UNIVERSITY OF KERALA

REVISED OUTCOME BASED SYLLABUS FOR FIRST DEGREE PROGRAMME IN PHYSICS

UNDER

CHOICE BASED-CREDIT & SEMESTER-

SYSTEM (CBCSS)

(2023 admission onwards)

BOARD OF STUDIES

1. Dr. Jayasree V., KSMDB College, Sasthamcotta, Kollam (Chairperson)
2. Dr. Biju V., University of Kerala, Kariavattom, Thiruvananthapuram (Member)
3. Dr. Hubert Joe I., University of Kerala, Kariavattom, Thiruvananthapuram (Member)
4. Dr. Renju R. Krishnan, St. Xavier's College, Thumba Thiruvananthapuram (Member)
5. Dr. Vikas L.S., Govt Arts College, Thiruvananthapuram (Member)
6. Dr. Jayakrishnan R., University of Kerala, Kariavattom, Thiruvananthapuram (Member)
7. Dr. Prabitha V. G., Govt. College for Women, Thiruvananthapuram (Member)
8. Dr. Arun. S. Prasad., TKMM College, Nangiarkulangara, Alappuzha (Member)
9. Dr. Saravana Kumar S., NSS College, Pandalam (Member)
10. Dr. Bindu R. G. NSS College, Nilamel, Thiruvananthapuram (Member)
11. Smt. Jaya A. S., Govt. College, Kariavattom, Thiruvananthapuram (Member)

List of Teachers Contributed in the Syllabus Restructuring

1. Dr. Rakesh Chandran S. B., S. D. College, Alappuzha
2. Dr. Savitha N., S. N. College, Cherthala, Alappuzha
3. Dr. Jyothi G., M. S. M. college, Kayamkulam, Alappuzha
4. Dr. Rose Leena Thomas, St. Joseph's College for Women, Alappuzha
5. Dr. Santhosh G., Govt. College, Kariavattom, Thiruvananthapuram
6. Dr. Anjana P. S., All Saint's College, Thiruvananthapuram
7. Sri. Srijith S., S. N. College, Kollam
8. Dr. Prabitha B. Nair, MMNSS College, Kottiyum, Kollam
9. Dr. Reshmy V. K., Govt. College, Nedumangad, Thiruvananthapuram
10. Sri. Sree Roop S. S., Iqbal College, Peringamala, Thiruvananthapuram
11. Smt. Aiswarya Mol N. S., S. N. College, Sivagiri, Varkala, Thiruvananthapuram
12. Dr. Muhammed Salim M., TKM College of Arts and Science, Kollam
13. Dr. Meenu S. HHMSPB NSS College for Women, Neeramankara, Thiruvananthapuram
14. Dr. Krishnakumar V., St. Gregorius College, Kottarakkara, Kollam
15. Smt. Devi R. Nair, University College, Thiruvananthapuram
16. Smt. Biji M. S., Govt. Arts College, Thiruvananthapuram
17. Dr. Seema C. S., Govt. Arts College, Thiruvananthapuram
18. Dr. Aranya S., S. N. College, Chempazhanthy, Thiruvananthapuram
19. Dr. Lija K. Joy, Bishop Moore College, Mavelikara, Alappuzha
20. Dr. Lynnette Joseph, Bishop Moore College, Mavelikara, Alappuzha

21. Dr. Sajan D, Bishop Moore College, Mavelikara, Alappuzha

Contributors to the design of industry-based course

1. Dr. V. P. Sudeep Kumar, Asst. General Manager, Transmission, BSNL, Thiruvananthapuram.
2. Dr. R. Jayakrishnan, University of Kerala, Kariavattom, Thiruvananthapuram.
3. Dr. S. B. Rakesh Chandran, S. D. College, Alappuzha.
4. Dr. L. S. Vikas, Govt Arts College, Thiruvananthapuram

AIM OF THE PROGRAMME

In this programme, we aim to provide a solid foundation in all aspects of Physics and to show a broad spectrum of modern trends in physics and to develop experimental, computational, and mathematical skills of students. The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of physics by providing more or less complete and logical framework in almost all areas of basic Physics. Based on the new initiative of the University of Kerala, industry-oriented courses are also included in the programme which enable students to get hands on training on selected area of Physics

The programme also aims to

(i) Provide education in Physics of the highest quality at the undergraduate level and generate graduates of the calibre sought by industries and public service as well as academic teachers and researchers of the future.

(ii) Attract outstanding students from all backgrounds.

(iii) Provide an intellectually stimulating environment in which the students can develop their skills and enthusiasms to the best of their potential.

(iv) Maintain the highest academic standards in undergraduate teaching.

(v) Impart the skills required to gather information from resources and use them.

(vi) Equip the students in methodology related to Physics.

OBJECTIVES

By the end of Second semester, the students should have,

(i) Attained a common level in basic mechanics and properties of matter and laid a secure foundation in mathematics for their future courses.

(ii) Developed their experimental and data analysis skills through a wide range of experiments in the practical laboratories.

By the end of the fourth semester, the students should have,

(iii) Been introduced to powerful tools for tackling a wide range of topics in Thermodynamics, Electrodynamics.

(iv) Been introduced to an Industry Based Course and have attained hands-on training on experimental skills.

(v) Become familiar with additional relevant mathematical techniques.

(vi) Further developed their experimental skills through a series of experiments which also illustrate major themes of the lecture courses.

(vii) Obtained an internship/apprenticeship certificate with industries/ Research institutions/ companies/ Govt. sectors/any institutions of similar status

By the end of the sixth semester, the students should have,

(viii) Covered a range of topics in almost all areas of physics including Classical, Relativistic, Statistical Mechanics, Quantum Physics, Solid State Physics, Computational Physics, Semiconductor Physics etc.

(ix) Had experience of independent work such as projects, seminars etc.

(x) Opportunities are given to visit reputed research and academic centres or industries and would have acquired knowledge of the works going on in such institutions/ organizations.

(xi) Developed their understanding of core Physics.

PROGRAMME OUTCOMES (PO)

The programme is designed with the intension that the graduate will be able to accomplish the following programme outcomes at the completion of the FDP in Physics

NO.	PROGRAMME OUTCOMES
PO – 1	**CRITICAL THINKING: -** Instill an attitude of being inquisitive, develop a capacity to become an active leaner through self-governing and reflective thinking in order to identify and analyze the logic connections between theoretical Physics and its applications
PO – 2	**EFFECTIVE COMMUNICATION: -** Competent proficiency in communication to deliver the acquired knowledge, problem solving skills, analyzing capacity formally or informally to a spectrum of spectators.
PO – 3	**SKILL DEVELOPMENT: -** Practical oriented and problem-solving approach provide opportunity to develop knowledge and skills to the best of their potential.
PO – 4	**INDIVIDUAL AND TEAM WORK:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO – 5	**DIGITAL COMPETENCE:** Ability to use techniques, skills and modern information technology tools at their study and work place.
PO – 6	**SOCIAL ACUITY AND OBLIGATION: -** Impart perception about social issues, human values, foster scientific temper, practice inclusiveness for the betterment of the society and disseminate scientific knowledge in appropriate situation.
PO – 7	**ENVIRONMENTAL AWARENESS: -** Discern the environmental issues and involves in promoting ethics and attitudes that endorse coexistence and sustainable living with reduced, minimal, or no damage upon ecosystems
PO – 8	**MULTIDISCIPLINARY APPROACH:** -Interdisciplinary and multidisciplinary approaches permit to gain a solid foundation in various disciplines of science and provide a basis for higher studies and research
PO – 9	**SUSTAINABLE LEARNING: -** make the students to realize that acquiring knowledge and skills suitable for their professional developments is a never-ending process
PO – 10	**ETHICAL STANDARDS: -** Inspire the students to recognize values such as justice, equity, trust, kindness and to develop a commitment and upholding standards of ethical behavior in all walks of life.

PROGRAMME SPECIFIC OUTCOMES (PSO)

The Programme Specific Outcomes that the graduates will be able to attain on completion of FDP in Physics are the following: -

No.	Upon completion of B.Sc. Physics Degree programme, the graduates will be able to	PO. No.
PSO – 1	Conceptual understanding of Physics and its practical applications and scope in the present world.	PO – 1
PSO – 2	Analyzing the theory part with practical experiments, interpretation of experimental results, finding out errors, suggestions to improve the errors.	PO – 1 PO – 2 & PO – 3
PSO – 3	Develop and construct practical model systems from their conceptual knowledge.	PO – 1 PO – 2 & PO – 3
PSO – 4	Acquire conceptual understanding of properties of matter, fundamentals of mechanics and their practical applications	PO – 1 & PO – 3
PSO – 5	Acquire knowledge about basics of thermodynamics and working of heat engines and their practical applications	PO – 1 PO – 3 & PO – 7
PSO – 6	Acquire the theoretical basis of electrodynamics, Magnetism, Super conductivity, Classical, Statistical and Relativistic Mechanics, Optics, Solid State Physics, Quantum Mechanics, Nano technology	PO – 1& PO – 8
PSO – 7	Impart knowledge about the relevance of Industry Based Course and have attained hands-on training on experimental skills.	PO - 3 & PO – 4
PSO – 8	Distinguish Microscopic Macroscopic Systems and statistical distributions	PO – 1
PSO – 9	Acquire conceptual understanding of Physics to General real-world situations.	PO – 1 & PO – 6
PSO – 10	Integrate the Quantum Mechanics to understand the fundamentals of other branches of Physics such as Vibrational, Raman, Electronic, Resonance Spectroscopy	PO – 1 & PO – 6
PSO – 11	Identify possible atomic and molecular energy levels and transitions and predict the existence of new elements	PO – 1
PSO – 12	Develop an idea regarding X-rays, and different spectroscopic techniques	PO – 1
PSO – 13	Acquire the knowledge of the basic idea about Electronics, Digital Electronics and working of different electronic components	PO – 1& PO – 2
PSO – 14	Students will use the knowledge of electronics and communication to analyze the contemporary communication systems and to design the system.	PO – 1& PO – 3
PSO – 15	Apply the Langrangian and Hamiltonian formalisms to solve various dynamical problems which involve constraints.	PO – 1 & PO – 3

PSO – 16	Basic understanding and concepts of the causes, effects, and control of various types of environmental pollution.	PO – 1& PO – 7
PSO – 17	Students will use the knowledge of Mechanics to describe the motion of objects in different force fields.	PO – 1
PSO – 18	Develop Basic idea about linear and non- linear optical phenomena and their practical application in real world	PO – 1 & PO – 3
PSO – 19	Use advanced computer language for problem solving and practical applications	PO –3 PO – 5 PO – 8& PO – 9
PSO – 20	Acquire knowledge about the concept of project, methodology in research and working of scientific institutions	PO – 4 PO – 5 PO – 8 & PO – 10

I. General Structure for the First-Degree Programme in Physics

L-Lecture, P-Practical, CE-Continuous Evaluation, ESE-End Semester Examination

Semester	Course code and title	Instructional hours/week		Credit	ESE Duration (hrs.)	Percentage of Evaluation/ Examination		Total Credit
		L	**P**			CE	ESE	
1	EN1111 English Language I	5		4	3	20	80	16
	1111 Additional Language I	4		3	3			
	EN1121 Foundation Course I	4		2	3			
	PY1141 Core Course I (Foundation Course)	2		2	3			
	Core practical I	-	2	-	-			
	MM1131.1 Complimentary Course I	4		3	3			
	Complimentary Course II (CH1131.1/ST1131.2/EL1131)	2	2	2	3			
2	EN1211 English Language II	5		4	3	20	80	17
	EN1212 English Language III	4		3	3			
	1211 Additional Language II	4		3	3			
	PY1241 Core Course II	2		2	3			
	PY 1442 Core practical I		2		-			
	MM1231.1 Complimentary Course III	4		3	3			
	Complimentary Course IV (CH1231.1/ST1231.2/EL1231)	2	2	2	3			
3	EN1311 English Language IV	5		4	3	20	80	18
	1311 Additional Language III	5		4	3			
	Industry based core course PY1341.1/PY1341.2/PY1341.3/ PY1341.4	3		3	3			
	PY1442 /PY1442.1 Core Practical I&II	-	2	-	-			
	MM1331.1 Complimentary Course V	5		4	3			
	Complimentary Course VI (CH1331.1/ST1331.2/EL1331)	3	2	3	3			
4	EN1411 English Language V	5		4	3	20	80	25
	1411Additional Language IV	5		4	3			
	PY1441Core Course IV	3		3	3			
	PY 1442 Core Practical I	-	2	2	3			
	PY1442.1Core practical II (Industry based)			1	3			
	MM1431.1 Complimentary Course VII	5	-	4	3			
	Complimentary Course VIII (CH1431.1/ST1431.2/EL1431)	3	-	3	3			
	Complimentary Practical IX (CH1432.1/ST1432.2/EL1432)	-	2	4	3			

5	PY1541 Core Course V	4		4	3	20	80	18
	PY1542 Core Course VI	4		4	3			
	PY1543 Core Course VII	4		4	3			
	PY1544 Core Course VIII	4		4	3			
	PY1645Core Practical III	-	4					
	Open Course (PY1551.1/PY1551.2/ PY1551.3/ PY1551.4/PY1551.5)	3		2				
	PY1647 Project	-	2	-	-	-	-	-
6	PY1641 Core Course IX	4	-	4	3	20	80	26
	PY1642 Core Course X	4	-	4	3			
	PY1643 Core Course XI	4	-	4	3			
	PY1644 Core Course XII	4	-	3	3			
	PY1645 Core Practical III	-	2	2	3			
	PY1646 Core Practical IV	-	2	3	3			
	Elective Course (PY1661.1/PY1661.2/PY1661.3/ PY1661.4/PY1661.5)	3	-	2	3			
	PY1647 Project and Research Institute/Science Museum visit	-	2	4				
TOTAL CREDITS								**120**

II. Course structure: -

(1a). *Core Courses (Theory)*

Semester	Course		No. of Hours/ week	Credit	Total hours /semester	ESE Duration (hrs.)
	Code	Title				
1	PY1141	Basic mechanics and Properties of matter	2	2	36	3
2	PY1241	Heat and Thermodynamics	2	2	36	3
3	PY1341	Industry based course	3	3	54	3
4	PY1441	Electrodynamics	3	3	54	3
5	PY1541	Classical, Statistical and Relativistic Mechanics	4	4	72	3
	PY1542	Classical and Modern Optics	4	4	72	3
	PY1543	Semiconductor devices and circuits	4	4	72	3
	PY1544	Atomic and Molecular Physics	4	4	72	3
	PY1551	Open Courses	3	2	54	3
6	PY1641	Solid State Physics	4	4	72	3
	PY1642	Nuclear and Particle Physics	4	4	72	3
	PY1643	Quantum Mechanics	4	4	72	3
	PY1644	Digital circuits and Computational Physics	4	3	72	3
	PY1661	Elective Courses	3	3	54	3

(1b). Core Courses (*Practical and Project Work)*

Semester	Course		Duration of Examination	Credit	Weightage		Allotted hours	
	Code	Title			CE	ESE	Per week	Per year
4	PY1442	Basic Physics Lab	3	2	1	3	S1-2 S2-2 S4- 2	144
	PY1442.1	Industry Based Lab	3	1	1	3	S3-2	
6	PY1645	Advanced Physics Lab I	3	2	1	3	S5-2 S6-2	72
	PY1646	Advanced Physics Lab II	3	3	1	3	S5-2 S6-2	72
	PY1647	Project	-	4	-	4	S5-2 S6-2	72

2(a). Complementary Courses (General structure)

Semester	Theory			Practical		Weightage (For both theory & practical)	
	Number of hours/ week	Number of credits	Total hours/sem.	number of hours/week	Number of credits	CE	ESE
1	2	2	36	2	-	1	3
2	2	2	36	2	-	1	3
3	3	3	54	2	-	1	3
4	3	3	54	2	4	1	3

(2b). COMPLEMENTARY COURSES (Theory and Practical)

1. Physics for Mathematics B. Sc. Programme

Semester	Course		No. of Hours/ week	Credit	Total Credit	Total hours /semester	ESE Duration (hrs.)	Weightage	
	Code	Title						CE	ESE
1	PY1131.1	Mechanics and Properties of matter	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
2	PY1231.1	Thermal Physics and Statistical Mechanics	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
3	PY1331.1	Optics, Magnetism and Electricity	3	3	3	54	3	1	3
	PY1432	Practical	2			36			
4	PY1431.1	Modern Physics and Semiconductor Physics	3	3	7	54	3	1	3
	PY1432	Practical	2	4		36	3	1	3

2. Physics for Chemistry B. Sc. Programme

Semester	Course		No. of Hours/ week	Credit	Total Credit	Total hours /semester	ESE Duration (hr)	Weightage	
	Code	Title						CE	ESE
1	PY1131.2	Rotational Dynamics and Properties of matter	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
2	PY1231.2	Thermal Physics	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
3	PY1331.2	Optics, Magnetism and Electricity	3	3	3	54	3	1	3
	PY1432	Practical	2			36			
4	PY1431.2	Atomic Physics Quantum Mechanics and Semiconductor Physics	3	3	7	54	3	1	3
	PY1432	Practical	2	4		36	3	1	3

3. Physics for Statistics B. Sc. Programme

Semester	Course		No. of Hours/ week	Credit	Total Credit	Total hours /semester	ESE Duration (hr.)	Weightage	
	Code	Title						CE	ESE
1	PY1131.3	Mechanics and Properties of matter	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
2	PY1231.3	Thermal Physics and Statistical Mechanics	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
3	PY1331.3	Optics, Magnetism and Electricity	3	3	3	54	3	1	3
	PY1432	Practical	2			36			
4	PY1431.3	Modern Physics and Semiconductor Physics	3	3	7	54	3	1	3
	PY1432	Practical	2	4		36	3	1	3

4. Physics for Geology B. Sc. Programme

Semester	Course		No. of Hours/ week	Credit	Total Credit	Total hours /semester	ESE Duration (hr.)	Weightage	
	Code	Title						CE	ESE
1	PY1131.4	Mechanics and Properties of matter	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
2	PY1231.4	Thermal Physics and Physics of the Earth	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
3	PY1331.4	Optics and Electrodynamics	3	3	3	54	3	1	3
	PY1432	Practical	2			36			
4	PY1431.4	Modern Physics Semiconductor Physics and Crystallography	3	3	7	54	3	1	3
	PY1432	Practical	2	4		36	3	1	3

5. Physics for Home Science B. Sc. Programme

Semester	Course		No. of Hours/ week	Credit	Total Credit	Total hours /semester	ESE Duration (hrs.)	Weightage	
	Code	Title						CE	ESE
1	PY1131.5	Mechanics and Properties of matter	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
2	PY1231.5	Thermal Physics	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
3	PY1331.5	Optics and Electricity	3	3	3	54	3	1	3
	PY1432	Practical	2			36			
4	PY1431.5	Atomic Physics and Semiconductor Physics	3	3	7	54	3	1	3
	PY1432	Practical	2	4		36	3	1	3

6. Electronics for B. Sc. Physics programme

Semester	Course		No. of Hours/ week	Credit	Total Credit	Total hours /semester	ESE Duration (hrs.)	Weightage	
	Code	Title						CE	ESE
1	EL1131	Electronics I	2	2	2	36	3	1	3
	EL1432	Practical	2			36			
2	EL1231	Electronics II	2	2	2	36	3	1	3
	EL1432	Practical	2			36			
3	EL1331	Electronics III	3	3	3	54	3	1	3
	EL1432	Practical	2			36			
4	EL1431	Electronics IV	3	3	7	54	3	1	3
	EL1432	Practical	2	4		36	3	1	3

7. Physics for Polymer Chemistry B. Sc. Programme

Semester	Course		No. of Hours/ week	Credit	Total Credit	Total hours /semester	ESE Duration (hrs.)	Weightage	
	Code	Title						CE	ESE
1	PY1131.7	Mechanics and Fluid Dynamics	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
2	PY1231.7	Thermal Physics	2	2	2	36	3	1	3
	PY1432	Practical	2			36			
3	PY1331.7	Modern Optics and Electricity	3	3	3	54	3	1	3
	PY1432	Practical	2			36			
4	PY1431.7	Atomic Physics and Semiconductor Physics	3	3	7	54	3	1	3
	PY1432	Practical	2	4		36	3	1	3

III. QUESTION PAPER PATTERN

For all semesters

1. The examination has a duration of 3 hours
2. Each question paper has four parts A, B, C & D.
3. Part A contains 10 questions and the candidate has to answer all questions. *Each question carries 1mark.* The answer may be in the forms-one word/one sentence.
4. Part B contains 12 short answer questions. Out of these 12 questions, the candidate has to answer 8 questions. *Each question carries 2marks*.
5. Part C contains 9 questions of which the candidate has to answer 6 of them. *Each question carries 4 marks*.
6. Part D contains 4 long answer questions (essays) of which the candidate has to answer 2 questions. *Each question carries 15 marks.*
7. The total weightage for the entire questions to be answered is 80 marks.

