics, error analysis, superconductivity and condensed matter physics; with special emphasis on the contributions by eminent scientists in these fields.

4. DEFINITIONS

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

4.2. ***Semester*** means a term consisting of a minimum of 450 contact hours distributed over 90 working days, inclusive of examination days, within 18 five-day academic weeks.

4.3. ***Academic Week*** is a unit of five working days in which distribution of work is organized from day-one today-five, with five contact hours of one hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.

4.4. ***Course*** means a complete unit of learning which will be taught and evaluated within a semester.

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

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

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

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

4.9. ***Choice based core course*** means a compulsory course for all under graduate students (as per the UGC directive) to enrich their general awareness.

4.10. ***Credit*** is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

4.11. ***Additional credit or extra credit*** is the numerical value assigned to Club activities, Social service, Internship etc. which is not added with the total academic credits of the students.

4.12. ***Grade*** means a letter symbol (*e.g.*, A, B, C, etc.), which indicates the broad level of performance of a student in a course/ semester/programme.

4.13. ***Grade point (GP)*** is the numerical indicator of the percentage of marks awarded to a student in a course

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

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

5. DURATION OF THE PROGRAMME

The duration of U.G. programmes shall be 6 semesters The duration of odd semesters shall be from June to October and that of even semesters from November to March. A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.

6. COURSE DESIGN

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

A student can earn extra credits as detailed below:

- **Service - Learning.**
- **Courses offered by talent clubs.**

7. PROGRAMME STRUCTURE

Programme Duration	**6 Semesters**
Total Credits required for the successful completion of the programme	**120 Credits**
Credits required from Common Course I (*English*)	**22 Credits**
Credits required from Common Course II (*Second Language*)	**16 Credits**
Credits required from Core Course, Complementary Courses and Project	**79 Credits**
Open Course	**3 Credits**
Minimum attendance required	**75 %**

7.1. *Course-wise Distribution of Credits:*

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

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

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

7.2. *Extra-Credit Courses:*

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

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

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

	Sem I		Sem II		Sem III		Sem IV		Sem V		Sem VI	
	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week
Common Course I (*English*)	7	9	7	9	4	5	4	5	-	-	-	-
Common Course II (*Second Language*)	4	4	4	4	4	5	4	5	-	-	-	-
Core Course - *Theory*	2	2	2	2	3	3	3	3	12	11	12	12
Core Course - *Practical*	-	2	2	2	-	2	2	2	-	8	8	10
Complementary Course – I Chemistry- *Theory*	2	2	2	2	3	3	3	3	-	-	-	-
Complementary Course – I *Chemistry - Practical*	-	2	2	2	-	2	2	2	-	-	-	-
Complementary Course – II *Maths - Theory*	3	4	3	4	4	5	4	5	-	-	-	-
Project	-	-	-	-	-	-	-	-	-	2	2	-
Open Course	-	-	-	-	-	-	-	-	3	4	-	-
Choice Based Core Course	-	-	-	-	-	-	-	-	-	-	3	3
Total	18	25	22	25	18	25	22	25	15	25	25	25

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

7.4. Course Code:

Every course is coded using an 11 digit alpha numeric code that gives a brief description on the following details.

A. First 2 position specifies the last 2 digits of the year when this course is implemented. 19 specifies 2019 admission onwards.

B. 3rd position specifies type of course is an Undergraduate Course and its given the notation U.

C. 4th position specifies the semester number.

D. Positions 5-6 defined the 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 CR – Core Course, CP – Complementary Course, PR – Core Practical, PC- Complementary Practical, PJ – Project and OC – Open Course.

E. Position 7-9 says is taken by the letter PHY which mentions that its stand for the PHYSICS course.

F. 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 1stpaper, 05 indicates 5th paper, etc.

Sample Course Code

The Course code "19U5CRPHY07" indicates that the paper is "As of syllabus 2019 admission the code is for 5th semester core Physics Course of paper number 7 as mentioned in the syllabus.