QUESTION PAPER PATTERN FOR EXAMINATION			
Question No	Type of Question	No. of Questions to be answered	Marks
Part A: 1-10	One word/One sentence	10	10
Part B: 11-22	Short answer	8 out of 12	16
Part C: 23-31	Short essay/problem	6 out of 9	24
Part D: 32-35	Essay	2 out of 4	30
			Total=80

IV. INDUSTRY BASED, OPEN AND ELECTIVE COURSES

During the programme, the student must study an industry-based course, an open course and an elective course. The student must do the industry- based course during the third semester, open course during the fifth semester and the elective course during the sixth semester. During third semester the student can opt an industry- based course offered by the department. The student can opt a course of her/his choice, offered by any other department in the college during fifth semester (Open Course) and during sixth semester she/he can opt one course offered by the Physics department (Elective course). The department has the liberty to choose at least one course in the third, fifth and sixth semester from the list provided below depending on the faculty and infrastructure available.

(a). Industry-based course offered by Physics Department for the students of their own department.

Sl. No.	Course Code	Course Title
1	PY1341.1	Computer Hardware and Operating systems
2	PY1341.2	Microprocessor and embedded systems
3	PY1341.3	Electronic & Electrical instrumentation and circuit design
4	PY1341.4	Fiber Optics and Telecommunication

(b). Open Courses offered by Physics Department for students of other discipline.

Sl. No.	Course Code	Course Title
1	PY1551.1	Bio-Physics
2	PY1551.2	Astronomy and Astrophysics
3	PY1551.3	Applied Physics
4	PY1551.4	Environmental Physics
5	PY1551.5	Energy Physics

(c) Elective Courses offered by Physics department for the students of their own department.

Sl. No.	Course Code	Course Title
1	PY1661.1	Electronic Instrumentation and Research Methodology
2	PY1661.2	Space Science and Research Methodology
3	PY1661.3	Photonics and Research Methodology
4	PY1661.4	Nanoscience and Research Methodology
5	PY1661.5	Computer Networking and Research Methodology

V. IMPLEMENTATION OF PROJECT WORK AND STUDY TOUR (RESEARCH INSTITUTE/SCIENCE MUSEUM VISIT)

a) PROJECT WORK

As part of study the candidate must do project works. The aim of the project work is to bring out the talents of students and to introduce the research methodology. The work may be chosen from any branch of Physics, which may be experimental, theoretical or computational. Emphasis should be given for originality of approach. The project shall be done individually or as a group of maximum 5 students. The projects are to be identified during the 4th semester with the help of the supervising teacher. The report of the project (of about 30-40 pages) in duplicate shall be submitted to the department by the end of the 6th semester, well before the commencement of the examination. The reports are to be produced before the external examiners appointed by the University, for valuation.

In addition to this, the students are expected to do internship/apprenticeship in association with Industries/ Research institutions/Companies or any other organizations related to the field of study. The students can be divided into batches (maximum 5 students) and the mentor/s (Department level) shall see to the fact that the team under him/her completes his/her internship successfully. The report of the project (of minimum 10 pages) evaluated by the mentor shall be submitted to the department by the end of 4th semester. The status of completion of project specifying the industry-based course and marks awarded shall be intimated to the University along with the mark list of practical of industry- based course.

b) STUDY TOUR

Students are directed to visit one research institute /science museum preferably within the state of Kerala. Scientifically prepared hand-written study tour report (of minimum 10 pages) must be submitted by each student for ESE on the day of the examination of project evaluation.

VI. CONTINUOUS EVALUATION

There will be continuous evaluation (CE) based on continuous assessment and end semester examination (ESE) for each course. CE carries 20 marks based on specific components such as tests, assignments, seminars etc. and ESE 80 marks. Out of the 20 marks in continuous evaluation, 10 marks to test papers and 10 marks to seminar / assignments (minimum one test & one assignment). The components of the continuous evaluation for theory and practical and their marks are given below.

a) Theory

The continuous evaluation (CE) shall be based on periodic written tests, assignments / seminar in respect of theory courses.

Written Tests: Each test paper may have duration of maximum 3 hours. For each course there shall be a minimum of one written test during a semester.

Assignments/ Seminar: Each student is required to submit one assignment/ present one seminar for a theory course.

No	Component	Marks
1	Assignment/Seminar	10
2	Test paper	10
Total		20

(i) Written Tests

For each course there shall be **at least two class tests** during a semester. Marks for the test in continuous evaluation shall be awarded based on the marks secured for the **better of the two tests.** Valued answer scripts shall be made available to the students for perusal within 10 working days from the date of the test.

(ii) Assignments and Seminars

Each student shall be required to do **one assignment /one seminar** for each course. Valued assignments shall be returned to the students. The seminars shall be organized by the teacher in charge and the same shall be assessed by a group of teachers including the teacher in charge of that course.

b) Practical

(i) Industry based Lab: During the fourth semester the student must do practical related to industry-based course also. The student must do 6 experiments and should write a separate record related to this. Lab skill is to be assessed based on the performance of the student in practical classes. Minimum one practical test paper and an internal viva – voce examination based on the experiments done in the lab are to be conducted in the industry based practical course. The laboratory record should contain an index and a certificate page. Separate record is to be used for industry based practical course. The evaluation is internal and the **candidate shall be permitted to attend an end semester internal practical examination only if he / she submit a certified record with a minimum of 3 experiments**. This is to be endorsed by the internal examiners. The mark sheet duly certified by the head of the institution should be sent to the University before the commencement of the end semester examinations.

Sl. No	Component	Marks
1	Attendance	5
2	Skill & Punctuality	5
3	Laboratory record	5
4	Test (internal exam)	5
Total		20

(ii) Basic Physics Lab course: Lab skill is to be assessed based on the performance of the student in practical classes. Minimum one practical test paper and an internal viva – voce examination based on the experiments done in the lab are to be conducted in each practical course. The laboratory record should contain an index and a certificate page. Separate records are to be used for each practical course. **A candidate shall be permitted to attend an end semester practical examination only if she / he submit a certified record with a minimum of 6 experiments.** This is to be endorsed by the examiners. The mark sheet duly certified by the head of the institution should be sent to the University before the commencement of the end semester examinations.

(iii) Advanced Physics Lab Course: Lab skill is to be assessed based on the performance of the student in practical classes. Minimum one practical test paper and an internal viva – voce examination based on the experiments done in the lab are to be conducted in each practical course. The laboratory record should contain an index and a certificate page. Separate records are to be used for each practical course. **A candidate shall be permitted to attend an end semester practical examination only if he / she submit a certified record with a minimum of 10 experiments**. This is to be endorsed by the examiners. The mark sheet duly certified by the head of the institution should be sent to the University before the commencement of the end semester examinations.

No	Component	Marks
1	Attendance	5
2	Skill & Punctuality	5
3	Laboratory record	5
4	Test (internal exam)	5
	Total	20

The allotment of marks for attendance in all Lab courses shall be as follows.

	% of attendance	Marks
Attendance	Attendance less than 50%	0
	51%-60%	1
	61%-70%	2
	71%-80%	3
	81%-90%	4
	91%-100%	5

VII. END SEMESTER EXAMINATION (ESE)

The external theory examinations of all semesters shall be conducted by the University. There will be no supplementary examinations. For reappearance/ improvement, as per university rules, the students can appear along with the next batch.

VIII. EVALUATION OF PROJECT AND TOUR REPORT

(a) Project

(i) IV Semester project evaluation for Industry- based course (Internal)

The evaluation of project done by the end of fourth semester shall be evaluated internally according to the scheme given below. Each candidate shall be evaluated separately. There shall be a maximum of 12 candidates per session with two sessions per day. However, there shall be no continuous evaluation for the project.

Component	Marks
Involvement	10
Viva-voce	5
Presentation of report	5
Total	**20**

(ii) VI Semester Project evaluation for core course (External)

The evaluation of the project at the end of sixth semester shall be done by two external examiners according to the scheme given below. Each candidate shall be evaluated separately. There shall be a maximum of 12 candidates per session with two sessions per day. However, there shall be no continuous evaluation for the project.

Component	Marks
Originality of approach	15
Relevance of the topic	10
Involvement	10
Viva-voce	15
Presentation of report	20
Total	**70**

(b) Tour report (VI semester External Evaluation))

The evaluation of tour report shall be according to the scheme given below

Component	**Marks**
Presentation of the report	10
Certified report	20
Total	30

IX. END SEMESTER EVALUATION OF PRACTICAL EXAMINATION

(a) Industry – based course

The practical examination for the industry-based course **shall be conducted internally** in the fourth semester. **Two teachers from the department can be assigned charges to conduct the internal examination. The mark sheet duly certified by the head of the institution should be sent to the University.** The evaluation scheme for the end semester internal practical examination for different industry – based courses are as follows:

(i) Computer hardware and operating systems

Component	Marks
Installation of OS/Demonstration of hardware or software diagnostics / networking	40
Installation of application	10
Certified record with 6 experiments	10
Total	60

(ii) Microprocessor and embedded system

Component	Marks
Correct programme	20
Neatness in soldering	10
Execution of the programme	20
Certified record with 6 experiments	10
Total	60

(iii) Electronic & Electrical instrumentation and circuit design

Component	Marks
Formula, circuit, graph, brief procedure	10
Setting and experimental skill	15
Observations and tabulations	15
Substitution, calculation, result with correct unit	10
Certified record with 6 experiments	10
Total	60

(iv) Fibre Optics and Telecommunication

Component	Marks
Identification of components, difference between types and explanation of types, experimental skill, knowledge about systems and formula for calculation	50
Certified record with 6 experiments	10
Total	60

The **evaluation of certified record** shall be according to the scheme given below.

No of experiments recorded	**Marks**
6	10
4	6
3	4

(b) Core course

The practical examinations for the core course shall be conducted by the University at the end of semesters 4 and 6 with a common time table and questions set by the University. Similarly, the practical examination for the complementary course shall be conducted by the University at the end of the 4th semester. The examiners shall be selected from a panel of experts prepared by the University. **For each examination centre there shall be two external examiners and one internal examiner who is not in charge of the practical at that centre.**

The **evaluation of certified record** (**Semester IV- Core Course**) shall be according to the scheme given below.

No of experiments recorded	Marks
14	10
12	9
10	8
8	7
6	6

The **evaluation of certified record** (**Semester IV- Complementary Course**) shall be according to the scheme given below.

No of experiments recorded	Marks
18	10
16	9
14	8
12	7
10	6

The evaluation of certified record (Semester VI- Core Course) shall be according to the scheme given below.

No of experiments recorded	Marks
18	10
16	9
14	8
12	7
10	6

The evaluation scheme for the end semester practical examinations shall be as follows.

IV Semester External Practical Examination

Component	Marks
Formula, circuit, graph, brief procedure	20
Setting and experimental skill	15
Observations and tabulations	15
Substitution, calculation, result with correct unit	20
Certified record with 14 experiments	10
Total	80

VI Semester External Practical Examination

Component	Marks
Formula, circuit, graph, brief procedure	20
Setting and experimental skill	15
Observations and tabulations	15
Substitution, calculation, result with correct unit	20
Certified record with 14 experiments	10
Total	80

For electronics experiments, the scheme shall be as follows.

Component	Marks
Formula, circuit, graph, brief procedure	20
Observations, skill and tabulations	25
Substitution, calculation, result with correct unit	25
Certified record with 18 experiments	10
Total	80

For computer experiments, the following scheme shall be followed.

Component	Marks
Writing the programme	30
Execution of the programme	20
Output/Result	20
Certified record with 18 experiments	10
Total	80

PY1141: BASIC MECHANICS AND PROPERTIES OF MATTER

(36 HOURS-2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Correlate the knowledge gathered to the immediate experimental curriculum	Apply	PSO – 1
CO – 2	Distinguish the dynamics of rigid bodies of different shapes	Apply	PSO –1, 2, 4
CO – 3	Explain the implications of conservation laws	Understand	PSO – 1
CO – 4	Interpret the flavor of classical fields from oscillations and waves	Understand	PSO – 1, 2
CO – 5	Handle the known problems in elasticity, surface tension and viscosity in a more mathematically rigorous way	Apply	PSO –1, 2,4

MECHANICS (21 hrs.)

UNIT 1 - DYNAMICS OF RIGID BODIES (7 hrs.) (Book 1 Chapter 8)

Angular momentum and Moment of Inertia, Theorems on MI.- calculation of MI. of bodies of regular shapes: thin uniform rod(revision) - ring(revision), disc(revision), annular ring, solid sphere, solid cylinder and hollow cylinder - torque and angular momentum, KE of rotating and rolling bodies - Motion of rigid bodies on an inclined plane, Determination of MI. of a flywheel (Theory only)

UNIT 2 - CONSERVATION OF ENERGY (3 hrs.) (Book 1 Chapter 5)

Energy Conservation law- Work – power- Kinetic Energy – Work Energy theorem - Conservative Forces - potential energy- Conservation of energy for a particle–energy function.

UNIT 3 - OSCILLATIONS (8 hrs.) (Book 1 Chapter 9)

Simple harmonic motion – Energy of harmonic oscillators-simple pendulum - mass on a spring - oscillation of two particles connected by a spring- compound pendulum - interchange ability of suspension and oscillation points-collinear points-conditions for maximum and minimum periods - Determination of g using symmetric bar pendulum (Discussion only).

UNIT 4 - WAVES (3 hrs.) (Book1 Chapter 2)

Mechanical and electromagnetic wave motion- General equation of a wave motion-expression for a plane progressive harmonic wave- energy density for a plane progressive wave.

PROPERTIES OF MATTER (15 hrs.)

UNIT 5 - ELASTICITY (8 hrs.) (Book1 Chapter 12)

Modulus of elasticity (revision) - Relations connecting the three elastic moduli-Poisson's ratio-bending of beams- bending moment-cantilever- Beams supported at its ends and loaded in the middle- twisting couple on a cylindrical rod or wire -work done in twisting a wire-torsion pendulum.

.

UNIT 6 - SURFACE TENSION (3 hrs.) (Book1 Chapter 16)

Surface tension - Explanation of surface tension - Surface energy --angle of contact(revision) - shapes of drops - expression for excess of pressure on a curved liquid surface -variation of surface tension with temperature.

UNIT 7 - FLUID DYNAMICS (4 hrs.) (Book3 Chapter 15)

Streamline and turbulent flow - Reynold's Number, Poiseuille's formula, Bernoulli's theorem- - viscosity-Newton's law- Stokes' formula.

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya and Ram Prasad, S. Chand Publications, 2017
2. Mechanics: H. S. Hans and S. P. Puri, TMH, 2ndEdn.
3. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014
4. Fundamentals of Physics: Halliday and Resnick, Wiley India Pvt. Ltd.,2006.

BOOKS FOR REFERENCE:

1. Properties of matter: Brijlal and Subramaniam, S. Chand & Co.,2004
2. Principles of Physics: P.V. Naik, PHI, 2010

TOPICS FOR ASSIGNMENTS /DISCUSSION IN THE TUTORIAL SESSION (SAMPLE)

1. Physics-The fundamental science-historical development of mechanics-some implications of the principle of mechanics-The scope of mechanics.
2. Life of eminent physicists- Newton, Einstein, C.V. Raman, Edison.
3. Study of Young's modulus for different types of wood.
4. Study of variation of surface tension for different detergents.
5. Study of viscosity of different types of ink and to arrive at knowledge of its fluidity.
6. Wide applications of Bernoulli's equation.
7. Variation of surface tension with temperature by Jaeger's method

PY 1241: HEAT AND THERMODYNAMICS

(36 HOURS-2 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO –1	Compare thermal conductivity of various types of conductors and explain the radiation of heat.	Analyse	PSO – 1
CO –2	Differentiate between various thermodynamic processes.	Analyse	PSO – 5
CO –3	Judge the efficiency of engines by comparing the performance of various vehicles	Evaluate	PSO – 1, 5
CO –4	Distinguish entropy and available energy in various thermodynamic processes	Analyse	PSO – 1
CO –5	Differentiate between various phase transitions	Analyse	PSO –1, 5

UNIT 1 - TRANSFERENCE OF HEAT (10 hrs.) (Book 1)

Thermal conductivity – determination by Lee's disc method for bad conductor – radial flow of heat, cylindrical flow, thermal conductivity of rubber – Wiedmann Franz law – Radiation of heat - Plank's law – Black body radiation – discussion of black body radiation curve - Stefan's law, determination of Stefan's constant – Solar constant, determination of solar temperature

UNIT 2 - THERMODYNAMICS (18 hrs.) (Book 2)

Zeroth law and first law of thermodynamics – first law in differential form – Thermodynamic processes – Expression for work done in isothermal and adiabatic process – Application of first law to specific heat and latent heat – reversible and irreversible processes – Second law of thermodynamics – Clausius and Kelvin statements – Carnot's engine – Principle of refrigerator – working and efficiency – Otto engine and Diesel engine – working and efficiency

UNIT 3 - ENTROPY (8 hrs.) (Book 2)

Definition of entropy – change of entropy in reversible and irreversible cycle – Clausius inequality and second law of thermodynamics –Carnot's theorem- entropy and available energy – entropy, probability, and disorder – Nernst theorem and third law of thermodynamics – Phase transition – phase diagram – first and second order phase transitions (qualitative idea) – Clausius – Clapeyron equation

BOOKS FOR STUDY:

1. Heat and Thermodynamics: D. S. Mathur, S. Chand & Sons, New Delhi (1995)
2. Heat and Thermodynamics: Brijlal and Subramaniam, S. Chand &Co.

BOOKS FOR REFERENCE:

1. Thermal and Statistical Mechanics: S. K. Roy, New Age International publishers, New Delhi (2001)
2. Heat and Thermodynamics: M. Zeemansky, McGraw Hill, New Delhi (2007)
3. Heat and Thermodynamics: Rose C. McCarthy, The Rosen Publishing Group, Inc. NY, (2005)
4. Thermodynamics Kinetic Theory and Statistical Thermodynamics: F. W. Sears and G. L. Salinger, Addison-Wesley Publishing Company, 3rd Edn. (1975)
5. Modern Trends in B Sc Physics: C. J. Babu, S. Chand & Co. Ltd., New Delhi (2010)

PY 1341: INDUSTRY BASED COURSES
(54 HOURS-3 CREDITS FOR EACH COURSE)

PY1341.1: COMPUTER HARDWARE AND OPERATING SYSTEMS
(54 HOURS-3 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO –1	Define what an operating system is	Understand	PSO- 1
CO –2	Describe components of an operating system	Understand	PSO- 1,9
CO –3	Recognize desktop hardware components and devices	Apply	PSO- 1
CO –4	Describe basic desktop setup practices, operating system settings, and good troubleshooting practices	Apply	PSO- 1,9
CO –5	Demonstrate an understanding of operating system fundamental	Apply	PSO- 1,9
CO – 6	Mount an OS into a desktop computer and configure	Apply	PSO- 1,3,9
CO – 7	Recognize and describe different memory architectures used in computers	understand	PSO- 1,9
CO – 8	Understand how different OS Installations can be done on a computer	understand	PSO- 1,3, 9
CO – 9	Understand BIOS & Power On-Self Test	Understand	PSO- 1,9
CO –10	Understand Safe Mode Boot Menu	Understand	PSO- 1,9
CO –11	Demonstrate installation and troubleshooting of hardware and OS	Apply	PSO- 1,3,9

UNIT 1 - OVERVIEW OF COMPUTER HARDWARE (12 hrs.) (Book 2,4, 9)

Computer hardware-CPU, Motherboard, RAM, HDD, ODD, SMPS, K/B, Mouse, Monitor.

Motherboard-Definition, Architecture, Chipset, FSB, Bus, CPU Sockets, Interface Ports used to connect different Peripherals I/O Ports (PS/2, Serial, Parallel, USB, VGA, HDMI, Audio, Ethernet).

Memory-Introduction to RAM, ROM, Cache Memory, Buffer Memory, Virtual Memory, SD, RD, DDR, DDR2, DDR3, Hybrid Memory.

UNIT 2 - COMPUTER ASSEMBLY (14 hrs.) (Book 5, 6)

Assembling and Disassembling a PC, Precautions to be taken while assembling the PC.

Introduction to BIOS/CMOS Setup, POST (Power on Self-Test). BIOS/CMOS Configuration (Date, Time, Enable/Disable Devices). Dual BIOS Feature BIOS/CMOS Setup, Booting Sequence/Boot Order

UNIT 3 - OPERATING SYSTEMS (14 hrs.) (Book 1, 10, **Book 7)**

Operating Systems objectives and functions, Evolution of operating systems, Types of operating systems, Different services of the operating system, GUI, Kernel, Booting, Virtual Machine, OS design consideration for Multiprocessor and Multicore

Overview on Operating Systems- WINDOWS, UNIX, LINUX

UNIT 4 - CONFIGURING A COMPUTER WITH NEW OS (14 hrs.) (Book 3, 9) (Hands on training) To be Delivered as contact lecture hours, laboratory practices, seminars etc. Not for End Semester Examination. Only for continuous evaluation through practice tests, assignments viva etc.

Performing Dual Boot / Multi Boot

Choosing Ubuntu version, Getting Ubuntu, Installing Ubuntu. Practical Sessions.

Installation of Windows 8.1, Demonstration on Windows Using: Safe Mode, Safe Mode Boot options, Last Known Good Configuration. Demonstrating Windows Diagnostic Tools, System Restore, Creating Restore point, restore using Restore point. Windows Recovery using System Factory Defaults/Recovery tools. Partitioning of Hard Drive - Primary, Extended, Logical partitions using Partition Tools.

BOOKS FOR STUDY:

1. Operating Systems: Achyut S Godbole, Atul Kahate, Tata Mc Graw-Hill Education.
2. Computing Fundamentals, Introduction to Computers: Faithe Wempen, Wiley Publications
3. The official Ubuntu Book: Benjamin Mako Hill, Matthew Helmke, Corey Burger, Pearson Education Inc.
4. PC Hardware A Beginner's Guide: Ron Gilster, McGraw-Hill Education (India) Pvt Ltd.

5. PC Assembly and Installation: Dr. Tariq Hussain Sheikh, Naresh Kumar, Books clinic publishers.
6. Building Your own pc for dummies: Mark L Chambers, Wiley Publications.
7. Guide to Operating Systems: Greg Tomsho, Cengage Learning.
8. Operating Systems made easy: C. Madana Kumar Reddy, Lexmi Publications.
9. PC Hardware: A Beginner's Guide: Ron Gilster, Osborne/McGraw-Hill, 2001.
10. Operating Systems Internals and Design principles: William Stallings, Prentice Hall publication 7th Edn.

PY1341.2: MICROPROCESSOR AND EMBEDDED SYSTEMS
(54 HOURS-3 CREDITS)

Course outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO –1	Understand the evolution of microprocessor	Understand	PSO- 1
CO –2	Describe the architecture of microprocessor	Understand	PSO- 1,9
CO –3	Execute programs using assembly level programming	Apply	PSO- 1
CO –4	Understand the Embedded system design	Understand	PSO- 1,9
CO –5	Distinguish between Microprocessor based and Microcontroller based electronics	Apply	PSO- 1,9
CO – 6	Design simple circuits using Arduino controllers	Apply	PSO- 1,3,9
CO – 7	Understand Arduino methodology	Understand	PSO- 1,9
CO – 8	Demonstrate practical applications using Arduino controllers	Apply	PSO- 1,9
CO – 9	Demonstrate interfacing between Arduino boards and computers	Apply	PSO- 1,9
CO –10	Describe Arduino hardware	Understand	PSO- 1,9

UNIT 1 - MICROPROCESSORS AND MICROCONTROLLERS (10 hrs.) (Book 5)

Evolution of Microprocessor, System Architecture. Basics of Intel 8085 processor, Instruction set, Assembly language programming- addition, subtraction.

UNIT 2 - EMBEDDED SYSTEMS (10 hrs.) (Book 4)

Embedded System Hardware: Input, Processor Units, Memories, Communication, Output, System software

UNIT 3 - UNDERSTANDING ARDUINO (14 hrs.) (Book 3, Book 1, 2, 3)

Arduino methodology- Prototyping, Tinkering, Patching, Circuit Bending, Hacking Toys

Arduino Hardware, The software IDE, Anatomy of an Interactive Device, Sensors and Actuators, Blinking an LED

Installing IDE, Setting up Arduino board, Using Arduino, simple projects with Arduino UNO - Controlling Light with PWM

UNIT 4 - ADVANCED APPLICATION WITH ARDUINO (20 hrs.) (Book 2,6,3) (Hands on Training) To be Delivered as contact lecture hours, laboratory practices, seminars etc. Not for End Semester Examination. Only for continuous evaluation through practice tests, assignments, viva etc.

Advanced projects with Arduino UNO - Light sensor instead of Push button, Serial Communication, Analog input. -Make an LED Blink at different rates, Set a Traffic Lights Pattern, Set up a Tone Melody, Make a Smart Doorbell, Set up a Fire Alarm, Make a Smart Lamp, Set up a Danger Detector, Control LED through Smartphone (Bluetooth),Control DC Motor, Rotate Servo Motor from 0 to 180 degree.

BOOKS FOR STUDY:

1. Arduino Cookbook: Michael Margolis, O'Reilly Media Inc.
2. Basic Arduino projects: Don Wilcher, Maker media
3. Getting Started with Arduino: Massimo Banzi, O'Reilly Media Inc.
4. Embedded system Design: Peter Marwedel, Springer
5. Fundamentals of Digital Electronics and Microprocessors: Anokh Singh, A K Chhabra, S Chand Publications

ONLINE RESOURCE FOR READING:

6. https://bastiaanvanhengel.files.wordpress.com/2016/06/arduino_projects_book.pdf
7. https://students.iitk.ac.in/eclub/assets/lectures/embedded14/arduino.pdf

PY1341.3: ELECTRONIC & ELECTRICAL INSTRUMENTATION AND CIRCUIT DESIGN

(54 HOURS-3 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO –1	Distinguish between the passive and active electrical components	Understand	PSO- 1
CO –2	Identify electronic components	Understand	PSO- 1,9
CO –3	Recognize electrical and electronic circuits	Apply	PSO- 1
CO –4	Design and construct simple electrical and electronic circuits	Understand	PSO- 1,9

UNIT 1 - MAJOR ELECTRONIC COMPONENTS FOR INSTRUMENTATION (14 hrs.) (Book 1 Chapter 7)

Types of electronic components, passive and active components, Capacitor-types-characteristics, and codes- Resistor-types-characteristics and colour codes-P-N Junction diodes-forward and reverse characteristics-Testing diodes using multimeter- Transistor: principle and working – Different types of transistors.

UNIT 2 - FAMILIARIZATION WITH ELECTRICAL CIRCUITS (12 hrs.) (Book 1 Chapters 3,4,5)

Comparison of A.C voltage and D.C voltage– R.M.S and peak value of A.C signal – Ohm's law - Electrical resistance and resistivity- Laws of resistance in series and parallel circuits – Series voltage divider - Electric circuit- Load resistance and load current- Power dissipation in the resistance- Open and short circuits- Kirchhoff's laws.

UNIT 3 - ELECTRICAL AND ELECTRONIC INSTRUMENTS (QUALITITATIVE STUDY ONLY) (12 hrs.) (Book 3 Chapter 11 and Book 2)

Solders, flux and soldering technique - Rheostat – Potentiometer – Galvanometer – Thermocouple – Electric tester – Electric shock and Earthing system- LED and types of LED– Solar cell

UNIT 4 - CIRCUIT DESIGN (16 hrs.) (Hands on training) To be Delivered as contact lecture hours, laboratory practices, seminars etc. Not for End Semester Examination. Only for continuous evaluation through practice tests, assignments viva etc.

Design and construction of variable dc power supply (0-12V) using diodes, capacitors and IC 7812)

Make a two-socket electric extension board. LED circuit design

Carey Foster's bridge – Resistivity, Potentiometer- Resistivity

Experiment to verify

a) Kirchhoff's voltage law
b) Kirchhoff's current law

Experiment to study time domain transient response of RC circuit., Transistor characteristics: Common emitter configuration, Transistor characteristics: Common base configuration

Clamper circuits

a) Positive clamping circuits
b) Negative clamping circuits

Clipping circuits – to observe the clipping waveform in different clipping configuration.

Design and verification of transistor potential divider bias circuit.

BOOKS FOR STUDY:

1. A text book of Applied Electronics, Dr. R. S. Sedha, S Chand and company Ltd.
2. Basic electrical engineering: I. Anwani, Dhanpat Rai and Co.
3. Principles of Electronics, V.K. Mehta and Rohit Mehta, *S. Chand Publishing*
4. Electronic instrumentation, H.S. Kalsi, *Mc Graw Hill Education, 3rd edn.*
5. Digital Electronics, C. Chinnapu Reddy, *Radiant Publishing Houser, Hyderabad*
6. Practical Electronics: Components and Techniques: Components and Techniques, J. M. Hughes, *O'Reilly Media*
7. Basic Electronics, B. L. Theraja, *S Chand & Co Ltd*
8. A Practical Approach to Analog and Digital Electronics, K G Raval, *Oxford Book Company.*

PY1341.4: FIBER OPTICS AND TELECOMMUNICATION

(54 HOURS-3 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO –1	Describe the structure and working of optical fiber	Understand	PSO- 1
CO –2	Describe the different types of fiber optic cables and cabling tools	Understand	PSO- 1,7,9
CO –3	Demonstrate the methods of cable splicing	Apply	PSO- 1,9
CO –4	Understand different testing methods for optical cables	Understand	PSO- 1,9
CO –5	understand the basics of optical communication system	understand	PSO- 1,9

UNIT 1 - BASIC CONCEPTS OF LIGHT (6 hrs.) (Book 3, Book 1 Chapter 3)

Electromagnetic waves - electromagnetic spectrum, nature of light- modes of light - single mode - multi mode - reflection - refraction - refractive index - critical angle - acceptance angle - cone of acceptance - numerical aperture, - infrared spectrum - optical windows - losses in these bands - absorption - scattering - reflection - dispersion - intermodal dispersion - intramodal dispersion - effect on bandwidth - optical power - gain - loss - decibel.

UNIT 2 - INTRODUCTION TO OPTICAL FIBER (5 hrs.) (Book 1 Chapter 4)

Core - cladding - primary buffer - types of fibers - silica core silica cladding - silica core - plastic cladding (PCS) - plastic core plastic cladding (POF) - single mode - multi mode - graded index - step index fiber.

UNIT 3 - FIBER OPTIC CABLE (7 hrs.) (Book 1 Chapter 7)

Cable construction - geometry of cable - core - cladding - plastic coating - buffer - strength member - jacket - sizes of cables in use - color coding - types of cables - simplex - duplex - multi fiber - GI - SI - tight buffer - loose tube - ribbon - breakout cable - distribution cable - hybrid cable - armored cable - composite cable - aerial cable - submarine cable.

UNIT 4 - FIBER CABLING TOOLS (8 hrs.)

General tools - scribe - shear - slit and ring tool - stripping tool - buffer stripper - polishing film - polishing pad - polishing puck - cleaning devices - crimping tool - inspection microscope - cleavers - fusion splicer - light source - power meter - optical loss test set - visual fault locator - mechanical splices - splice tray - closure - optical time domain reflectometer.

UNIT 5 - CABLE SPLICING (10 hrs.) (Book1 Chapter8)

Fusion splicing - mechanical splicing - single fiber fusion splicing - mass fusion splicing - stages of splicing - splicing precautions - misalignment - end gap - end angle - NA mismatch - core mismatch - axial run-out - bubble - incomplete fusion.

UNIT 6 - TESTING OF CABLES (9 hrs.) (Book1 Chapter 15)

Continuity test - light source-power meter - OLTS - visual fault locator - OTDR testing - measuring cable span - attenuation coefficient - connector/splice loss measurement - distance to fault - OTDR trace analysis - optical loss budget.

UNIT 7 - OPTICAL COMMUNICATION (9 hrs.) (Basic ideas only) (Book 1 Chapter 10, 11 Book4 Chapter 11,12 Book3, Chapter 14 15, 17)

Basics of Communications -Signal types - analog - digital - characteristics of alternating current - cycle, wavelength, frequency, amplitude, phase, phase difference - average value - rms value. Optical Communication - P2P system - transmitter - light source - LED - laser diode - detector - PIN diode - avalanche photo diode.

BOOKS FOR STUDY:

1. Fiber Optics Installer and Technician Guide: Bill Woodward and Emile B. Husson, Neil Edde, San Francisco (2005)
2. Fiber-Optic Communication Systems: Govind P. Agrawal, Wiley Interscience, 3rd Edn. (2002)
3. Introduction to Fiber Optics: John Crisp and Barry Elliot, Elsevier, Amsterdam, 3rd Edn. (2005)
4. Introduction to Fiber Optics: Ajoy Ghatak and K. Thyagarajan, Cambridge University Press (1997)
5. Troubleshooting Optical-Fiber Networks - Understanding and Using Your Optical Time-Domain Reflectometer: Duwayne R. Anderson, Larry Johnson and Florian G. Bell, Elsevier Academic press, Amsterdam, 2nd Edition (2004)

ONLINE RESOURCE FOR READING:

6. https://www.vedantu.com/physics/optical-fiber
7. http://krct.ac.in/ktgadmin/assets/php/pdf/1576331029.pdf

PY 1441: ELECTRODYNAMICS

(54 HOURS-3 CREDITS)

CO No.	Course Outcomes	Cognitive Level	PSO No.
CO1	Identify the principles of electrostatics and apply it to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density	Apply	PSO – 1 PSO – 6
CO2	Identify the principles of magnetostatics and apply it to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density	Apply	PSO – 1 PSO – 6
CO3	Recognize the concepts related to Faraday ‘s law, induced emf and Maxwell‘s equations.	Understand	PSO – 1
CO4	Compare the properties of electromagnetic waves in vacuum, and matter	Apply	PSO – 6
CO5	Analyse the growth and decay of transient currents in different electrical circuits	Understand	PSO – 6
CO6	Compare the properties of different ac circuits	Apply	PSO –3, 6

UNIT 1 - ELECTROSTATIC FIELD (10 hrs.) [Book 1 Chapter 2, 3 and 6]

Electric field: Introduction, Coulomb's law, Electric field, continuous distribution (Revision) Gauss's law, Integral form of Gauss's law, Electric field due to Some Symmetric Charge Distribution, Electric Potential Energy, Relation between E and V, Equipotential Surfaces and Field Lines, Potential Energy of a continuous charge distribution, Boundary conditions satisfied by an Electrostatic Field, Poisson's and Laplace's Equation, Potential at the centre of a sphere in a charge free region.

UNIT 2 - ELECTRIC FIELDS IN MATTER (10 hrs.) [Book 1 Chapter 8, 9]

Polar and Nonpolar molecules, Polarization P in a Dielectric Material, Bound and Free Charges, Bound Charge Density and Polarization, Electric Field due to a Uniformly Polarized Sphere, long and cylindrical dielectric. Displacement Field, Gauss's law in terms of displacement vector, Boundary conditions, Displacement Vector in a Linear Dielectric.

UNIT 3 - MAGNETOSTATICS AND ELECTROMAGNETIC INDUCTION (10 hrs.) [Book 1 Chapter 12, 13, 15, 17]

The Biot- Savart law, Ampere's force law (revision), Magnetic field due to a straight segment of a wire, force between two current carrying wires, Divergence of B, Ampere's law in integral form, Applications of Ampere's law, Boundary conditions on B, Magnetic Vector Potential Faraday's law, Induced Electric field, Integral form of Faraday's law, Induced emf.

UNIT 4 - ELECTROMAGNETIC WAVES (12 hrs.) [Book 1 Chapter 19, 20, 23, 25]

Maxwell's Equation, The Poynting Vector, The Poynting Theorem (Derivation not required), Electromagnetic waves, General Properties of EM waves, Energy in EM waves, Complex representation of EM Waves, Maxwell's equation in Material Medium, Linear Electric and Magnetic Materials, Displacement Current, Boundary conditions on Fields across a Surface, Reflection and Transmission of EM waves (Normal Incidence only).

UNIT 5 - TRANSIENT CURRENTS (6 hrs.) [Book 2 Chapter 12]

Growth and decay of current in LR and CR Circuits-Measurement of high resistance by leakage-Charging and discharging of a capacitor through LCR circuit.

UNIT 6 - ALTERNATING CURRENT (6 hrs.) [Book 2 Chapter 13]

AC through series LCR (acceptor circuit) and parallel LCR circuit (rejecter circuit)- Q- factor, Power in AC-power factor.

BOOKS FOR STUDY:

1. Classical Electromagnetism: H. C. Verma, Bharathi Bhavan Publishers.
2. Electricity and Magnetism: S. Murugesan, Chand & Co.

BOOKS FOR REFERENCE:

1. Electrodynamics: David J Griffith, PHI, 3rd Edn.
2. Electricity and Magnetism: Muneer H. Nayfeh & Norton K. Bressel, John Wiley & Sons
3. Electricity and Magnetism: E. M. Purcell, Berkley Physics course, Vol.2, MGH
4. Classical Electrodynamics: Walter Greiner, Springer International Edn.
5. Electromagnetics: B. B. Laud, Wiley Eastern Ltd., 2ndEdn.
6. Introduction to electrodynamics: Reitz & Milford Addison Wesley
7. Electricity and Magnetism: D. C. Tayal, Himalaya Publishing Co.
8. Electricity and Magnetism: K. K. Tiwari, S. Chand & Co.
9. Principles of electromagnetics: Matthew N.O Sadiku and S. V Kulkarni., Oxford University Press, 6th Edn.