8. MARKS DISTRIBUTION

MARKS DISTRIBUTION FOR PROJECT AND INDUSTRIAL VISIT (19U6PJPHY1)

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 5 th or 6th semester and submit a report in duplicate along with the project report. This industrial visit and the report will be evaluated internally and externally along with the project evaluation.

a) Marks of External Examination : 75

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

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

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

Marks Distribution for External and Internal Examination

The External examination of all semesters shall be conducted at the end of each semester. Internal evaluation is to be done by the continuous assessment. Mark distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

For all courses without practical

(a) Marks for End semester Examination (ESE) : 75

(b) Mark for internal evaluation : 25

Components of internal Evaluation	Marks
Attendance	5
Assignment	5
CIA-1	5
CIA-2	5
Seminar	5
Total	25

For all courses with practical

(a) Marks of theory – ESE – 60

(b) Marks of theory – Internal Evaluation – 20

Components of internal Evaluation	Marks
Attendance	5
Assignment/Seminar	5
CIA-1	5
CIA-2	5
Total	20

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

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

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

Division of internal marks for record (5 marks maximum)

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

Attendance Evaluation

For all theory courses

% 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)

For all Practical lab sessions

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

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

Condonation of Shortage of Attendance:

Candidate can seek condonation of shortage of attendance only once in a 2 year course and twice in other courses of longer duration. Following are the rules regarding attendance requirement:-

i.) Every candidate is to secure 75% attendance of the total duration of the course.

ii.) A candidate having a shortage of 10% can apply for condonation of shortage in prescribed form on genuine grounds. Condonation of shortage of attendance if any should be obtained at least 7 days before the commencement of the concerned semester examination.

iii.) It shall be the discretion of the Principal to consider such applications and condone the shortage on the merit of each case in consultation with the concerned course teacher and HoD.

iv.) Unless the shortage of attendance is condoned, a candidate is not eligible to appear for the examination.

COMPUTATION OF GRADE AND GRADE POINTS

For all courses (theory & practical), grades are given on a 08-point scale based on the total percentage of marks ***(CIA + ESE)*** as given below:

% of Marks for a course	Grade	Grade Point
95% and above	O - 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 - Satisfactory	6
45 to below 55%	C - Average	5
35 to below 45%	D - Pass	4
Below 35	F - Failure	0
	Ab – Absent	0

Computation of SGPA (*Semester Grade Point Average*)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses and the total number of credits of all the courses undergone by a student in a semester.

$$\textbf{SGPA } (S_i) = \frac{\sum (C_i \times G_i)}{\sum C_i}$$

Where, S*i* is the SGPA of the ith semester, C$_i$ is the number of credits of the i^{th} course and G$_i$ is the grade point scored by the student in the i^{th} course.

The SGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for SGPA:

Course	Credit	Grade Letter	Grade Point	Credit Point (*Credit* × *Grade Point*)
Course 1	3	B	6	3×6=18
Course 2	4	A	8	4×8=32
Course 3	3	A^+	9	3×9=27
Course 4	3	B^+	7	3×7=21
Course 5	3	C	5	3×5=15
Course 6	4	O	10	4×10=40
	Σ C*i* = 20			**Σ (C*i* × G*i*) = 153**

$$\textbf{SGPA } (S_i) = \frac{\sum (C_i \times G_i)}{\sum C_i} = \frac{153}{20} = 7.65$$

Computation of CGPA (*Cumulative Grade Point Average*)

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, *i.e.*

$$\mathbf{CGPA} = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

Where, S*i* is the SGPA of the i^{th} semester and C*i* is the number of credits in that semester.