Topics for discussion in Tutorial session/Assignments (sample)

1.Comment on how electrostatic energy is stored in a field
2. Discuss the electrostatic properties of conductors
3. What is meant by electrostatic shielding? In what way it helps us?
4. Discuss the peculiarities of electric displacement D and electric field E. How they are incorporated in Maxwell's Equations
5.Discuss the properties of linear dielectrics. What differentiates a dielectric to be linear or not?
6. Discuss applications of Ampere's circuital law
7. Compare electrostatics and magnetostatics
8. Why magnetic forces cannot do work
9. Discuss about cyclotron motion & cycloid motion
10. Discuss whether there exists any stand-off between ohm's law and Newton's second law
11. A battery has an emf. Can this emf. be a 'force'? How will you interpret electromotive force?
12. Discuss the role of motional emf in power generation
13. Discuss the orthogonality of E, B and propagation vector k
14. A wave function can have a sinusoidal representation. Solve the wave equation for this function and discuss the various terms related to a wave such as amplitude, frequency, phase, wave number.

15.Complex representation of wave function has good advantage. Why? Discuss the linearity of wave function. (Use complex notation)

16. Discuss AC through LC, LR and CR circuits

17. Show that sharpness of resonance is equal to Q- factor

18. What is a choke coil? Discuss the advantage of using a choke coil instead of a resistor

PY1541: CLASSICAL, STATISTICAL AND RELATIVISTIC MECHANICS

(72 HOURS- 4 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Recognize the mechanics of a single and a system of particles under different force fields	Understand	PSO – 1,8
CO – 2	Solve different mechanical problems in classical mechanics using Lagrangian formalism	Apply	PSO –3, 15
CO – 3	Generalize Hamiltonian mechanics to solve various problems in classical mechanics	Apply	PSO –3, 15
CO – 4	Able to define phase space, microstate, macrostate and ensemble	Understand	PSO – 1, 8
CO – 5	Learn to distinguish different statistical distributions and judge which distribution applies to a given system	Apply	PSO – 1, 3
CO – 6	Distinguish inertial and non- inertial frames of references	Understand	PSO – 1,6, 9
CO – 7	Understand the concept of Galilean and Lorentz Transformations and their applications	Understand	PSO – 1, 6

UNIT 1 - NEWTONIAN MECHANICS (4 hrs.) (Book 1 Chapter 2)

Newtons Laws, The equation of motion of a particle, Conservations theorems, Limitations of Newtonian mechanics

UNIT 2 - MOTION IN CENTRAL FORCE FIELD (12 hrs.) (Book 4 Chapter 5)

Reduction to one-body problem, General properties of central force motion, Motion in central force field, Inverse square law force, Kepler's laws.

UNIT 3 - LAGRANGIAN DYNAMICS (12 hrs.) (Book 2 Chapter 2)

Constraints-generalized coordinates- principle of virtual Work-D' Alembert's principle, Lagrange's equation from D'Alembert's Principle-Newton's equation of motion from Lagrange's equations, applications of Lagrange's equation in simple pendulum, Atwood's machine and compound pendulum.

UNIT 4 - HAMILTONIAN DYNAMICS (12 hrs.) (Book 2 Chapter 3)

Generalized momentum and cyclic coordinates- Hamiltonian function conservation of energy- Hamilton's equation - examples of Hamiltonian dynamics: Equation of motion of i) one dimensional harmonic oscillator ii) particle in central force field

UNIT 5 - FRAMES OF REFERENCE, GALILEAN TRANSFORMATION AND SPECIAL THEORY OF RELATIVITY (14 hrs.) (Book 2 Chapter 12 and 13)

Inertial and non- inertial frame of reference- Galilean transformations- Ether Hypothesis- The Michelson-Morley experiment- explanation of negative result- postulates of special theory of relativity- Lorentz transformations - Consequences of Lorentz transformations- length contraction, simultaneity, time dilation, twin paradox, Addition of velocities- variation of mass with velocity (Derivation not needed) – mass energy relation.

UNIT 6 - STATISTICAL MECHANICS (18 hrs.) (Book 3)

Macro states and micro states, thermodynamic probability, Bose - Einstein statistics, Fermi - Dirac statistics, Maxwell - Boltzmann statistics, The statistical interpretation of entropy, The Bose - Einstein distribution function, the Fermi - Dirac distribution function, the classical distribution function, comparison of distribution functions for indistinguishable Particles, the Maxwell· Boltzmann distribution function

BOOKS FOR STUDY:

1. Classical dynamics of particles and systems: Thornton & Morion, 2008.
2. Classical Mechanics: J. C. Upadhyaya, Himalaya Publishing
3. Thermodynamics Kinetic Theory and Statistical Thermodynamics: F. W. Sears and G. L. Salinger, Addison-Wesley Publishing Company
4. Classical Mechanics - G. Aruldhas, PHI Learning Private Limited

BOOKS FOR REFERENCE:

1. Classical Mechanics: G. Aruldhas, PHI Learning Pvt Ltd., 2008.
2. Mechanics: H. S. Hans and S. P. Puri, Tata-McGraw HilL
3. Concepts of Modern Physics: Arthur Beiser, McGraw-Hill, 2009.
4. Heat Thermodynamics and Statistical Physics: Brij Lal and N. Subrahmanyam, P. S. Hemne, S. Chand, 2008.
5. Thermal and Statistical Mechanics: S. K. Roy, New Age International- 2001

6. Classical Mechanics: Goldstein.
7. Classical Mechanics Systems of Particles & Hamiltonian Dynamics: Walter Greiner, Springer, 2nd Edn.
8. An Introduction to Mechanics: D. Kleppner, R. J. Kolenkow, McGraw-Hill, 1973.
9. Mechanics, Berkeley Physics: C. Kittel W. Knight, et.al., Tata McGraw-Hill, vol.1, 2007.
10. Introduction to Special Relativity: R. Resnick, John Wiley and Sons, 2005.
11. Statistical Mechanics: Kerson Huang
12. Statistical and Thermal Physics: S. Lokanathan and R. S. Gambhir, Prentice Hall, 1991.
13. Classical Mechanics: N. C. Rana & P. S. Joag

PY1542: CLASSICAL AND MODERN OPTICS

(72 HOURS-4 CREDITS)

CO No.	Upon completion of this course students will be able to	Cognitive Level	PSO NO.
CO – 1	Explain the different basic phenomena of light such as Interference, Diffraction, Dispersion and Polarization	Recognize	PSO – 1
CO –2	Differentiate between the two types of diffraction, viz., Fresnel and Fraunhofer diffraction	Identify	PSO – 1
CO –3	Apply diffraction theory in Rayleigh's criterion for resolution and in finding resolving power of diffraction grating	Apply	PSO – 1, 6, 9
CO –4	Distinguish between normal and anomalous types of dispersion and to derive region-specific dispersion formulae from the general dispersion relation	Understand	PSO – 1, 6, 9
CO –5	Understand the different methods for the production of plane polarized light and also the different rules governing polarization.	Understand	PSO – 1, 6, 9
CO –6	Have a good knowledge about the different types of polarizations, its theory and the production/analysis methods	Apply	PSO – 1, 6, 9
CO –7	Apply the concept of polarization in studying Nicol prism, quarter wave and half wave plates	Understand	PSO – 1, 6, 9
CO–8	Explain the basic constituents of a laser, different types and working	Apply	PSO – 1, 6, 9
CO –9	Obtain an idea about non-linear optical processes especially the different harmonic generations	Understand	PSO – 1, 6, 18
C –10	Gain knowledge about the principle and different types of optical fibers	Remember	PSO – 1, 6, 9
C –11	Understand the applications of optical fibers in different fields of science	Understand	PSO – 1, 6, 9

C –12	Have knowledge on the principles of holography, its production and different types	Understand	PSO – 1, 6, 9

UNIT 1 - INTERFERENCE (12 hrs.) (Book 1 Chapters 14, 15)

The principle of superposition – superposition of coherent and incoherent sources – Young's double slit interference (theory of interference fringes and band width) – conditions for sustained interference-interference by division of wavefront and amplitude –Fresnel's biprism-interference in thin films, classification of fringes-wedge shaped films-testing of optical flatness-colours in thin films- Newton's rings (reflected system)- determination of refractive index of a liquid

UNIT 2 - DIFFRACTION (14 hrs.) (Book 2 Chapter 3)

Diffraction-Huygens-Fresnel theory-Fresnel diffraction: Fresnel's assumptions - explanation of rectilinear propagation of light– zone plate-comparison between a zone plate and a convex lens-diffraction at a circular aperture, straight edge-Fraunhofer diffraction: - diffraction at a single slit, double slits – plane transmission grating (derivation not needed), grating law – prism and grating spectra- Resolving power- Rayleigh's criterion for resolution - resolving power of diffraction grating

UNIT 3 - DISPERSION (5 hrs.) (Book 2 Chapter 11, Book 3 Chapter 1)

Normal and anomalous dispersion – Cauchy, Hartmann, Sellmeier equations – Wood's experiment on anomalous dispersion – general dispersion formula

UNIT 4 - POLARIZATION (12 hrs.) (Book 1 Chapter 20)

Polarization -plane/linearly polarized light -polarization by reflection – Brewster's law - pile of plates-double refraction-Malus' law– optic axis- Huygen's explanation for double refraction in uniaxial crystals - Nicol prism-construction - Nicol prism as a polarizer and analyzer – quarter and half wave plates-Theory, production and analysis of plane, circularly and elliptically polarized light

UNIT 5 - LASER (14 hrs.) (Book 1 Chapter 22, Book 2 Chapter 12)

Laser beam characteristics-spatial and temporal coherence (qualitative ideas)-basic principle of laser operation-spontaneous emission-stimulated emission-Einstein's coefficients-light propagation through medium and condition for light amplification-population inversion-pumping and different pumping schemes-metastable states-optical resonant cavity (qualitative)-types of lasers: Ruby laser, He-Ne laser (construction and working)-applications of lasers-Non-linear optics (qualitative ideas only): non-linear polarization, second harmonic generation, phase matching.

UNIT 6 - FIBER OPTICS (8 hrs.) (Book 1 Chapter 24)

Optical fiber: types of optical fibers (based on material, refractive index, modes), structure of an optical fiber, working principle-numerical aperture: definition, derivation of expression-acceptance angle-coherent, incoherent and fused bundles-pulse dispersion in step index and graded index fibers- losses in optical fibers (qualitative) - advantages and applications of optical fibers: fiber optic sensors (qualitative), fiber optic communication system (qualitative ideas with block diagram)

UNIT 7- HOLOGRAPHY (7 hrs.) (Book 1 Chapter 23)

Principle of holography- recording of holograms, reconstruction of images (Theory not needed) - comparison of hologram and photograph - application of holography, different types of holograms-transmission, reflection, volume, white light reflection, rainbow holograms.

BOOKS FOR STUDY:

1. Textbook of Optics: Subramaniam, Brijlal, M. N. Avadhanulu
2. Optics and Spectroscopy: R. Murugeshan
3. Basic Optics- Principles and Concept: Avijit Lahiri, Elsevier

BOOKS FOR REFERENCE:

1. Optics: Ajoy Ghatak
2. Lasers- Principles, Types and Applications: K. R. Nambiar
3. Lasers and Non-linear optics: B. B. Laud

PY1543: SEMICONDUCTOR DEVICES AND CIRCUITS

(72 HOURS-4 CREDITS)

Course Outcome:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the network theorems	Understand	PSO – 1
CO – 2	Describe diode characteristics	Understand	PSO – 9, 13
CO – 3	Design power supply circuits by applying junction diodes	Apply	PSO – 2, 13
CO – 4	Design single stage transistor amplifiers, oscillators and operational amplifiers.	Apply	PSO – 2,13
CO – 5	Understand the concept of modulation	Understand	PSO – 9, 14
CO – 6	Explain the working of special devices, FET, MOSFET, UJT	Understand	PSO – 9, 13

UNIT 1 - NETWORK THEOREMS (6 hrs.) (Book 1 Chapter 4)

Kirchhoff's current and voltage laws-ideal current and voltage source-Thevenin's Theorem-Equivalent circuit-Norton's Theorem-Equivalent Circuit-Maximum Power transfer theorem (Proof not required for theorems)

UNIT 2 - DIODES AND DC POWER SUPPLIES (12 hrs.) (Book 1 Chapters 13,15 and 17)

PN Junction-Depletion layer-Barrier Potential-Effect of temperature on barrier voltage-Forward biased PN Junction-Forward VI characteristics-Reverse Biased PN Junction-Reverse Saturation Current-Junction Breakdown-Zener Diode-VI characteristics-Zener diode as voltage stabilizer - Rectifiers: Half wave rectifier, Full wave rectifier and Full wave bridge rectifier (working, average value, form factor, PIV, ripple factor, efficiency)

Filter circuits-Types of filter circuits: series inductor filter, shunt capacitor, LC filter, pi filter (basic working only)

UNIT 3 - TRANSISTORS AND TRANSISTOR AMPLIFIERS (18 hrs.) (Book 2 Chapters 8, 9, 10 &11)

Transistor Fundamentals-transistor action-transistor connections-CB connection and characteristics-CE connection and characteristics-CC connection-Comparison of Transistor Connections-Relations between α, β and Υ

Transistor as an amplifier in CE arrangement-operation-analysis of collector currents-load line analysis-dc load line-operating point- cut off and saturation points-faithful amplification-transistor biasing-stabilization-stability factor-voltage divider bias and stability factor-Single stage CE amplifier circuit-phase reversal-load line analysis-voltage gain-frequency response and bandwidth

UNIT 4 - FEEDBACK AMPLIFIERS AND OSCILLATOR CIRCUITS (9 hrs.) (Book 1 Chapters 25 and 28)

Principle of Feedback Amplifiers-Negative and Positive Feedback-Gain of Negative Feedback - Advantages of Negative Feedback-Gain Stability-Increased Bandwidth-Decreased Distortion- - Oscillator criterion- Hartley Oscillator- Colpitts oscillator- Phase shift Principle-Phase Shift Oscillator (Derivations not required)

UNIT 5 - MODULATION (9 hrs.) (Book 2 Chapter 16)

Need for modulation-Types of Modulation-Amplitude Modulation-Modulation Factor-Analysis of AM wave-Side bands and Frequencies in AM wave-Power in AM wave-Limitations of Amplitude Modulation-Frequency Modulation-Theory of Frequency Modulation-Comparison of FM and AM, Demodulation (definition only).

UNIT 6 - FIELD EFFECT TRANSISTORS (9 hrs.) (Book 1 Chapter 26)

Types of FET-JFET: Basic construction (n-channel & p-channel)-Theory of Operation-Static Characteristics -Drain characteristics without external bias and with external bias - Transfer Characteristics-Small Signal JFET Parameters-Advantages of FETs

UNIT 7- OPERATIONAL AMPLIFIERS (IC 741) (9 hrs.) (Book 3 Chapter 7)

Op Amp as a Differential Amplifier (Block Diagram) - Differential gain and common mode gain-common mode rejection ratio-Op Amp-Schematic Symbol and Pin Configuration-Inverting and Non-inverting inputs-Ideal Op Amp-Virtual Ground-Parameters of Op amp-inverting amplifier-non-inverting amplifier-summing amplifier-Difference Amplifier

BOOKS FOR STUDY:

1. Basic Electronics-Solid State: B. L. Theraja, S. Chand Ltd., 2005
2. Principles of Electronics: V. K. Mehta, S. Chand Ltd.,2005
3. Basic Electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI, 2010

BOOKS FOR REFERENCE:

4. Electronic Devices and Circuits: Theodore F. Bogart Jr., Universal Book Stall
5. Electronic Devices and Circuit theory: Robert Boylestad & Louis Nashelski, PHI,5th Edn.
6. Electronic Fundamentals & Applications: John D Ryder, PHI, 4thEdn.

PY1544: ATOMIC AND MOLECULAR PHYSICS

(72 HOURS-4 CREDITS)

Course Outcome:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize different atomic models, their significances, properties, merits and demerits	Understand	PSO – 1, 6
CO – 2	Distinguish between atomic and molecular spectra and their relevant uses	Apply	PSO – 6, ,11
CO – 3	Understand the features of X- ray spectra	Understand	PSO – 12
CO – 4	Recognize different spectroscopic techniques	Understand	PSO – 12

UNIT 1 - VECTOR ATOM MODEL (12 hrs.) (Book1 Chapter 6)

Bohr's theory, correspondence principle- Somerfield's atom model and explanation of fine structure of H line in Balmer series of hydrogen atom. Limitation of Sommerfeld atom model Vector atom model-Various quantum numbers associated with vector atom model-, L.S and j.j couplings –application of spatial quantization- Pauli's exclusion principle - magnetic dipole moment of electron due to orbital and spin motion - Stern-Gerlach Experiment - Spin-Orbit coupling.

UNIT 2 - ATOMIC SPECTRA (14 hrs.) (Book1 Chapter 6)

Optical spectra-Spectral terms and notations - selection rules - intensity rule and interval rule - fine structure of sodium D lines – hyperfine structure - Zeeman effect - Larmor's theorem – quantum mechanical explanation of normal Zeeman effect. Anomalous Zeeman effect –Paschen-Back Effect-Stark effect.

UNIT 3 - X-RAYS (6 hrs.) (Book2 Chapter 7)

X-ray spectra - Characteristic X-ray spectrum - Moseley's law - Absorption of X-rays - X-ray absorption edges

UNIT 4 - MOLECULAR SPECTRA (28 hrs.) (Book2 Chapter 9)

Electromagnetic spectra-molecular energies-classification of molecules-rotational spectra of diatomic molecules-rotational energy levels-selection rules-rotational spectrum-isotope effect-bond length and atomic mass. Diatomic vibrational spectra-vibrational energy levels-selection rule-vibrational transitions-Rotation-Vibration transitions-IR spectrometer - Raman scattering-classical description of Raman scattering, quantum theory of Raman scattering-vibrational Raman

spectra-diatomic molecules-polyatomic molecules-rotational Raman spectra Raman spectrometer - Electronic spectra sequences and progressions-Frank-Condon principle

UNIT 5 - RESONANCE SPECTROSCOPY (12 hrs.) (Book2 Chapter 9)

NMR principle-Resonance condition-NMR spectrometer-chemical shift-indirect spin-spin Interaction- applications of NMR spectroscopy- ESR principle- Resonance condition –ESR spectrometer- hyperfine interaction – applications of ESR spectroscopy, Mossbauer spectroscopy-principle -isomer shift

BOOKS FOR STUDY:

1. Modern Physics: R. Murugesan, S. Chand& Co., Reprint, 2008
2. Modern Physics: G. Aruldhas and P. Rajagopal, PHI, New Delhi, 2005

BOOKS FOR REFERENCE:

1. Atomic and Nuclear Physics: N. Subramaniam & Brijlal, S. Chand& Co.
2. Atomic Physics: J. B. Rajam, S. Chand& Co.
3. Concepts of Modern Physics: A. Beiser, TMH, New Delhi, 6thEdn.
4. Fundamentals of Molecular Spectroscopy: Banwell, TMH
5. Spectroscopy: Walker & Straw, Chapman & Hill.
6. Molecular Spectroscopy: G. Aruldhas, PHI, 2004
7. Atomic and Nuclear Physics: Dr. V. W. Kulkarni-Himalaya Publishing House

PY 1551 OPEN COURSE

(54 HOURS-2CREDITS FOR EACH COURSE)

PY1551.1: BIO PHYSICS

(54 HOURS-2CREDITS)

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	Cognitive Level	PSO No.
CO – 1	Realize the physics of audition and vision	Understand	PSO – 1
CO – 2	Obtain knowledge about biological systems	Understand	PSO – 1
CO – 3	Get an idea about different biological measuring instruments	Understand	PSO – 1,9
CO – 4	Familiarize the idea of bioinformatics	Understand	PSO – 1, 9
CO – 5	Identify the biological application of radiation physics	Understand	PSO – 1, 9

UNIT 1 - BIO MECHANICS (18 hrs.) (Book 3 Chapter 1 to 5)

Bio mechanics - biophysics and fluid flow—Gas transport—physics of audition- Physics of vision

UNIT 2 - CELLULAR – MOLECULAR BIOPHYSICS (18 hrs.) (Book 3 Chapter 6 to 9)

Cell -components-proteins-nucleic acids—physics of bio-membranes -Thermodynamics of bio systems

UNIT 3 - RADIATION BIOPHYSICS (18 hrs.) (Book 1 Chapters 17, 6 & Book 3)

Bio –electronics and Bio Instrumentation Bio –informatics - Demonstration of biophysics experiments

BOOKS FOR STUDY:

1. Essentials of Biophysics: P. Narayanan, 2nd Edn. New Age publishers
2. A text book of biophysics: R. N. Roy, New central book agency Kolkata.
3. Elementary bio physics: P. K. Srivastava, Narosa publishing house, New Delhi

BOOKS FOR REFERENCE:

4. Introduction to Biophysics: Pranab Kumar Banerjee, S. Chand& co, New Delhi
5. Biological Science: Green, Stout& Taylor, Cambridge university press

PY 1551.2: ASTRONOMY AND ASTROPHYSICS

(54 HOURS-2CREDITS)

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Differentiate between astronomy and astrophysics and understand the different branches, scientific methods and scope of astronomy	Remember, Understand	PSO – 1
CO – 2	Understand earlier astronomical works and the different laws involved in astronomy	Remember, Understand	PSO – 1, 9
CO – 3	Understand planets and solar system objects and apply the laws of physics to describe their structure and characteristics.	Remember, Understand Apply	PSO – 1, 9
CO – 4	Understand the evolution and properties of stars and galaxies and apply the different laws of physics to describe the structure and evolution of stars, galaxies and the universe	Remember, Understand Apply	PSO – 1, 9

UNIT 1 - INTRODUCTION TO ASTRONOMY (10 hrs.) (Book 1, Chapter 1)

What is Astronomy – Branches of Astronomy - Astronomy and Astrophysics, Importance of Astronomy, Methods of Astronomy and Astrophysics, The Scientific Methods, Scope of Astronomy

UNIT 2 - HISTORY OF MODERN ASTRONOMY (10 hrs.) (Book 2, Chapter 1)

Ptolemy's model of Universe – Copernican and Galilean contributions – Laws of planetary motion: Tycho Brahe's observations, Kepler's laws

UNIT 3 - THE SOLAR SYSTEM (18 hrs.) (Book 2, Chapter 2,3) (Book 3, Chapter 6,8)

Formation of solar system: Nebular hypothesis – The Sun: Physical properties – Internal structure – Solar atmosphere - Sun spots – Solar wind, prominences and flares – Physical characteristics of planets in solar system- Lunar and Solar eclipses

Earth's motion and Seasons - Brief familiarization of solar system objects: Satellites, Asteroid belt, Kuiper belt, Comets and Meteorites (qualitative study).

UNIT 4 - OUTER UNIVERSE (16 hrs.) (Book 2, Chapter 6,8)

Properties of stars: luminosity, colour and surface temperature – Spectral types of stars – Hertzsprung-Russel diagram – Evolution of a Sun-like star – Fate of high mass stars: Supernova, Neutron stars and Black holes (qualitative description only) – Brief familiarization of Milky Way galaxy, Types of galaxies according to shape.

BOOKS FOR STUDY:

1. Astrophysics - K. D. Abhayankar (University Press)
2. Introduction to Astronomy and Cosmology – Ian Morison (Wiley)
3. Planet Earth, Cesare Emiliani, (Cambridge University Press)

BOOKS FOR REFERENCE:

1.Introduction to Astrophysics – Baidyanadh Basu
2. Astrophysics – Stars and Galaxies by K. D. Abhyankar Tata McGraw Hill Publishing Company (1th edition) 1992.
3. https://theplanets.org/solar-system/
4. https://www.space.com/16014-astronomy.html

PY 1551.3: APPLIED PHYSICS

(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed.
CO-1	Understand the principles of working and the specifications of different electronic equipment	Understand	PSO – 1, 9
CO-2	Gain knowledge about X-rays and Lasers and their applications	Understand	PSO – 1, 12
CO-3	Understand a knowledge about holography, holograms and their applications	Understand	PSO – 1, 9
CO-4	Understand the basics of fibre optics and fibre optic communications.	Understand	PSO – 1, 9

UNIT 1 - ELECTRIC AND ELECTRONIC EQUIPMENTS (12 hrs.) (Book 1, 2 &3)

Electric motor-principles of working, public addressing system-Block diagram representation-function of each unit-CD player and drives-DVD player and drives- Telephonic communication (Cable and cellular)-principles (qualitative study using block diagram) -Cell phone-SIM card-technical specifications-Touch screens & ATM (Automated Teller machine)

UNIT 2 - X-RAY AND ITS APPLICATIONS (11 hrs.) (Book 4&5)

Discovery of X-rays, Gas filled tube, Coolidge X-ray tube, Properties of X-ray, X-ray spectra-Continuous and characteristic spectra, C T Scan-basic principle applications and advantages –MRI Scan-Principle, applications and advantages.

UNIT 3 - FUNDAMENTALS OF LASERS (13 hrs.) (Book 6)

Introduction-Interaction of light with matter, Absorption, Spontaneous emission, stimulated emission, Light amplification, Population inversion, metastable states- Components of Laser-Principal pumping Schemes-Role of resonant cavity- Ruby laser (Qualitative study only).

UNIT 4 - HOLOGRAPHY (8 hrs.) (Book 6)

Introduction, Basic Principle of holography, Holograms, Important Properties of Hologram, Recording and reconstruction transmission holograms (Qualitative study only), Medical Applications of Holography.

UNIT 5 - FIBER OPTICS (10 hrs.) (Book 6)

Introduction, Optical fiber, Principle of operation of Optical Fiber, Total internal reflection, Critical angle Structure of Optical Fiber, Classification: Step index fiber and Graded index fibre.

Propagation of light through an optical fiber, Need for Cladding. Optical sources, modulators and detectors, Optical fiber Communication system (qualitative study only), Advantages and applications of Optical fibers.

BOOKS FOR STUDY:

1. A Textbook of Electrical Technology (Vol 1& 2): B. L. Theraja and A. K. Theraja.
2. Audio and Video Systems: R. G. Gupta, Technical Education Series
3. Mobile Satellite Communication Network (chapters 1 &2): Ray E Sherrif & Y. Funttu, Wiley India Edu.
4. Modern Physics: R. Murugesan & Kiruthiga Siva Prasath S. Chand & Company Pvt Ltd
5. Atomic and Nuclear Physics: Dr. V. W. Kulkarni, Himalaya Publishing House.
6. A Text book of Optics: Dr. N. Subrahmanyam Brijlal, Dr M. N. Avadhanulu -S. Chand & Company Pvt Ltd

PY1551.4: ENVIRONMENTAL PHYSICS

(54 HOURS – 2 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed.
CO – 1	Identify, realize, and enlist the causes of environmental pollution.	Apply	PSO –1, 9
CO – 2	Become aware of environmental issues and their effects on man and other living beings.	Analyse	PSO –9, 16
CO – 3	Examine major environmental disasters and propose control and prevention measures.	Analyse	PSO –9, 16
CO – 4	Systemic and critical thinking in relation to environmental, human, economic, and development factors	Analyse	PSO –9, 16

UNIT 1 - ESSENTIALS OF ENVIRONMENTAL PHYSICS (18 hrs.)

Structure and thermodynamics of the atmosphere; composition of air; Greenhouse effect; Transport of matter; energy and momentum in nature; Stratification and stability of the

atmosphere; Laws of motion; Hydrostatic equilibrium; General circulation of the tropics; Elements of weather and climate in India.

UNIT 2 - ENVIRONMENTAL POLLUTION AND DEGRADATION (18 hrs.)

Factors governing air, water and noise pollution; Air and water quality standards; Waste disposal; Heat Island effect; Land and sea breeze; Puffs and Plumes; Gaseous and particulate matter; Wet and dry deposition; Dispersal mechanism of air and water pollutants; Mixing height and turbulence; Environmental degradation; Thermal and radioactive pollution; Nuclear radiation; Health hazards and safety.

UNIT 3 - ENVIRONMENTAL CHANGES AND REMOTE SENSING (18 hrs.)

Energy sources and combustion processes; Renewable sources of energy; Solar energy, Wind energy, Bio energy, hydro power; fuel cells; and nuclear energy; Forestry and bio-energy; Deforestation; Degradation of soils; Agriculture and land use changes; Changing composition of local and global environment; Remote sensing techniques.

BOOKS FOR STUDY:

1. The Physics of Monsoon: R. N. Kesavamoorthy and N. Sankar Rao, Allied Publications

2.The Physics of Atmosphere: J. T. Houghton, Cambridge University

3. Renewal Energy Resources: J. T. Widell and J. Weir, ELBS 1988

4. Numerical Weather Prediction: G. J. Haltiner and R. T. Williams, John Wiley

PY1551.5: ENERGY PHYSICS

(54 HOURS, 2 CREDITS)

Course outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed.
CO – 1	Explain the principle of conversion of energy	Understand	PSO – 1, 9
CO – 2	Understand energy conservation policies	Understand	PSO – 1, 9
CO – 3	To obtain knowledge about non-conventional energy sources	Understand	PSO – 1, 9
CO – 4	Distinguish reliable and clean energy sources	Apply	PSO – 1, 9
CO – 5	Gain knowledge about energy storage	Apply	PSO – 1, 9

UNIT 1 - INTRODUCTION (7 hrs.) (Book 1 section 1.4 - 1.14)

Units and scales of energy - various forms of energy – renewable and conventional energy systems – comparison – coal, oil and natural gas – availability– applications – merits and demerits. Impact due to non-conventional energy sources – global warming, Approaches to Energy conservation - energy conservation policies of different Governmental bodies.

UNIT 2 - SOLAR ENERGY (10 hrs.) (Book 1 section 2.6, 3.1-3.4, 3.7,3.8, 4.1-4.3, 5.2-5.8, 5.10-5.12)

Solar radiation measurements (qualitative only), solar energy collector, principle of the conversion of solar radiation in to heat, classification of different types of solar energy collectors (qualitative ideas only)- merits and demerits, Solar energy storage, solar heaters, solar cookers, solar green houses, merits and demerits of solar energy, Solar cell technology (basic principle only)

UNIT 3 - WIND ENERGY (9 hrs.) (Book 1 section 6.2, 6.5-6.8, 6.13)

Basic principle of wind energy conversion, basic components of wind energy conversion system (WECS), wind energy collectors. Applications of wind energy.

UNIT 4 - BIOMASS ENERGY (9 hrs.) (Book 1 section 7.1-7.5)

Biomass conversion process, photosynthesis, biogas generation and influencing factors, Gober gas plants, wood gasification, ethanol from wood, merits and demerits of biomass as energy source.

UNIT 5 - ALTERNATIVE ENERGY SOURCES (9 hrs.) (Book 1 Section - 1.7 - 1.8, 8.1, 8.4, 8.13)

Geothermal energy sources, Applications of Geothermal energy, Energy from Oceans and Chemical energy resources: Ocean thermal energy Conversion, energy from waves and tides – basic ideas, nature, applications, merits and demerits.

UNIT 6 - CLEAN ENERGY AND STORAGE (10 hrs.) (Book 1 Section - 16.2-16.9 & 17.3)

Nuclear energy-nuclear fission and fusion (definition only)-nuclear reactors-nuclear energy policy of our nation.

Mechanical, Electrical, Chemical, Thermal and Biological storage. Primary and secondary cells – fuel cells (basics). Distribution of Energy.

BOOKS FOR STUDY:

1. Non – Conventional Energy Resources: G. D. Rai, Khanna Publishers, 2008.

2. Solar energy: G. D. Rai, 5th edition, 1995.

3. Solar Energy Fundamentals and application: H.P. Garg and J. Prakash,

Tata McGraw - Hill Publishing company Ltd., 1997.

BOOKS FOR REFERENCE:

1. Energy Technology: S. Rao and Dr. B. B. Parulekar., 2ndEdn, 1997.

2. Power Plant Technology: A. K. Wahil. 1993.

3. Solar energy: S. P. Sukhatme, Tata McGraw- Hill Publishing company Ltd., 1992.

PY 1641 SOLID STATE PHYSICS
(72 HOURS -4 CREDITS)

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO–1	Able to distinguish types of crystals according to their structure	Understand	PSO – 1, 6, 9
CO–2	Able to illustrate the concepts of unit cell and lattice of crystals	Apply	PSO – 1,6
CO–3	Able to discuss diffraction of X rays by crystals and to demonstrate its experimental techniques	Apply	PSO – 1, 2, 9
CO–4	Able to describe and evaluate mechanical, electrical and magnetic properties of metals	Understand	PSO – 1, 6, 9
CO–5	Learn to discuss and evaluate dielectric properties of materials	Apply	PSO – 1,9
CO–6	Able to discuss types of magnetic properties of materials	Understand	PSO – 1, 6,9
CO–7	Learn to explain different physical characteristics of superconductors	Understand	PSO – 1, 6, 9
CO–8	Able to illustrate theoretical formulation of superconductors	Apply	PSO – 1, 9

UNIT 1 - CRYSTAL STRUCTURE (18 hrs.) (Book 1 Chapter 1, 8)

Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors Lattice with a Basis – Unit Cell-Elements of symmetry Revision topics qualitative ideas only-Bravais Lattice -two and three dimensional- Miller Indices- X-ray Diffraction Bragg's Law- The Reciprocal Lattice- (Qualitative Ideas only) X- ray diffraction Experiment- Powder method- Laue Method (Experimental Techniques only)

UNIT 2 - CONDUCTION IN METALS- FREE ELECTRON MODEL (18 hrs.) (Book 1 Chapter 10)

Introduction-conduction electrons-Fermi Dirac Statistics-Electrical conductivity of metals-Relaxation time and mean free path- electrical conductivity and Ohm's Law Electrical resistivity of metals-Hall effect - failure of free electron model.

UNIT 3 - DIELECTRIC AND MAGNETIC PROPERTIES OF MATERIALS (20 hrs.) (Book 1 Chapter 14, 16)

Polarization- Local Electric Field at an Atom- Depolarization Field- Electric Susceptibility- Polarizability- Clausius-Mossotti Equation- Classical Theory of Electric Polarizability
Response of a substance to magnetic field- Classification of magnetic materials- Atomic Theory

of Magnetism- The origin of permanent magnetic moment-Classical Langevin Theory of Diamagnetism - Sources of Para magnetism- Langevin Classical Theory of Para magnetism- Ferromagnetism- The Weiss molecular Exchange field Curie temperature - Ferromagnetic Domains- Discussion of B-H Curve. Hysteresis and Energy Loss (qualitative ideas only)

UNIT 4 - SUPERCONDUCTIVITY (16 hrs.) (Book 1 Chapter 17)

Introduction- Sources of Superconductivity- Response of magnetic field- Critical Temperature- Critical magnetic field-Meissner effect- Origin of Energy gap- Isotope effect- London's Equations- London Penetration Depth-Coherence length-BCS theory- Normal Tunnelling-dc and ac Josephson Effect -high temperature super conductivity

BOOKS FOR STUDY:

1. Solid State Physics: M. A. Wahab, Narosa Publication, 2011
2. Elementary Solid-State Physics: M. Ali Omar, Pearson India, 1999
3. Elements of Solid-State Physics: J. P. Srivastava, Prentice-Hall of India, 2nd Edn., 2006

BOOKS FOR REFERENCE:

1. Introduction to Solid State Physics: Charles Kittel, Wiley India Pvt. Ltd., 8th Edn., 2004
2. Introduction to Solids: Leonid V. Azaroff, Tata Mc-Graw Hill, 2004
3. Solid State Physics: Neil W. Ashcroft and N. David Mermin, Cengage Learning, 1976
4. Solid State Physics: Rita John, McGraw Hill, 2014
5. Solid-State Physics: H. Ibach and H. Luth, Springer, 2009

PY 1642: NUCLEAR AND PARTICLE PHYSICS

(72 HOURS-4 CREDITS)

Course Outcomes:

CO. No.	**Upon completion of this course, students will be able to**	**Cognitive Level**	**PSO Addressed**
CO – 1	Identify nuclear **constituents** and general properties of nuclei	Understand	PSO – 1
CO – 2	Describe nuclear forces, phenomena of radioactivity & radiation Hazards	Understand	PSO – 1 ,6, 9
CO – 3	Distinguish different nuclear models	Understand	PSO –1, 6, 3

CO – 4	Understand different types of nuclear reactions, fission & fusion energies and applications	Apply	PSO – 1,6
CO – 5	Recognize different particle detectors and accelerators	Understand	PSO – 1, 9
CO – 6	Classify elementary particles and relate their properties	Understand	PSO – 1, 9

UNIT 1 - GENERAL PROPERTIES OF NUCLEI (10 hrs.) (Book 1 Chapter 11, Book 2 Chapter 27)

Nuclear composition-Some nuclear properties-quantitative facts about size, mass, charge, density, spin and magnetic moment, electric quadrupole moments - nuclear stability-Segre chart, binding energy- average binding energy and its variation with mass number, main features of binding energy versus mass number curve, nuclear forces-properties, meson theory.

UNIT 2 - NUCLEAR MODELS (11 hrs.) (Book 1 Chapter 11, Book 2 Chapter 27)

Liquid drop model -comparison of nucleus with liquid drop-semi empirical mass formula and significance of various terms. Shell model-evidence for nuclear shell structure, nuclear magic numbers, basic assumptions of shell model, Collective model.

UNIT 3 - RADIOACTIVITY (12 hrs.) (**Book 1 Chapter 12, Book 2 Chapter 31**)

Basics of radioactivity-Law of Radioactive Disintegration, Unit of activity, half-life, mean life, properties of alpha, beta and gamma rays, Law of Successive Disintegration- Ideal equilibrium, transient and secular equilibrium, radioactive series, Radioactive Dating : The Age of the Earth, Alpha decay-basics of α-decay processes, α-ray spectra, Geiger Nuttall law, β -decay- βray spectra, positron emission, electron capture, neutrino hypothesis, Gamma decay- Gamma ray spectra, internal conversion.

UNIT 4 - NUCLEAR REACTIONS (6 hrs.) (**Book 1 Chapter 12, Book 2 Chapter 34)**

Types of Reactions, Conservation Laws, Q-value- reaction rate- reaction cross section- reaction mechanism-Concept of compound nucleus.

UNIT 5 - PARTICLE DETECTORS & ACCELERATORS (10 hrs.) (Book 1-Chapter 15, Book 2- Chapter 29 &30, Book 4- Chapter 13 (section 13.4))

Particle Detectors –GM counter, scintillation counter, Micro-pattern Gas Detectors: Gas Electron Multiplier (GEM) - Particle Accelerators- Linear accelerator, Cyclotron, Betatron, Synchrotron, Synchrocyclotron, LHC

UNIT 6 - NUCLEAR FISSION AND FUSION (13 hrs.) (Book 1 Chapter 12, Book 2 Chapter 32, 35 & 36)

Nuclear fission-energy released in fission-Bohr and Wheeler's theory-chain reaction - multiplication factor-critical size-atom bomb-nuclear reactors-breeder reactors-uses of nuclear

reactors. Nuclear fusion-sources of stellar energy-thermonuclear reactions-hydrogen bomb-controlled thermonuclear reactions-magnetic bottle-Tokamak- inertial confinement-nuclear power in India, Radiation Hazards-Radiation Levels for Safety, Radiation Protection Methods, Nuclear Disasters, Nuclear Waste Disposal.