Note: The CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for CGPA:

Semester	SGPA (*Si*)	Credits (*Ci*)	*Si* × *Ci*
I	9.69	18	174.42
II	9.12	22	200.64
III	8.50	18	153.00
IV	8.75	22	192.50
V	9.13	15	136.95
VI	9.50	25	237.50
		Σ C*i* = 120	Σ (S*i* × C*i*) = 1095.01

$$\mathbf{CGPA} = \frac{\sum(S_i \times C_i)}{\sum C_i} = \frac{1095.01}{120} = 9.13$$

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

SGPA /*CGPA*	Grade
9.50 to 10.00	***O - Outstanding***
8.50 to 9.49	***A+ - Excellent***
7.50 to 8.49	***A -Very Good***
6.50 to 7.49	***B+ – Good***
5.50 to 6.49	***B – Satisfactory***
4.50 to 5.49	***C – Adequate***
3.5 to 4.49	***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 a pass for a course.

For a pass in a programme, a separate minimum of Grade **D** is required for all the individual courses. If a candidate secures **F** Grade for any one of the courses offered in a Semester / Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this

to **D** grade or above within the permitted period. Candidate secure **D** grade and above will be eligible for higher studies.

GRIEVANCE REDRESSAL MECHANISM

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

Level 1:

At the level of the concerned course teacher

Level 2:

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

Level 3:

A committee with the Principal as Chairman, Dean of concerned Faculty, HODs of concerned departments and one member of the Academic council nominated by the principal every year as members.

9. CONSOLIDATED SCHEME FOR I TO VI SEMESTERS

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

Semester	B Sc Programme in Physics, Sacred Heart College (Autonomous), Thevara Title of the course	Hrs/week	Credits	Total Hrs	End Exam Duration	Internal Marks	External Marks
1	Methodology and Perspectives of Physics	2	2	36	3	20	60
	Core Practical I – Mechanics and Properties of Matter	2	-	36	-	-	-
2	Mechanics and Properties of Matter	2	2	36	3	20	60
	Core Practical 1- Mechanics and Properties of Matter	2	2	36	3	10	30
3	Optics, Laser and Fiber Optics	3	3	54	3	20	60
	Core Practical II - Optics and Semiconductor Physics	2	-	36	-	-	-
4	Semiconductor Physics	3	3	54	3	20	60
	Core Practical II - Optics and Semiconductor Physics	2	2	36	3	10	30
5	Electricity and Electrodynamics	3	3	54	3	20	60
	Classical and Quantum Mechanics	3	3	54	3	20	60
	Digital Electronics and Programming	3	3	54	3	20	60
	Energy and Environmental Physics	4	4	72	3	25	75
	Open Course- Physics in Daily Life	4	3	72	3	25	75
	Core Practical III – Electricity, Magnetism and Laser	2	-	36	-		
	Core Practical IV – Digital Electronics	2	-	36	-		
	Core Practical V – Thermal Physics, Spectroscopy and C^{++} Programming	2	-	36	-		
	Core Practical VI – Acoustics, Photonics and Advanced Semiconductor Physics	2	-	36	-		
6	Thermal and Statistical Physics	3	3	54	3	20	60
	Relativity and Spectroscopy	4	3	72	3	20	60
	Nuclear, Particle and Astrophysics	3	3	54	3	20	60
	Solid State Physics	4	3	72	3	20	60
	Choice based Course – Computational Physics OR Materials Science	3	3	54	3	25	75
	Core Practical III – Electricity, Magnetism and Laser	2	2	36	3	10	30
	Core Practical IV – Digital Electronics	2	2	36	3	10	30
	Core Practical V – Thermal Physics, Spectroscopy and C^{++} Programming	2	2	36	3	10	30
	Core Practical VI – Acoustics, Photonics and Advanced Semiconductor Physics	2	2	36	3	10	30
	Project and Industrial Visit	-	1	-	-	25	75

9.2 Complementary Physics for B.Sc Mathematics

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

9.3 Complementary Physics for Chemistry

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

10. SYLLABUS CORE PHYSICS

B.Sc. Physics Programme with Course Objectives (CO)

Semester-I

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

19U1CRPHY01: METHODOLOGY AND PERSPECTIVES OF PHYSICS

CO	CO Statement
CO1	Understand the development of physics in the last century and new scientific concepts from various scientist.
CO2	Understand Number systems and its significance.
CO3	Apply vector algebra in Physics.
CO4	Apply basic measurement techniques in Physics and experimental data.