UNIT 7 - PARTICLE PHYSICS (10 hrs.) (Book 1 Chapter 13, Book 2 Chapter 38 & 39)

Particle interactions- basic features- types of particles and its families-Symmetries and Conservation Laws-baryon number, Lepton number- Isospin- Strangeness - concepts of quark model & Standard model

BOOKS FOR STUDY:

1. Concepts of Modern Physics: A. Beiser, Tata McGraw-Hill, New Delhi, 6th Edn.
2. Modern Physics: R. Murugesan, S. Chand & Co., Reprint,2008
3. Modern Physics: G. Aruldhas and P. Rajagopal, PHI, New Delhi, 2005.
4. Gaseous Radiation Detectors: Fundamentals and Applications, Fabio Sauli, Cambridge University Press

BOOKS FOR REFERENCE:

1. Atomic and Nuclear Physics: N. Subramaniam and Brijlal, S. Chand & Co.
2. Nuclear Physics: S. N. Ghoshal, S. Chand & Co.
3. Introduction to Elementary Particles: D. Griffith, John Wiley & Sons
4. Nuclear Physics: Kaplan, Narosa publications
5. Introductory nuclear Physics: Kenneth S. Krane, Wiley India Pvt Ltd., 2008
6. Nuclear Physics an Introduction: S. B. Patel, New Age International (P) Ltd., 2nd Edn.
7. Nuclear Physics: D. C. Tayal, Himalaya Publishing House, 4thEdn.
8. Pattern Recognition, Tracking and Vertex Reconstruction in Particle Detectors: Rudolf Frühwirth, Are Strandlie, Particle Acceleration and Detection book series, Springer, Published with the support of the Austrian Science Fund (FWF): PUB 733-Z, https://doi.org/10.1007/978-3-030-65771-0
9. Radiation Detection and Measurement, G. Knoll Publisher: John Wiley, New York, ISBN: 0-471-07338-53rd Edn., 2000.

PY1643: QUANTUM MECHANICS
(72 HOURS-4 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the limitations of Classical Physics to explain certain physical phenomena	Understand	PSO –1,6, 9
CO – 2	Identify the quantum mechanical concepts applicable to Physical systems	Apply	PSO –1,6, 9
CO – 3	Apply the concepts of Quantum Mechanics to solve problems	Apply	PSO – 1, 9
CO – 4	Derive Equations of motion of Physical systems using quantum concepts	Apply	PSO – 1, 9

UNIT 1 - LIMITS OF CLASSICAL PHYSICS (20 hrs.) (Book 1, Sections A-E, Chapter 1, Book 2 Chapter 2)

Blackbody Radiation, Photoelectric Effect, Compton Effect, Electron Diffraction, Bohr Atom, Correspondence Principle.

UNIT 2 - WAVE PACKETS AND UNCERTAINTY RELATIONS (12 hrs.) (Book 2 Sections 3.1-3.4, 3.7-3.8, Book 4 Section 2.2,2.3,2.4)

De Broglie Waves, Wave Packets, Group and Phase Velocities, Uncertainty Principle and its applications

UNIT 3 - WAVEFUNCTION AND SCHRODINGER EQUATION (14 hrs.) (Book 3 Chapter 1.1-1.5, Book 1, Book 4 Chapter 3)

Schrodinger Equation, Statistical Interpretation, Expectation Values, Normalization of Wavefunction, Position and Momentum Operators.

UNIT 4 - SOME ONE-DIMENSIONAL SYSTEMS (26 hrs.) (Book 3 Sections 2.1, 2.2, 2.3 (only 2.3.2), 2.4, 2.6, Book 2 Section5.8)

Stationary States, Time-Independent Schrodinger Equation, Free Particle, Particle in (i) Infinite Square Well Potential and (ii) Finite Potential Well, Quantum Tunnelling, Harmonic Oscillator (by solving the differential equation)

BOOKS FOR STUDY:

1. Quantum Physics: Stephen Gasiorowicz, John Wiley and Sons.
2. Concepts of Modern Physics: Arthur Beiser, McGraw Hill. 6th Edn
3. Introduction to Quantum Mechanics: David J. Griffiths, Prentice Hall, 1995.
4. Quantum Mechanics: G. Aruldhas, PHI, 2nd Edn., 2002

BOOKS FOR REFERENCE:

1. Quantum mechanics: Concepts & Applications, N. Zettilli, Second Edition, Wiley
2. A Text book of Quantum Mechanics: P.M. Mathews & K. Venkatesan- McGraw Hill, 2nd Edn., 2010
3. Quantum Mechanics: Robert Eisberg and Robert Resnick, Wiley, 2nd Edn. 2002
4. Quantum Mechanics: Leonard I. Schiff, TMH, 3rd Edn., 2010
5. Quantum Mechanics: Eugen Merzbacher, John Wiley and Sons Inc.,2004
6. Quantum Mechanics: Walter Greiner, Springer,4th Edn., 2001
7. Quantum Mechanics: Bruce Cameron Reed, Jones and Bartlett, 2008.
8. Quantum Mechanics for Scientists & Engineers: D.A. B. Miller, Cambridge University Press, 2008
9. Shaum's outline series

PY1644: DIGITAL CIRCUITS AND COMPUTATIONAL PHYSICS

(72 HOURS- 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Explain different number systems and their mathematical operations.	Understand, Apply	PSO – 1
CO – 2	Differentiate different logic gates.	Understand	PSO -1, 9
CO – 3	Summarize digital circuits and their functions.	Analyse	PSO -1, 9
CO – 4	Develop and compile programs in Python.	Apply	PSO -2, 9, 19
CO – 5	Apply numerical methods to solve physical problems.	Apply, Evaluate	PSO –1, 2, 9

UNIT 1 - (18 hrs.) (Book 1 Chapter 2)

NUMBER SYSTEMS :-Decimal number system-binary number system-conversion of binary number to decimal and decimal number to binary-binary addition and subtraction-1's complement-2's complement-binary subtraction using 2's complement-signed arithmetic operation-conversion of real numbers-conversion of decimal fraction to binary fraction-binary coded decimal - hexadecimal number system-conversion of hexadecimal number to decimal, decimal to hexadecimal, binary to hexadecimal and hexadecimal to binary-real or floating point representation of numbers-ASCII code.

UNIT 2 - (18 hrs.) (Book 2 Chapters 2, 6, and 8)

BOOLEAN ALGEBRA AND LOGIC GATES: - Logic gates AND, OR, NOT, NAND, NOR And Ex-OR gate-realization of other logic functions using NAND / NOR gates-tri state logic gate-Boolean laws- De-Morgan's Theorems-Simplification of Boolean equations using Boolean laws.
ARITHMETIC CIRCUITS: - Half adder-full adder-controlled inverter.
FLIP-FLOPS: - Flip-Flop, S-R Flip Flop, J-K Flip-flop, Master slave JK Flip- Flop.

UNIT 3 - COMPUTATIONAL PHYSICS (18 hrs.) (Book 3 Chapters 2,3,4 and 5)

About Python – Statements and Lines: one statement per line; multiple statements per line – Comments –Basic Data types (Literals and Operations): int type; float type; complex type; str type; bool type-Identifiers – Keywords – Variables – Print ( ), input ( ) and format ( ) functions – Control flow statements: Decision statements (if , if-else and nested if); Loops (while, for) – Terminating control – Lists: Definition; creating lists; accessing and counting list elements; searching elements within Lists (checking for existence, counting occurrences and locating elements; adding and deleting elements (appending elements, inserting elements, deleting elements using del, remove( ), pop( ) and clear( ); adding, multiplying and copying lists; operations on Lists [min( ), max( ), list reverse ( ), list .sort ( )] – Tuples: Definition; creating Tuples, accessing and counting Tuple elements; searching elements within Tuples (checking for existence, counting occurrences and locating elements); adding, multiplying and copying Tuples, operations on Tuples [min( ), max( ), sorted( )] – Comparison of Lists and Tuples.

UNIT 4 - COMPUTER ORIENTED NUMERICAL METHODS (18 hrs.) (Book 5 Chapters 3,5,6,8. Book 7 Chapter 4)

Solution to Numeric, Algebraic and Transcendental equations:-method of successive bisection to find the roots of an equation (include algorithm also)- Newton – Raphson iterative method-Forward and backward differences-Interpolation-Lagrange interpolation-Newton - Gregory forward interpolation-least square approximation of functions-linear regression-regression coefficients (Include algorithm also for linear regression) - Numerical differentiation using Newton's forward difference formulae- Numerical integration; Simpson's 1/3 rule; Trapezoidal rule.

BOOKS FOR STUDY:

1. Fundamentals of Microprocessors and Microcomputers: B. Ram, Dhanpat Rai Publications
2. Digital principles and Applications: Donald P. Leach, Albert Paul Malvino and Goutam Saha. TMH, New Delhi, 7th Edn.
3. Learning Python, B. Nagesh Rao, Cyber Plus Infotech Pvt Ltd., Bengaluru, India.
4. Fundamentals of Python -First Programs: Kenneth Lambert, Cengage Learning India Pvt Ltd, Delhi, India.
5. Numerical methods: Dr. V. N. Vedamurthy and Dr. N. Ch. S. N. Iyengar, Vikas Publishing House, Pvt Ltd. New Delhi, India.

6. Computer oriented numerical methods: V. Rajaraman, PHI Learning Pvt Ltd., Delhi, India.
7. Introductory methods of numerical analysis: S.S Sastry, PHI Learning Pvt Ltd., Delhi, India.

BOOKS FOR REFERENCE:

1. Python for Programmers: Paul Deitel and Harvey Deitel, Pearson India Education Services Pvt Ltd, Uttar Pradesh, India.
2. Introduction to Computing and Problem- Solving Using Python: E. Balaguruswamy, Mc Graw Hill India.

PY1661: ELECTIVE COURSES

(54 HOURS-2 CREDITS FOR EACH COURSE)

PY1661.1: ELECTRONIC INSTRUMENTATION AND RESEARCH METHODOLOGY

(54 HOURS-2 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO-1	Understand the basic concepts of measurements	Understand	PSO – 1, 2
CO-2	familiarize working basic measurement instruments like galvanometer, voltmeter, ammeter, multimeter etc.	Understand, Apply	PSO – 1, 9
CO-3	Describe the working of oscilloscopes	Understand	PSO – 1, 9
CO-4	Distinguish between passive and active transducers	Understand	PSO – 1, 2, 9
CO-5	Understand the objectives, motivation of research	Understand	PSO – 1, 20
CO-6	Identify the steps in research process	Understand	PSO – 1, 20
CO-7	Understand what is research problem and how to select a research problem	Understand	PSO – 1, 20
CO-8	Identify plagiarism in research report and can avoid it	Understand Apply	PSO – 1, 20
CO-9	Understand the components of thesis and able to write a thesis	Understand, apply	PSO – 1, 20

UNIT 1 - MEASUREMENTS AND MEASUREMENT SYSTEMS (18 hrs.) (Book 1 Chapter1, 3, 4)

Measurements - Significance of measurements- Methods of measurements : *Direct and indirect methods*- Instruments and measurement systems- Mechanical, Electrical and Electronic instruments- Classification of instruments - Deflection and Null type Instruments with comparison - Analog and Digital modes of operation - Functions of Instruments and Measurement systems- Applications of Measurement Systems - Elements of a generalised Measurement system- Concepts of {Static and Dynamic Characteristics of measurements - errors in measurements- True value - Static error- Scale range and scale pan- reproducibility and drift - Repeatability - Noise: Signal to noise ratio, Sources of Noise, Accuracy and Precision - Significant figure - Static sensitivity - Linearity - Loading effect - Input and Output impedances} - Impedance Matching and maximum power transfer

UNIT 2 - CATHODE RAY OSCILLOSCOPES AND TRANSDUCERS (18 hrs.) (Book 1 Chapter7)

Cathode Ray Oscilloscope (CRO)

Introduction - Cathode ray tube (CRT) -Electron Gun- Basic CRO Circuits - Observation of Waveform on CRO - Measurements of Voltages and Currents - Measurement of Phase and Frequency.

Transducers

Transducers- Passive and active transducers-Analog and Digital transducers - Resistive transducer - Potentiometers - Strain Gauges - Theory of strain gauge - Thermistors: Construction and Applications - Thermocouples: Construction, advantages and disadvantages

UNIT 3 - RESEARCH METHODOLOGY (18 hrs.) (Book 3 Chapter1, 2, Book 4 Chapter 16, Book 5 Chapter 5)

Research - Objectives and motivation in research – different types of research – Various steps in a research process- criteria of good research.

Research Problem, selecting the problem, technique involved in defining a problem -

Thesis/ Report writing - preliminary section (Title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface acknowledgement), Main Text (abstract, introduction, experimental section, results and discussion), Conclusions, references, scope for future study.

Undesirable authorships - General responsibilities of authors.

BOOKS FOR STUDY:

1. Electronic Instrumentation and measurement techniques: William David Cooper, Prentice Hall of India Pvt Ltd.

2. A course in Electrical and Electronic Measurements and Instrumentation: A. K. Sawhney
3. Research Methodology, methods and techniques: C. R. Kothari, New Age Publications
4. Fundamentals of Research Methodology and statistics: Yogesh Kumar Singh, New Age international Publications
5. Ethics in science education, research and governance: Edited by Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi, Indian National Science Academy

BOOKS FOR REFERENCE:

6. Instrumentation-Devices and Systems: C. S. Rangan, G. R. Sarma, V. S. V. Mani, TMH Publishers.
7. Electronic Instruments and Instrumentation Technology: M. M. S. Anand, PHI Ltd.
8. Sensors and Transducers: D. Patranabis, Wheeler Publishing Co. Ltd.
9. Industrial Electronics and Control: S. K. Bhattacharya & S. Chatterjee, TMH Publishers.
10. Electronic measurement and Instrumentation: K. B. Klaassen, Cambridge University Press.
11. Measurement Systems-Applications and Design: Ernest O. Doebelin & Dhanesh N. Manik, TMH Publishers, 5th Edn.
12. Principles of Measurement systems: John P. Bentley, Longman, Pearson Education Publishers. 3rd Edn.

PY 1661.2: SPACE SCIENCE AND RESEARCH METHODOLOGY

(54 HOURS - 2 CREDITS)

Course outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Understand the structure of universe	Understand	PSO – 1, 9
CO – 2	Knowledge about evolution of stars	Understand	PSO – 1, 9
CO – 3	Gain knowledge about Earth's atmosphere	Understand	PSO – 1, 9
CO – 4	Understand research methodology, ethics in research, report writing and plagiarism	Understand Apply	PSO – 1, 9, 20

UNIT 1 - UNIVERSE (8 hrs.) (Book 3)

Large Scale Structure of the Universe: Astronomy and Cosmology, Our Galaxy, Galaxy types, Radio sources, Quasars, Structures on the largest scale, Coordinates and catalogues of astronomical objects, Expansion of the Universe.

UNIT 2 - THE EVOLUTION OF STARS (12 hrs.) (Book 4)

Introduction, Classification of Stars: The Harvard classification, Hertzsprung – Russel diagram, Stellar evolution, White dwarfs, Electrons in a white dwarf star, Chandrasekhar limit, Neutron stars, Black holes, Supernova explosion, Photon diffusion time, Gravitational potential energy of a star, Internal temperature of a star, Internal pressure of a star

UNIT 3 - THE EARTH'S ATMOSPHERE AND MAGNETOSPHERE (16 hrs.) (Book 1, Book 2)

Nomenclature and temperature profile, Temperature distribution in the troposphere, Temperature of stratosphere, temperature of mesosphere and thermosphere, Temperature variability, The pressure profile, Scale height, Density variation. The Ionosphere: Effect on scale height, Ionospheric electric fields. The magnetic field of Earth, Earth's variable magnetic field, Solar activity and Earth's magnetic weather, solar wind interaction, Structure of the magnetosphere: Magneto tail and Plasma sheet, Plasma sphere.

UNIT 4 - RESEARCH METHODOLOGY (18 hrs.) (Book 5 Chapter1, 2, Book 6 Chapter 16, Book 7 Chapter 5)

Research - Objectives and motivation in research – different types of research – Various steps in a research process- criteria of good research.

Research Problem, selecting the problem, technique involved in defining a problem -

Thesis/ Report writing - preliminary section (Title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface acknowledgement), Main Text (abstract, introduction, experimental section, results and discussion), Conclusions, references, scope for future study.

Undesirable authorships - General responsibilities of authors.

BOOKS FOR STUDY:

1. Introduction to Space Science: Robert C Hymes, John Wiley & Sons Inc,. 1971.
2. Earth's Proximal Space: Chanchal Uberoi, Universities Press (India) 2000.
3. Introduction to Cosmology: J. V. Narlikar, Cambridge University Press, 1993.
4. Modern Physics: R. Murugeshan, KiruthikaSivaprasath, S.Chand& Company Ltd., 2007.
5. Research Methodology, methods and techniques: C R Kothari, New Age Publications
6. Fundamentals of Research Methodology and statistics: Yogesh Kumar Singh, New Age international Publications

7. Ethics in science education, research and governance: Edited by Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi, Indian National Science Academy

BOOKS FOR REFERENCE:

8. Space Physics and Space Astronomy: Michael D Pappagiannis, Gordon and Breach Science Publishers Ltd, 1972.
9. Introduction to Ionosphere and magnetosphere: Ratcliffe CUP, 1972.
10. The Physics of Atmospheres: Houghton, Cambridge University Press
11. Introduction to Ionospheric Physics: Henry Rishbeth& Owen K. Garriot, Academic Press, 1969
12. Space Science: Louise K. Harra& Keith O. Mason, Imperial College Press, London, 2004.
13. Introduction to Space Physics: Kivelson and Russel
14. Introduction to Astrophysics: Baidyanadh Basu
15. Astrophysics: K. D. Abhayankar, University Press.

PY1661.3: PHOTONICS AND RESEARCH METHODOLOGY (54 HOURS- 2 CREDITS)

Course outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish the different conduction mechanisms in semiconductors	Understand	PSO – 1
CO – 2	Understand the working of LED	Understand	PSO – 1,9
CO – 3	Recognize the basic features of semiconductor lasers	Understand	PSO – 1,9
CO – 4	Understand the basics of photodetectors	Understand	PSO – 1,9
CO – 5	Understand the electro-optic mechanism	Understand	PSO – 1,9
CO – 6	Get idea about non- linear optical phenomena	Understand	PSO – 1,9
CO – 7	Understand the basics of optical computing	Understand	PSO – 1, 9
CO – 8	Understand research methodology, ethics in research, report writing and plagiarism	Understand Apply	PSO– 1, 9, 20

UNIT 1 - PHOTONS IN SEMICONDUCTORS (5 hrs.) (Book 1 Chapter 16)

semiconductors-energy band and charge carriers-direct and indirect gap semiconductors - generation, recombination and injection

UNIT 2 - LIGHT EMITTING DIODES AND SEMICONDUCTOR LASERS (8 hrs.) (Book 1 Chapter 17, Book 2 Chapter 9)

light emitting diodes- injection electroluminescence-in thermal equilibrium, in the presence of carrier injection- LED characteristics- internal photon flux, output photon flux and efficiency, responsivity (Basics)-semiconductor lasers - central features- condition for laser action, p-n junction lasers- injection lasers- advances in semiconductor lasers

UNIT 3 - SEMICONDUCTOR PHOTON DETECTORS (6 hrs.) (Book 1Chapter 18)

external photo effect-photo electron emission- the internal photo effect- properties of semiconductor photo detectors-quantum efficiency, responsivity- devices with gain- response time

UNIT 4 - ELECTRO OPTICS (6 hrs.) (Book 1 Chapter 20)

Pockels and Kerr effects- electro optic modulators- phase modulators- scanners-directional couplers- spatial light modulators

UNIT 5 - NONLINEAR OPTICS (5 hrs.) Book 2, Chapter 13

harmonic generation- second harmonic generation- third harmonic generation- self-focusing of light

UNIT 6 - PHOTONIC SWITCHING AND COMPUTING (6 hrs.) (Book 1 Chapter 23)

switches- opto- mechanical, electro optic, acousto-optic and magneto optic- optical computing- digital optical computing, analog optical processing

UNIT 7 - RESEARCH METHODOLOGY (18 hrs.) (Book 3 Chapter1, 2, Book 4 Chapter 16, Book 5 Chapter 5)

Research - Objectives and motivation in research – different types of research – Various steps in a research process- criteria of good research.