Module I

Concepts and Development Physics: (8hours)

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

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

Module II **(18 hours)**

Number systems- Decimal, hexadecimal and Binary. Conversions, Binary arithmetic addition, subtraction and multiplication. 1's and 2's complement subtraction –signed binary numbers. Signed binary arithmetic, BCD code, ASCII code, Significance of binary number system in digital electronics, microprocessors and in computers,

Introductory Vector Analysis - Applications of vectors in Physics. Differential and integral vector calculus: – The operator - physical significance of Gradient, Divergence and Curl, Line integral, surface integral and volume integral of vectors Co-ordinate systems:Cartesian Co-ordinate system, plane polar and spherical polar coordinates, 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, length, time, angle , current, voltage. Fundamental units. Precision and accuracy of measurements, source of error in measurements, necessity of estimating errors , types of errors, reading error of instrument, calibration error, random error, systematic error, significant digits, order of magnitude and rounding of numbers, rounding error, absolute and relative errors, Errors of computation - addition, subtraction, multiplication, division, error in power and roots, Propagation of errors, analysis of data, standard deviation, calculation of mean value.

References:

1. **Text book: Advanced course in Practical Physics by D Chattopadhyay- Chapter-1**

2. Practical Physics, G L Squires, Third edn. Cambridge University Press.

3. The theory of Errors in Physical Measurements- J C Pal- New Central Book Agency- 2010

Semester-II

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

19U2CRPHY02: MECHANICS AND PROPERTIES OF MATTER

CO	CO Statement
CO1	Understand superposition of waves.
CO2	Analyse the theory of oscillation.
CO3	Define the basic concepts of angular velocity- angular acceleration- angular momentum.
CO4	State parallel and perpendicular axes theorems.
CO5	Calculate the moment of Inertia of different bodies.
CO6	Analyse the basic concepts of elasticity
CO7	Determine coefficient of viscosity by Poiseuille's method
CO8	Evaluate factors affecting surface tension
CO9	Examine the basic principles of Mechanics and Properties of Matter

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.

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)**

19U3CRPHY03: OPTICS, LASER AND FIBER OPTICS

CO	CO Statement
CO1	Understand the important and fascinating areas of interference with many experiments associated with it.
CO2	Differentiate between Fraunhofer and Fresnel diffraction
CO3	Apply skill to find the wavelength of spectral lines using Plane diffraction grating
CO4	Distinguish the methods of polarisation by reflection, refraction and scattering
CO5	Explain the Brewsters law and Malus law
CO6	Describe the different types of lasers, its principle, properties of laser beam
C07	Classify the different types of fibre

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-Chapt 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.

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.

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

Semester-IV

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

19U4CRPHY04: SEMICONDUCTOR PHYSICS

CO	CO Statement
CO1	Discuss basic idea of doping , p-n junction diode and its V-I characteristics using graphical and mathematical methods
CO2	Explain wave shaping circuits and voltage multipliers in electronics and its responses
CO3	Illustrate various biasing circuits of a transistor
CO4	Analyse various transistor amplifier circuits
CO5	Design simple oscillator circuits
CO6	Apply the concept of feedback in operational amplifiers
CO7	Identify the need for modulation with AM techniques in detail

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**

A **References:**

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

Semester-V

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

19U5CRPHY05: ELECTRICITY AND ELECTRODYNAMICS

CO	**CO Statement**
CO1	**Analyze EMF induced in a coil rotating in a magnetic field.**
CO2	**Analyze growth and decay of current in an LR circuit.**
CO3	**Understanding Fundamental theorems of divergence and curl.**
CO4	**Understanding Maxwell's equations.**

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)**

19U5CRPHY06: CLASSICAL AND QUANTUM MECHANICS

CO	CO Statement
CO1	Identify the various types of constraints involved in motion of a system.
CO2	Apply concept of constraints to represent certain dynamics
CO3	Explain quantum mechanical phenomena such as photoelectric effect and Compton effect.
CO4	Explain how the wave nature of particle leads to the understanding of quantum mechanics.
CO5	Apply general formalism of quantum mechanics to various problems.
CO6	To analyze quantum mechanical system by finding eigenvalues and eigenvectors.
CO7	Define the probability density and the probability current density
CO8	Compute the Ehrenfest theorem and its extension to three dimensions
CO9	Solve the Schrodinger equation for a particle in a box and square potential barrier

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,**

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

19U5CRPHY07: DIGITAL ELECTRONICS AND PROGRAMMING

CO	CO Statement
CO1	Analyzing Basic gates
CO2	Describe the functionality and applications of logic circuits
CO3	Simplify circuits and Boolean expressions using the Boolean laws
CO4	Explain the logic behind the operation of registers and counters
CO5	Design basic combinational andsequential logic circuits
CO6	Use the methods of systematic reduction of Boolean algebra expressions including Karnaugh maps
CO7	Outline the basic concepts of OOPs
CO8	List out the tokens used in C++ programming language
CO9	Discuss the concept of object and classes
C10	Design OOPs concepts through C++ programs for solving simple problems

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).

Module III

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**

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)**

19U5CRPHY08: ENERGY AND ENVIRONMENTAL

PHYSICS AND HUMAN RIGHTS Vision

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

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

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

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

Objectives

Environmental Education encourages students to research, investigate how and why things happen, and make their own decisions about complex environmental

issues by developing and enhancing critical and creative thinking skills. It helps to foster a new generation of informed consumers, workers, as well as policy or decision makers.

Environmental Education helps students to understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future. It encourages character building, and develops positive attitudes and values.

To develop the sense of awareness among the students about the environment and its various problems and to help the students in realizing the inter-relationship between man and environment and helps to protect the nature and natural resources.

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

CO	CO Statement
CO1	Identify various types of natural resources, human impact on these resources, and common resource management practices
CO2	Understand the multidisciplinary nature, important theories and concepts of environmental science, ecosystems, natural resources and conservation
CO3	Describe environmental hazards and risks and familiarize with the major environmental problems its causes and potential solutions
CO4	Explain Non-renewable energy sources:-Coal, Oil, Natural gas; Nuclear fission energy; Merits and demerits of non-renewable energy and different Renewable energy sources
CO5	Identify the environmental aspects of solar energy resources. In Comparison with various conventional energy systems, their prospects and limitations
CO6	Identify issues and problems relating to the human rights
CO7	Create awareness on various environmental acts in India

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

Environmental Impact Assessment and Home Energy Audit (8 hours) Basic Ideas of environmental impact assessment – environmental laws and constitutional provisions to control pollution in India: Air Act, Water Act & Environmental Protection Acts. Introduction to energy audit (basic ideas only): power in electrical circuits, consumption by home appliances and assessment of home power consumption.

REFERENCES

1. 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.

21. Environmental Science: Principles and Practices by R C Das and D K Behera

22. Principles of Physics, 10th edition, 2017 by Jearl Walker, David Halliday and Robert Resnick- Wiley.

23. Sears and Zemansky's University Physics with modern physics, 14th edition, 2018 by Hugh D Young and Roger A Freedman- Pearson.