Research Problem, selecting the problem, technique involved in defining a problem -

Thesis/ Report writing - preliminary section (Title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface acknowledgement), Main Text (abstract, introduction, experimental section, results and discussion), Conclusions, references, scope for future study.

Undesirable authorships - General responsibilities of authors.

BOOKS FOR STUDY:

1. Fundamentals of Photonics: B. E. A. Saleh and M. C. Teich, John Wiley & Sons, Inc.
2. Lasers and Nonlinear Optics: B. B. Laud, New Age International Pvt Ltd.
3. Research Methodology, methods and techniques: C R Kothari, New Age Publications

4. Fundamentals of Research Methodology and statistics: Yogesh Kumar Singh, New Age international Publications
5. Ethics in science education, research and governance: Edited by Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi, Indian National Science Academy

BOOKS FOR REFERENCE:

1. Semiconductor optoelectronic devices: Pallab Bhattacharya, Prentice Hall of India.
2. Optics and Photonics- An introduction: F. Graham Smith and Terry A. King, John Wiley & Sons, Inc.
3. Problems and Solutions in Optics & Photonics: Ajoy Ghatak and K Thyagarajan, McGraw Hill Education
4. Text Book of Optics: N. Subrahmaniam, Brij Lal and M.N. Avadhanulu, S. Chand & Company Ltd.

PY1661.4: NANO SCIENCE AND RESEARCH METHODOLOGY (54 HOURS- 2 CREDITS)

Course outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Explain the foundations of nanoscience and the different length scales in Physics	Remember	PSO – 1, 9
CO – 2	Gather basic ideas on the energy bands and density of states at the nanoscale	Understand	PSO – 1, 9
CO – 3	Compare the conduction mechanisms in nanomaterials and bulk materials	Analyze	PSO – 1, 9
CO – 4	Have a basic understanding of the quantum mechanics at the nanoscale and the different types of carbon nanostructures	Understand	PSO – 1, 9,
CO – 4	Synthesis of nanomaterials using different techniques	Understand	PSO – 1, 9,
CO – 5	Characterization of the synthesized nanomaterials using different methods	Analyze	PSO – 1, 9,
CO – 6	Understand the applications of nanotechnology in different fields of science	Understand	PSO – 1, 9,
CO – 7	Have basic idea about the different types of research	Understand	PSO – 1, 9,
CO – 8	Explain the difference between research methods and methodology	Understand	PSO – 1, 9,
CO – 9	Explain the basic steps in a scientific research process	Apply	PSO – 1, 9,

CO –10	Develop scientific way of writing thesis/research report	Apply	PSO – 1, 9,
CO–11	Have a basic knowledge on Plagiarism and ethics in research	Understand	PSO – 1, 9,
CO –12	Explain the foundations of nanoscience and the different length scales in Physics	Remember	PSO – 1, 9,

UNIT 1 - INTRODUCTION (6 hrs.)

Length scales in Physics- nanometer- Nanostructures: Zero-, One-, Two- and Three-dimensional nanostructures (elementary ideas) **(Book 2 Chapter 3)**

Band Structure and Density of State at nanoscale: Energy Bands, Density of States at low dimensional structures. **(Book 1: Chapter 3)**

UNIT 2 - ELECTRICAL TRANSPORT IN NANOSTRUCTURE (6 hrs.)

Various conduction mechanisms in 3D (bulk), 2D (thin film) and low dimensional systems: Thermionic emission, field enhanced thermionic emission (Schottky effect). **(Book 1 Chapter 4)**

UNIT 3 - INTRODUCTORY QUANTUM MECHANICS AND CARBON NANOSTRUCTURES (8 hrs.) (Book 1 Chapter 5,8)

Size effects in small systems, Quantum behaviors of nanometric world: trapped particle in 3D (nanodot), electron trapped in 2D plane (nanosheet), electrons moving in 1D (nanowire, nanorod, nanobelt), Excitons, Quantum confinement effect in nanomaterials. Carbon nanostructures: Buckminster fullerene-carbon nanotube-nano diamond

UNIT 4 - GROWTH TECHNIQUES AND CHARACTERIZATION OF NANOMATERIALS (12 hrs.)

(Elementary ideas only, detailed working of individual techniques/tools not required):

Top- down vs bottom- up techniques- Lithographic/non-Lithographic techniques: Plasma arc discharge, sputtering. Evaporation: Thermal evaporation, Electron beam evaporation. Chemical Vapor Deposition (CVD). Pulsed Laser Deposition, Molecular Beam Epitaxy, Sol-Gel Technique, Electro-deposition, Ball-milling. **(Book 1 Chapter 6)**

Atomic Structures-Grain size determination: XRD (Debye Scherrer equation), Microscopy: Scanning Electron Microscope (SEM), Tunneling Electron Microscope (TEM), Scanning Probe Microscope (SPM), Scanning Tunneling Microscope (STM), Atomic Force Microscope (AFM). **(Book 3 Chapters 2.1-2.4, 2.6)**.

UNIT 5 - NANOMATERIALS AND APPLICATIONS OF NANOTECHNOLOGY (Elementary ideas only) (4 hrs.)

Nanoelectronics-single electron transistor (no derivation)-Molecular machine- Nano biometrics **(Book 1 Chapter 8)**

Potential applications-expected benefits from nanotechnologies: Energy and Energy efficiency, new energy producers, Medicine, security-other applications **(Book 2 Chapters 5, 6, 7 &8).**

UNIT 6 - RESEARCH METHODOLOGY (18 hrs.) (Book 4 Chapter1, 2, Book 5 Chapter 16, Book 6 Chapter 5)

Research - Objectives and motivation in research – different types of research – Various steps in a research process- criteria of good research.

Research Problem, selecting the problem, technique involved in defining a problem -

Thesis/ Report writing - preliminary section (Title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface acknowledgement), Main Text (abstract, introduction, experimental section, results and discussion), Conclusions, references, scope for future study.

Undesirable authorships - General responsibilities of authors.

BOOKS FOR STUDY:

1. Introduction to Nanoscience & Nanotechnology: K. K. Chattopadhyay and A.N. Banerjee, Publisher: PHI Learning and Private Limited
2. Nanotechnology: Rakesh Rathi, S Chand & Company, New Delhi
3. Nano: The Essentials: T. Pradeep, McGraw Hill Education (India) Private Limited
4. Research Methodology, methods and techniques: C. R. Kothari, New Age Publications
5. Fundamentals of Research Methodology and statistics: Yogesh Kumar Singh, New Age international Publications
6. Ethics in science education, research and governance: Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi, Eds., Indian National Science Academy

BOOKS FOR REFERENCE:

7. Nanoparticle Technology Handbook: M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama (Eds.), Elsevier 2007
8. Encyclopedia of Materials Characterization, Surfaces, Interfaces, Thin Films: Brundle, Evans and Wilson, Butterworth, Heinemann Eds., 1992
9. Springer Handbook of nanotechnology: Bharat Bhushan, Eds., Springer-Verlag, Berlin, 2004
10. Nano Science and Technology: V. S. Muraleedharan and A Subramaniam, Anne Books Pvt. Ltd, New Delhi

11. How to write dissertations and project reports: Kathleen McMillan and Jonathan D. B. Weyers, Pearson

PY1661.5: COMPUTER NETWORKING AND RESEARCH METHODOLOGY (54 HOURS - 2 CREDITS)

Course outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Understand different types of networks and related protocols	Understand	PSO – 1, 9
CO – 2	Get Basic knowledge about connectivity devices	Understand	PSO – 1, 9
CO – 3	Gain knowledge Different address classes	Understand	PSO – 1, 9
CO – 4	Understand research methodology, ethics in research, report writing and plagiarism	Understand	PSO – 1, 9, 20

UNIT 1 - NETWORKING ESSENTIALS (12 hrs.) (Book 3 Chapter1, Book 4 Chapter 3, 4)

Introduction-Uses of computer networking-Network hardware-LAN, WAN, MAN, Reference model-OSI Model, TCP/IP Model Network Models: Peer-to-Peer, client / server network Topology- bus topology, ring topology, Example network- Ethernet Networking Protocols-LAN Protocols- Classification, networking-WAN Protocols- PPP, X.25, PPTP, L2TP, ISDN

UNIT 2 - LAN CONNECTIVITY DEVICES (10 hrs.) (Book 2)

NIC, Repeater, Hub, Switch, Bridge. Internet Connectivity Device-Routers, Gateways, CSU/DSU-TCP/IP Protocol Suite-What is TCP/IP, Importance, OSI vs TCP/IP

UNIT 3 - IP ADDRESSING (10 hrs.)

Overview, Address classes, Network ID, Host ID and Subnet Mask, Addressing guidelines, Reserved IP Address, Subnetting and Super netting (overview)

UNIT 4 - EMERGING TECHNOLOGIES (4 hrs.)

Wireless Technology - Bluetooth, WAP-Mobile Technology- GSM, CDMA, GPRS

UNIT 5 - RESEARCH METHODOLOGY (18 hrs.) (Book 6 Chapter1, 2, Book 7 Chapter 16, Book 8 Chapter 5)

Research - Objectives and motivation in research – different types of research – Various steps in a research process- criteria of good research.

Research Problem, selecting the problem, technique involved in defining a problem -

Thesis/ Report writing - preliminary section (Title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface acknowledgement), Main Text (abstract, introduction, experimental section, results and discussion), Conclusions, references, scope for future study.

Undesirable authorships - General responsibilities of authors.

BOOKS FOR STUDY:

1. The Complete Reference: Networking, Craig Zacker, Tata McGraw Hill
2. Networking All in One Desk Reference: Doug Lowe, 3rd Edn, Wiley India Pvt Ltd
3. Computer Networks: Tannenbaum, A.S., Prentice Hall2003
4. Networking: The Complete Reference: Bruce Hallberg 1st Edition, Mcgraw Hill Education
5. Local and Metropolitan Area Networks: Stallings, William, Macmillan Publishing Co.
6. Research Methodology, methods and techniques: C R Kothari, New Age Publications
7. Fundamentals of Research Methodology and statistics: Yogesh Kumar Singh, New Age international Publications
8. Ethics in science education, research and governance: Edited by Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi, Indian National Science Academy

BOOKS FOR REFERENCE:

1. Introduction to Networking: Richard Mc Mohan Tata McGraw Hill.
2. Data Network: Black Prentice Hall of India.
3. CCNA Cisco Certified Network Associate Study Guide : 3rd Edition, Mc Graw Hill Education
4. Cisco a Beginner's Guide: Fifth Edition, McGraw-Hill/Osborne Media
5. https://en.wikipedia.org/wiki/Point-to-Point_Tunneling_Protocol
6. https://www.tutorialspoint.com/ipv4/ipv4_address_classes.htm

PRACTICAL
(Semester 4, External Examination)
PY1442- Basic Physics Lab
(Minimum 14 experiments to be done)

CO.NO.	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO1	Familiarize with the precautions and steps of systematic recording of an experiment.	Understand, Apply
CO2	Understand multiple experimental techniques for determining physical quantities.	Understand, Apply
CO3	Develop skill in setting up of apparatus for accurate measurement of physical quantities.	Understand, Apply
CO4	Apply and illustrate the concepts of mechanics, heat and acoustic experiments	Understand, Apply

1. Fly Wheel - Moment of Inertia
2. Compound Bar Pendulum – Symmetric
3. Compound Bar Pendulum – Asymmetric
4. Uniform Bending---Y---Pin and Microscope
5. Uniform bending—Y- optic lever method
6. Non-uniform bending-Y-Optic lever& telescope
7. Rigidity modulus –Static torsion
8. Torsion pendulum I- By Torsional oscillations
9. Torsion pendulum I- By Equal masses
11. Kater’s pendulum-Acceleration due to gravity
12. Melde’s string-----Frequency of fork
13. Phase transition-determination of M.P of wax.
14. Determination of thermal conductivity of rubber
15. Lee’s disc-determination of thermal conductivity of a bad conductor
16. Viscosity-Continuous flow method using constant pressure head.
17. Viscosity-Variable pressure head arrangement
18. Surface tension-Capillary rise
19. Sonometer-frequency of A.C
20. Kundt’s tube-determination of velocity of sound.
21. Determination of m and Bh using deflection and vibration magneto meters.
22. Potentiometer-Resistivity.
23. Comparison of least counts of measuring instruments.
24. Evaluation of errors in simple experiments.

BOOKS FOR REFERENCE:

1.Yarwood and Wittle; Experimental Physics for Students, Chapman &Hall Publishers.
2. An advanced course in practical physics, Chathopadhyaya, Rakshit and Saha, New central agency, Kolkata.
3. A text book of practical physics, S. Viswanathan& Co., Chennai.
4. Advanced Practical Physics, B. L. Worsnop and H. T. Flint, Khosla Publishers, Delhi.

PY 1442.1: INDUSTRY BASED LAB
(Semester 4, Internal Examination)
(Minimum 6 experiments should be done)

Computer hardware and operating systems

CO No.	Upon completion of this course the student will be able to	Cognitive Level
CO – 1	Mount an OS into a desktop computer and configure	Apply
CO – 2	Recognize and describe different memory architectures used in computers	understand
CO – 3	Understand how different OS Installations can be done on a computer	understand
CO – 4	Understand BIOS & Power On-Self Test	Understand
CO –5	Understand Safe Mode Boot Menu	Understand
CO –6	Demonstrate installation and troubleshooting of hardware and OS	Apply

1. Choosing Ubuntu version, Getting Ubuntu, Installing Ubuntu.
2. Installation of hardware devises like printer scanner etc.in Ubuntu.
3. Local area networking between two computers
4. Installation of Windows 8.1
5. Demonstration on Windows Using: Safe Mode, Safe Mode Boot options, Last Known Good Configuration.
6. Demonstrating Windows Diagnostic Tools, System Restore, Creating Restore point, restore using Restore point.
7. Windows Recovery using System Factory Defaults/Recovery tools.
8. Partitioning of Hard Drive - Primary, Extended, Logical partitions using Partition Tools.

Microprocessor and embedded systems

CO. No	Upon completion of this course, students will be able to	Cognitive Level
CO – 1	Design simple circuits using Arduino controllers	Apply
CO – 2	Understand Arduino methodology	Understand
CO – 3	Demonstrate practical applications using Arduino controllers	Apply
CO – 4	Demonstrate interfacing between Arduino boards and computers	Apply
CO –5	Describe Arduino hardware	Understand

Basic Accessories Required for experiments with Arduino

•Arduino UNO (DIP) • Arduino Un

o Cable • LED (RED) • LED (GREEN) • LED (YELLOW) • LED (WHITE) • IR Sensor • LDR sensor module • Flame sensor • Ultrasonic Sensor • Servo Motor (Small) • Flat DC motor • Fan propeller • Bluetooth Module • Battery (9V) • Battery cap (DC jack) • Breadboard (half) • Jumper wire (M-F) • Jumper Wires (M-M) • Motor Driver Module (L293D) • Small Screwdriver • Resistor • PVC Base (Arduino+ Breadboard) • Piezo buzzer • Double sided tape.

1. Make an LED Blink at different rates.
2. Set a Traffic Lights Pattern
3. Set up a Tone Melody
4. Make a Smart Doorbell
5. Set up a Fire Alarm
6. Make a Smart Lamp
7. Set up a Danger Detector
8. Control LED through Smartphone (Bluetooth)
9. Control DC Motor
10. Rotate Servo Motor from 0 to 180 degree

Electronic & Electrical instrumentation and circuit design

CO. No	Upon completion of this course, students will be able to	Cognitive Level
CO –1	Design and construct variable dc power supply	Understand
CO – 2	Design and construct electrical circuits	Understand
CO – 3	Understand different transistor configurations and their Characteristics	Understand
CO – 4	Understand the working of clamper circuits	Understand, Apply

1. Design and construction of variable dc power supply (0-12V) using diodes, capacitors and IC 7812)
2. Make a two-socket electric extension board.
3. LED circuit design
4. Carey Foster's bridge – Resistivity
5. Potentiometer- Resistivity
6. Experiment to verify
   c) Kirchhoff's voltage law
   d) Kirchhoff's current law
9. Experiment to study time domain transient response of RC circuit.
10. Transistor characteristics: Common emitter configuration
11. Transistor characteristics: Common base configuration
12. Clamper circuits
    c) Positive clamping circuits
    d) Negative clamping circuits
13. Clipping circuits – to observe the clipping waveform in different clipping configuration.
14. Design and verification of transistor potential divider bias circuit.

Fiber Optics and Telecommunication

CO. No	Upon completion of this course, students will be able to	Cognitive Level
CO –1	Describe the different types of fiber optic cables and cabling tools	Understand
CO –2	Identify and use different measuring instruments	Understand
CO –3	Demonstrate the methods of cable splicing	Apply
CO –4	Understand different testing methods for optical cables	Understand

1. Introduction to Optical Fiber Cable (i) Study the Composition of Fiber Optic Cable (ii) Single and ribbon type (iii) Underground and overhead and Colour coding(iv) Pig Tail (v) Patch Chord (vi) Splice Protection Sleeve (vii) Fusion Splicer (viii) Fiber Closure.
2. Measuring instruments identification: Light Source (x) Power Meter (xi) Optical Loss Test Set (xii) OTDR.
3. Connectors (i) FC/SC/ST/LC/FDDI/ESCON/SMA (ii) Various types of ratio couplers (iii) splitters
4. Splicing (i) Fusion Splicing Set Up (ii) Splicing Stage by Stage (iii) Arranging in Splice Tray (iv) Securing in Fiber Closure.
5. Fiber Optic Testing (i) Fiber Continuity Test using Light Source and Power Meter (ii) Cable Loss Test.

6. OTDR Test (i) Setting up of OTDR (ii) Measuring Cable Span (iii) Measuring Attenuation Coefficient (iv) Connector/Splice Loss Measurement (v) Distance to Fault.
7. OTDR Trace Analysis and Optical Loss Budget in long distance optical links and FTTH networks.

PY1645: Advanced Physics Lab I
(Minimum 18 experiments to be done)

CO No	Upon completion of the course, students will be able to	Cognitive Level
CO 1	Understand how to use a spectrometer	Understand
CO 2	Obtain a practical understanding of the refraction of light by a prism	Understand, Apply
CO 3	Use basic laws to study the spectral and optical properties of the given prism and grating	Understand, Apply
CO 4	Understand the working of different electrical circuits and use it to determine different physical quantities	Understand, Apply

1. Spectrometer-A, D and n of a solid prism.
2. Spectrometer –Dispersive power and Cauchy's constants
3. Spectrometer Grating—Normal incidence- N & wavelength
4. Spectrometer-i-d curve
5. Spectrometer- Hollow prism
6. Liquid lens-refractive index of liquid and lens
7. Newton's Rings—Reflected system
8. Air wedge-diameter of a wire
9. Potentiometer-Calibration of ammeter
10. Potentiometer –Reduction factor of T.G
11. Potentiometer –Calibration of low range voltmeter
12. Potentiometer – Calibration of high range voltmeter
13. Thermo emf-measurement of emf using digital multimeter.
14. Carey Foster's Bridge-Resistivity
15. Carey Foster's Bridge-Temperature coefficient of resistance.
16. Mirror galvanometer-figure of merit.
17. BG- Absolute capacity of a condenser
18. Conversion of galvanometer into ammeter and calibration using digital Multimeter
19. Conversion of galvanometer into voltmeter and calibration using digital Voltmeter.