Semester-V

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

19U5OCPHY01: Physics in Daily Life

CO	**CO Statement**
CO1	**List the units and dimensions of fundamental and derived quantities.**
CO2	**Explain the concepts of reflection, refraction, diffraction, interference, scattering and total internal reflection**
CO3	**Understanding various defects of the eye.**
CO4	**Apply the fundamental concepts of motion in everyday life.**
CO5	**Generalize the physics behind matter and energy.**
CO6	**Illustrate the different phenomenon occurring in the universe.**
CO7	**Distinguish between the different methods of power generation.**
CO8	**Understanding Planets and Satellites.**

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) – example

s 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-VI

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

19U6CRPHY09: THERMAL AND STATISTICAL PHYSICS

CO	CO Statement
CO1	State the laws of thermodynamics
CO2	Describe the working of engines.
CO3	Define the concept of entropy and explain its physical significance.
CO4	Understanding Lees disc and calculating thermal conductivity
CO5	Explain the significance of Clausius-Clapeyron equation
CO6	Explain fundamental concepts of statistical mechanics
CO7	Compute the thermodynamics of an ideal monoatomic gas.
CO8	Derive Maxwell-Boltzmann,Bose-Einstien and Fermi-Dirac distribution laws and compare the laws.

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)**

19U6CRPHY10: RELATIVITY AND SPECTROSCOPY

CO	**CO Statement**
CO1	**Understanding Inertial and non inertial frames of reference**
CO2	**Significance of Michelson-Morley experiment**
CO3	**State the postulates of special theory of relativity-introductory concept of GTR**
CO4	**Derive Lorentz transformation equation and Einstein mass - energy relation**
CO5	**Analyze the consequence of Lorentz transformation**
CO6	**Describe atom models- Bohr atom model and vector atom model**
CO7	**Interpret the spin of electron using Stern-Gerlach experiment**
CO8	**Define the rotational and vibrational spectra of molecules and electronic energy levels of atom**
CO9	**Explain the Raman effect classically and quantum mechanically,Zeeman effect and Paschen Back effect,NMR,ESR**
CO10	**Explain IR and microwave spectroscopes with instrumentation**

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)**

19U6CRPHY11: NUCLEAR, PARTICLE PHYSICS AND ASTROPHYSICS

CO	**CO Statement**
CO1	**Understanding Nuclear composition and Nuclear forces**
CO2	**Understanding Interactions between energetic particles**
CO3	**Understanding Radioactive decay –**
CO4	**Differentiates the different types of reactors and Cosmic showers**
CO5	**Explain the properties of elementary particles and their interactions**
CO6	**Explain the explosive nature of Supernova and the subsequent productions of elements**
CO7	**Identify different stages in the evolution of stars**

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)**

19U6CRPHY12: SOLID STATE PHYSICS

CO	CO Statement
CO1	Understanding Solid state, crystalline, polycrystalline and amorphous materials
CO2	Understanding Inter-atomic forces, ionic bonding, bond dissociation and cohesive energy, madelung energy, covalent bonding, metallic bonding, hydrogen bonding, van derwaals bonding
CO3	Explain the basic concepts of free electron theory and band theory of solids
CO4	Explain the basic concept of semiconductor, hall effect, the principles of LED and photodiodes
CO5	Explain the basic concepts of polarization
CO6	Analyze the theories related to dielectric polarizability
CO7	Classify magnetic materials and their properties
CO8	Solve problems related to coherence length, penetration depth, isotopic mass, in superconductivity.

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 – XIII-1 **Credit-3 (54 hours)**

19U6CRPHY13: COMPUTATIONAL PHYSICS

Algorithms of all methods required

CO	CO Statement
CO1	Discuss the methods to solve algebraic and transcendental equations
CO2	Compare the methods to solve algebraic and transcendental equations
CO3	Discuss the methods to solve linear systems
CO4	Solve problems of nonlinear equations by numerical methods
CO5	Explain the methods for curve –fitting and interpolation
CO6	Solve the problems of curve fitting and interpolation
CO7	Discuss various numerical integration and differentiation methods
CO8	Solve the problems of numerical integration and differentiation methods

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 – XIII-2 **Credit-3 (54 hours)**

19U6CRPHY13:

MATERIAL SCIENCE

CO	CO Statement
CO1	Memorize the Materials and classification
CO2	Discuss the mechanical properties Materials
CO3	Summarise the optical properties of materials
CO4	Implementation of advanced materials in the modern engineering applications
CO5	Identify the purpose of the nano materials and applications
CO6	Investigate the importance of carbon nanostructures
CO7	Significance of modern characterisation techniques

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

B. Sc. PHYSICS PRACTICAL

Minimum of experiments to be done in each paper is 14. Minimum number of experiments for appearing practical examination is 8. Maximum possible number of repetitions must be done to reduce error in a measuring quantity. Do calculation of percentage error for all experiments.
The S.I. units must be specified along with the results.

SEMESTER 1&2 (First Year)

Core Practical 1: 19U2PRPHY01– 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: 19U4PRPHY02–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: 19U6PRPHY03– 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: 19U6PRPHY04– 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: 19U6PRPHY05– 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: 19U6PRPHY06– 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.**

11. COMPLEMENTARY PHYSICS FOR MATHEMATICS

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

19U1CPPHY01: PROPERTIES OF MATTER & ERROR ANALYSIS

CO	CO Statement
CO1	Define the basic concepts related to modulus of elasticity
CO2	Illustrate the different examples of elasticity
CO3	Explain the molecular theory of surface tension
CO4	Categorize the factors affecting the surface tension
CO5	Discuss the theories related to viscosity
CO6	List different types of errors
CO7	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)**

19U2CPPHY03: MECHANICS AND ASTROPHYSICS

CO	CO Statement
CO1	Recall the basic ideas of gravity
CO2	illustrate the experiments related to gravity
CO3	Recognize the ideas of rotational dynamics
CO4	Determine the moment of inertia of different bodies
CO5	Differentiate periodic and oscillatory motion
C06	Explain the theories related to progressive waves
C07	Explain various physical parameters that affecting the star.
C08	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. (TMH)**
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

19U3CPPHY05:MODERN PHYSICS AND ELECTRONICS **3 credits (54 hours)**

CO	CO Statement
CO1	Understanding Basic features of different atom models
CO2	Compute the binding energy of nucleus
CO3	Interprets the theory of radioactivity
CO4	Explain the physical concepts of quantum mechanics
CO5	Summarise the Schrödinger equation (time dependent and time independent) for a particle in a potential box.
CO6	Explain the quantum theory of Raman Effect
CO7	Explain the physics of semiconductors
CO8	Evaluate the working of diodes and rectifiers
CO9	Recognize different types of number systems as they relate to computers
CO10	Describe the operation of the logic gates
CO11	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)**

19U4CPPHY07: OPTICS & Electricity

CO	**CO Statement**
CO1	**Explain the phenomenon of interferenc**
CO2	**Analyze Newton‟s ring experiment**
CO3	**Compute the resolving power of grating**
CO4	**Explains the concept of Polarization**
CO5	**State and analyze Brewste's law**
CO6	**Explains the e-ray and o-ray**
CO7	**Describe the different types of lasers, its principle, properties**
CO8	**Recognize and classify the structures of Optical fiber and types**
CO9	**Explain the electrical behaviour of dielectric materials**
CO10	**Illustrate the theory related to Gauss‟s law in dielectrics**
CO11	**Describe various Series Circuits at resonance and its significance.**

Module I

Light waves- phase difference and coherence, optical path and phase change, principle of superposition, Analytical treatment of interference-young's double slit experiment, conditions for interference, bandwidth - Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness. Newton's rings-reflected system -measurement of wavelength.
Fresnel and Fraunhofer diffractions. Fresnel's theory of approximate rectilinear propagation of light-. Fraunhofer diffraction. Theory of Plane transmission grating-determination of wavelength-dispersive power of grating. Prism and grating spectra, resolving power, Rayleigh criterion, resolving power of grating,
Polarization, types of polarization, Brewster's law, dichroism, birefringence – e ray and o-ray, polarizer and analyser, Malu's law, optical activity

Module II

Laser and Fiber Optics (10 hours)

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

Module III

Dielectrics (10 hours)

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

Module IV

Varying Currents (12 hours)

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

References:

1. **Optics - Brijlal and N. Subrahmanyam, S Chand-2015**
2. **Electricity and Magnetism , D C Tayal**

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

12. COMPLEMENTARY PHYSICS FOR CHEMISTRY

Semester 1

19U1CPPHY02: PROPERTIES OF MATTER AND THERMODYNAMICS

CO	**CO Statement**
CO1	**Define the basic concepts related to modulus of elasticity**
CO2	**Illustrate the different examples of elasticity**
CO3	**Explain the molecular theory of surface tension**
CO4	**Categorize the factors affecting the surface tension**
CO5	**Discuss the theories related to viscosity**
CO6	**Classify different thermodynamic systems**
CO7	**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

19U2CPPHY04: MECHANICS AND SUPERCONDUCTIVITY

CO	CO Statement
CO1	Recall the basic ideas of gravity
CO2	illustrate the experiments related to gravity
CO3	Recognize the ideas of rotational dynamics
CO4	Determine the moment of inertia of different bodies
CO5	Differentiate periodic and oscillatory motion
C06	Explain the theories related to progressive waves
C07	Describe different theories related to superconductivity
C08	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

19U3CPPHY06: MODERN PHYSICS AND MAGNETISM

CO	**CO Statement**
CO1	**Understanding Basic features of different atom models**
CO2	**Compute the binding energy of nucleus**
CO3	**Interprets the theory of radioactivity**
CO4	**Explain the physical concepts of quantum mechanics**
CO5	**Summarize the Schrödinger equation (time dependent and time independent) for a particle in a potential box.**
CO6	**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

19U4CPPHY08: OPTICS AND SOLID STATE PHYSICS

CO	CO Statement
CO1	Explain the phenomenon of interferenc
CO2	Analyze Newton's ring experiment
CO3	Compute the resolving power of grating
CO4	Explains the concept of Polarization
CO5	State and analyze Brewster's law
CO6	Explains the e-ray and o-ray
CO7	Describe the different types of lasers, its principle, properties
CO8	Explain about the crystal structure and Bragg‟s law of x-ray diffraction
CO9	Illustrate the theory related to Gauss's law in dielectrics
CO10	Illustrate the theory related to Gauss's law in dielectrics
CO11	Describe various Series Circuits at resonance and its significance.

Module I

Interference, Diffraction and Polarization (22 hours) Light waves- phase difference and coherence, optical path and phase change, principle of superposition,

Analytical treatment of interference-- young's double slit experiment, conditions for interference, bandwidth Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness. Newton's rings-reflected system-measurement of wavelength

Fresnel and Fraunhofer diffractions. Fresnel's theory of approximate rectilinear propagation of light. Fraunhofer diffraction. Theory of Plane transmission grating-determination of wavelength- dispersive power of grating. Prism and grating spectra, resolving power, Rayleigh criterion, resolving power of grating, Polarization, types of polarization, Brewster's law, dichroism, birefringence – e ray and o-ray, polarizer and analyzer, Malu's law, optical activity

Module II

Laser and Fiber Optics (10 hours)

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

Module III

Dielectrics (10 hours)

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

Module IV

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

Text Books:

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

References:

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

COMPLEMENTARY PHYSICS PRACTICALS

COMPLIMENTARY PHYSICS LAB: Minimum of experiments to be done in each paper is 14. Minimum number of experiments for appearing practical examination is 8. Maximum possible number of repetitions must be done to reduce error in a measuring quantity. Do calculation of percentage error for all experiments.
The S.I. units must be specified along with the results.

Semester I&II
Complementary Physics Practical 1: (for Maths:19U2PCPHY01 ; for Chemistry : 19U2PCPHY02)

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: (for Maths:19U4PCPHY03 ; for Chemistry : 19U4PCPHY04)

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**