20. Circular coil-Calibration of ammeter.
21. Study of network theorems-Thevenin's & Norton's theorems and maximum power transfer theorem.
22. Circular coil-Study of earth's magnetic field using compass box.
23. Absolute determination of m and B_h using box type and Searle's type vibration magnetometers.
24. Searle's vibration magnetometer-comparison of magnetic moments.

BOOKS FOR REFERENCE:

1. Yarwood and Wittle; Experimental Physics for Students, Chapman &Hall Publishers.
2. An advanced course in practical physics, Chathopadhyaya, Rakshit and Saha, New central agency, Kolkata.
3. A text book of practical physics, S. Viswanathan& Co., Chennai.
4. Advanced Practical Physics, B. L. Worsnop and H. T. Flint, Khosla Publishers, Delhi.

PY1646: Advanced Physics Lab II

(Minimum 18 experiments to be done – 4 from Computational programming)

CO No	Upon completion of the course, students will be able to	Cognitive Level
CO 1	Understand the working of PN junction diodes, Zener diodes and their applications	Understand, Apply
CO 2	Understand the working of transistors and their applications	Understand, Apply
CO 3	Understand the working of operational amplifiers and their circuits	Understand, Apply
CO 4	Understand computational programming using Python and apply it to find the solution to different physical problems	Understand, Apply

ELECTRONICS

1. PN junction Diode (Ge & Si) characteristics-To draw the characteristic curves of a PN junction diode and to determine its ac and dc forward resistances.

2. Full wave (centre tapped) rectifier-To construct a full wave rectifier using junction diode and

to calculate the ripple factor with and without shunt filter (10 readings for R_L 100 to 5000).

3. Full wave (centre tapped) rectifier-To construct a full wave rectifier using junction diode and to study effect of L, C, and LC filters on the ripple factor (for different R_L).

4. Bridge rectifier-To construct a bridge rectifier using junction diodes and to calculate the ripple factor with and without shunt filter (10 readings for R_L 100 to 5000).

5. Bridge rectifier- Dual power supply-To construct a dual power supply using bridge rectifier and measure the output voltages for different pair of identical load resistors.

6. Zener diode characteristics-To draw the I-V characteristic of a Zener diode and to find the break down voltage and the dynamic resistance of the diode.

7. Zener diode as a voltage regulator-To construct a voltage regulator using Zener diode and to study the output voltage variation (i) for different RL and (ii) for different input voltage with same R_L.

8. Transistor characteristics-CE-To draw the characteristic curves of a transistor in the CE configuration and determine the current gain, input impedance and output impedance.

9. Transistor characteristics-CB-To draw the characteristic curves of a transistor in the CB configuration and determine the current gain, input impedance and output impedance.

10. Single stage CE amplifier-To construct a single stage CE transistor amplifier and study its frequency response.

11. OP amp. IC741- Inverting amplifier-To construct an inverting amplifier using IC741 and determine its voltage gain.

12. OP amp. IC741- Non-inverting amplifier

To construct a non-inverting amplifier using IC741 and determine its voltage gain

13. OP amp. IC741- Differentiator-To construct an OP amp. Differentiator, determine its voltage gain and study the output response to pulse and square wave.

14. OP amp. IC741- Integrator-To construct an OP amp. Integrator, determine its voltage gain and study the output response to pulse and square wave.

15. Phase shift oscillator-To construct a phase shift oscillator using transistor and measure the frequency of the output waveform.

16. Logic gates- OR and AND-To verify the truth tables of OR and AND gates using diodes.

17. Logic gate- NOT-To verify the truth tables of NOT gate using a transistor.

18. Network theorems (Superposition, Thevenin's & Norton's theorems)

To verify the (i) Superposition, (ii) Thevenin's & (iii) Norton's theorems

19. RC-Filter circuits (Low pass)

To construct an RC –low pass filter circuit and to find the upper cut off frequency

20. RC-Filter circuits (High pass)-To construct an RC –high pass filter circuit and to find the lower cut off frequency.

COMPUTATIONAL PROGRAMMING (PYTHON)

21. Program to find square, cube, square root and factorial.
22. Program to find logarithm and anti-logarithm of a number.
23. Program to find the roots of a quadratic equation.
24. Program to find sin (x), cos (x), tan (x), cosec (x), sec (x), cot (x)
25. Program that classifies a given pair of coordinates as (a) the point is on the origin, (b) the point is on the x-axis, (c) the point is on the y-axis, (d) the point lies in which quadrant.
26. Program to print the sum of digits of a given number
27. Program to classify a given number as prime or not.
28. Program to generate all prime numbers till a given number.
29. Program to determine whether a number is a palindrome or not.
30. Program for implementation of least square fitting.
31. Program for implementation of Bisection method for solving equations

REFERENCES:

1. Basic electronics and linear circuits; N.N. Bhargava, D.C. Kulshreshtha, S.C.Gupta
2. OP- Amps and linear integrated circuits; Ramakant A. Gayakwad
3. Basic electronics; Santiram Kal
4. Basic electronics; B. L. Theraja
5. Principles of electronics; V. K. Mehta
6. A first course in Electronics; Anwar A. Khan, Kanchan K. Dey

II COMPLEMENTARY COURSES

SEMESTER 1
(MATHEMATICS MAIN)

PY1131.1 MECHANICS AND PROPERTIES OF MATTER
(36 HOURS- 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the dynamics of rigid bodies of different shapes and their applications	Understand, Apply	PSO – 1
CO – 2	Understand the basics of simple harmonic motion and mechanical waves and their applications	Understand	PSO – 1,9
CO – 3	Understand the concepts of moduli of elasticity and applications	Understand Apply	PSO – 1,9
CO – 4	Explain the properties of fluids such as surface tension and viscosity and their applications with examples	Understand Apply	PSO – 1,9

UNIT I - (28 hrs.)

DYNAMICS OF RIGID BODIES (7 hrs.) (Book 1 Chapter 8)

Theorems of MI with proof-Calculation of MI of bodies of regular shapes rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid sphere-Kinetic energy of a rotating body. Determination of MI of a fly wheel (theory only).

OSCILLATIONS AND WAVES (13 hrs.) (Book 1 Chapter 9, 11)

Examples of SHM oscillator-compound pendulum-determination of g -torsion pendulum-oscillations of two particles connected by a spring-vibration state of a diatomic molecule
Wave motion-general equation of wave motion-plane progressive harmonic wave - energy density of a plane progressive wave -intensity of wave and spherical waves-

MECHANICS OF SOLIDS (8 hrs.) (Book1 Chapter 12)

Bending of beams-bending moment-cantilever-beam supported at its ends and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity**.**

UNIT 2 - (8 hrs.)

SURFACE TENSION (5 hrs.) (Book1 Chapter 16)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger' method-equilibrium of a liquid drop over solid and liquid surfaces

VISCOSITY (3 hrs.) (Book2 Chapter 15)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula -limitations-Ostwald's viscometer-variation of viscosity with temperature

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya, Ram Prasad & Sons
2. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014
3. Oscillations & Waves: K. Rama Reddy, S. Badami& V. Balasubramaniam (University Press)

SEMESTER 2
(MATHEMATICS MAIN)

PY1231.1: THERMAL PHYSICS AND STATISTICAL MECHANICS
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish the various process of heat transmission	Understand, Apply	PSO –1,9
CO – 2	Recognize the different thermodynamic processes	Understand	PSO – 1,9
CO – 3	Recognize the difference of petrol and diesel engines	Understand	PSO – 1,9
CO – 4	Obtain the concept of entropy and apply it to physical situations	Understand Apply	PSO – 1,9
CO – 5	Identify different statistical distribution	Understand Apply	PSO – 1,8

UNIT I - TRANSMISSION OF HEAT (14 hrs.) (Book 2)

Thermal conductivity and thermometric conductivity-Lee's disc experiment-Weidman and Franz law (statement only)-energy distribution in the spectrum of black body and results-Wien's displacement law-Rayleigh-Jeans law-their failure and Planck's hypothesis-Planck's law-comparison-solar constant-its determination-temperature of sun.

UNIT 2 - THERMODYNAMICS (9 hrs.) (Book 2)

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity Heat engines-Carnot's cycle -derivation of efficiency-petrol and diesel engine cycles-efficiency in these two cases-second laws of thermodynamics-Kelvin and Clausius statements.

UNIT 3 - ENTROPY (9 hrs.) Book 2

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.

UNIT 4 - STATISTICAL MECHANICS (4 hrs.) Book 5

Statistical probability-Macro and Microstates- Phase space-statistical ensemble-postulates of equal probability-Maxwell Boltzmann Distribution- velocity distribution

BOOKS FOR STUDY:

1. Heat and Thermodynamics: D. S. Mathur, S. Chand &Co.
2. Heat & Thermodynamics: N. Subramaniam & Brijlal, S. Chand & Co
3. Heat & Thermodynamics: W. Zemansky, McGraw Hill
4. Heat & Thermodynamics: C. L. Arora
5. Statistical Mechanics: Sinha (TMH).

SEMESTER 3
(MATHEMATICS MAIN)

PY1331.1: OPTICS, MAGNETISM AND ELECTRICITY
(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Differentiate the optical phenomena - interference and diffraction	Understand, Apply	PSO – 1,9
CO – 2	Explain the principle behind the experiments -Newton's rings, air wedge and diffraction grating	Understand Apply	PSO – 1,9
CO – 3	Understand the working and application of laser in the field of Fiber Optics	Understand	PSO – 1,9
CO – 4	Distinguish different magnetic materials	Understand Apply	PSO – 1,6 9

CO – 5	Attain knowledge about the theory of magnetism	Understand Apply	PSO – 1,6, 9
CO –6	Explain the production of ac and its characteristics and also about ac circuits	Understand	PSO – 1, 9

UNIT I - (36 hrs.) (Book 1)

INTERFERENCE (12 hrs.)

Analytical treatment of interference-theory of interference fringes and 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 and refractive index of liquid.

DIFFRACTION (16 hrs.)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge and circular aperture. Fraunhofer diffraction at a single slit, two slits and N slits (Derivation required only for single slit). Plane transmission grating-determination of wavelength.

LASER AND FIBRE OPTICS (8 hrs.)

Principle of operation of laser-population inversion-optical pumping-ruby laser applications of lasers. Light propagation in optical fibres-step index fibre-graded index fibre-applications. Fibre optic communication system.

UNIT 2 - (18 hrs.) (Book 2)

MAGNETISM (8 hrs.)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism, para magnetism, ferromagnetism-ant ferromagnetism. Electron theory of diamagnetism- ferromagnet domains.

ELECTRICITY (10 hrs.)

EMF induced in a coil rotating in a magnetic field-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 and choke coil-transformers.

BOOKS FOR STUDY:

1.A text book of optics – Brijlal & Subramaniam
2.Electricity and Magnetism – R. Murugeshan, S. Chand & Co Ltd.

SEMESTER 4

(MATHEMATICS MAIN)

PY1431.1: MODERN PHYSICS AND SEMICONDUCTOR PHYSICS (54HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize different atomic models	Understand	PSO – 1,
CO – 2	Identify radioactive process and its applications	Understand Apply	PSO – 1,9
CO – 3	Understand the concepts Quantum Mechanics, Planck's hypothesis and applications	Understand Apply	PSO – 1, 9
CO – 4	Obtain the theoretical concept of working of various electronic circuits	Understand Apply	PSO – 1,9 13
CO – 5	Obtain the knowledge about basics of Digital electronics and its applications	Understand Apply	PSO – 1,9 13

UNIT 1 - (30 hrs.) Book 1

MODERN PHYSICS (20hrs)

Basic features of Bohr atom model-Bohr's correspondence principle -vector atom model-various quantum numbers-magnetic moment of orbital electrons -electron spin-Spin-Orbit coupling-Pauli's exclusion principle-

Atomic nucleus-basic properties of nucleus-charge, mass, spin, magnetic moment-binding energy and packing fraction-nuclear forces-salient features-radioactivity-radioactive decay-decay laws-decay constant-half life and mean life-radioactive equilibrium-secular and transient equilibrium-measurement of radioactivity.

QUANTUM MECHANICS (10 hrs.)

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

UNIT 2 - (24 hrs.) Book 2

SEMICONDUCTOR DEVICCES (16 hrs.)

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-transistor configurations current

components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits- voltage divider bias. amplifier-basic features of an amplifier-gain, -frequency response and band width

NUMBER SYSTEMS AND LOGIC GATES (8 hrs.)

Number systems and codes-decimal numbers-binary arithmetic -1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers-binary coded decimal-digital codes-logic gates-NOT, OR, AND, NOR and NAND gates. Boolean algebra-Boolean operations -logic expressions-laws of Boolean algebra-de Morgan's theorem-Boolean expression for gate network-simplification of Boolean expression

BOOKS FOR STUDY:

1. Modern Physics – Murugesan, S. Chand& Co. Ltd.
2. Principles of Electronics – V. K. Mehta.

SEMESTER 1
(CHEMISTRY MAIN)

PY1131.2: ROTATIONAL DYNAMICS AND PROPERTIES OF MATTER
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the Rotational dynamics of rigid bodies of different shapes and their applications	Understand Apply	PSO – 1,9
CO – 2	Understand the basics of simple harmonic motion and mechanical waves and their applications	Understand	PSO – 1,9
CO – 3	Understand the concepts of moduli of elasticity and their applications	Understand Apply	PSO – 1,9
CO – 4	Explain the properties of fluids such as surface tension and viscosity and their applications with examples	Understand Apply	PSO – 1,9

UNIT 1 - (28 hrs.)

DYNAMICS OF RIGID BODIES (7 hrs.) (Book 1 Chapter 8)

Theorems of MI with proof -Calculation of MI of bodies of regular shapes- rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid cylinder, solid sphere-KE of a rotating body-Determination of MI of a flywheel (Theory only)

OSCILLATIONS AND WAVES (13 hrs.) (Book 1 Chapter 9, 11)

Examples of S.H oscillator-compound pendulum-determination of g-torsion pendulum-oscillations of two particles connected by a spring-vibration state of a diatomic molecule-
Wave motion-general equation of wave motion-plane progressive harmonic wave - energy density of a plane progressive wave -intensity of wave and spherical waves

MECHANICS OF SOLIDS (8 hrs.) (Book1 Chapter 12)

Bending of beams-bending moment-cantilever-beam supported at its ends-and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

UNIT 2 - (8 hrs.)

SURFACE TENSION (5 hrs.) (Book1 Chapter 16)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger' method-equilibrium of a liquid drop over solid and liquid surfaces

VISCOSITY (3 hrs.) (Book2 Chapter 15)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula -limitations-Ostwald's viscometer-variation of viscosity with temperature

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya, Ram Prasad & Sons
2. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014
3. Oscillations &Waves: K. Rama Reddy, S.B. Badami & V. Balasubramaniam (University Press)

SEMESTER 2
(CHEMISTRY MAIN)

PY1231.2: THERMAL PHYSICS
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Identify the process of diffusion	Understand	PSO – 1,9
CO – 2	Distinguish the various process of heat transmission	Understand Apply	PSO –1, 9
CO – 3	Recognize the different thermodynamic processes	Understand	PSO – 1,9
CO – 4	Recognize the difference of petrol and diesel engines	Understand	PSO – 1,9
CO – 5	Obtain the concept of entropy and apply it to physical situations	Understand Apply	PSO – 1,9

UNIT 1 – DIFFUSION (4 hrs.) (Book1 chapter 10)

Graham's law of diffusion in liquids-Fick's law-analogy between liquid diffusion and heat conduction-methods of estimating concentrations-determination of coefficient of diffusivity

UNIT 2 – TRANSMISSION OF HEAT (14 hrs.)

Thermal conductivity and thermometric conductivity – Lee's Disc experiment- Weidman and Franz law (statement only) -Radiation of heat-black body radiation-Kirchhoff's laws of heat radiation-absorptive power-emissive power-Stefan's law (no derivation) -energy distribution in the spectrum of black body and results-Wien's displacement law - Rayleigh-Jeans law-their failure and Planck's hypothesis -Planck's law-comparison-solar constant-temperature of sun

UNIT 3 – THERMODYNAMICS (9 hrs.)

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity Heat engines-Carnot's cycle -derivation of efficiency-petrol and diesel engine cycles-efficiency in these two cases-second laws of thermodynamics-Kelvin and Clausius statements.

UNIT 4 – ENTROPY (9 hrs.)

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second

law in terms of entropy-calculation of entropy when ice is converted into steam.

BOOKS FOR STUDY:

1. The general Properties of matter: F. H. Newman & V. H. L. Searle
2. Heat & Thermodynamics: N. Subramaniam & Brijlal, S. Chand& Co
3. Heat & Thermodynamics: W. Zemansky, McGraw Hill
4. Heat & Thermodynamics: C. L. Arora.
5. https://archive.org/details/dli.ernet.16965/page/11/mode/2up

SEMESTER 3
(CHEMISTRY MAIN)

PY1331.2: OPTICS, MAGNETISM AND ELECTRICITY
(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Differentiate the optical phenomena - interference diffraction and Polarization	Understand Apply	PSO – 1,9
CO – 2	Explain the principle behind the experiments -Newton's rings, air wedge and diffraction grating	Understand Apply	PSO – 1,9
CO – 3	Identify the phenomenon of polarization	Understand	PSO – 1,9
CO – 4	Understand the working and application of laser in the field of Fiber Optics	Understand	PSO – 1,9
CO – 5	Distinguish different magnetic materials	Understand Apply	PSO – 1,6 9
CO –6	Attain knowledge about the theory of magnetism	Understand Apply	PSO – 1,6, 9
	Explain the production of ac and its characteristics and also about ac circuits	Understand	PSO – 1, 9

UNIT 1 - (38 hrs.) (Book 1)

INTERFERENCE (11hrs)

Analytical treatment of interference-theory of interference fringes and bandwidth. Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness.

DIFFRACTION (13 hrs.)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge.
Fraunhofer diffraction at a single slit- two slits and N slits (Derivation is required only for single slit). Plane transmission grating-determination of wavelength.

POLARISATION (8 hrs.)

Experiments showing the transverse nature of light-plane polarized light-polarization by reflection-Brewster's law-double refraction-Nicol prism-propagation of light in uni-axial crystals-positive and negative crystals-principal refractive indices, optical activity.

LASER AND FIBRE OPTICS (6 hrs.)
Principle of operation of laser-population inversion-optical pumping-ruby laser-applications of lasers. Light propagation in optical fibres-step index fibre-graded index fibre-applications.

UNIT 2 - (16 hrs.) (Book 2)

MAGNETISM (6 hrs.)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism-para magnetism, ferromagnetism-anti ferromagnetism. Electron theory of diamagnetism- ferromagnetic domains.

ELECTRICITY (10 hrs.)
EMF induced in a coil rotating in a magnetic field-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 and choke coil-transformers.

BOOKS FOR STUDY:

1. A text book of optics – Brijlal & Subramaniam
2. Electricity and Magnetism – R. Murugeshan, S. Chand & Co Ltd.

SEMESTER 4
(CHEMISTRY MAIN)

PY1431.2: ATOMIC PHYSICS, QUANTUM MECHANICS AND SEMICONDUCTOR PHYSICS
(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish different atom models	Understand	PSO – 1,
CO – 2	Obtain the theoretical aspects of different types of superconductors and its applications	Understand	PSO – 1,9

CO – 3	Understand the concepts Quantum Mechanics, Planck's hypothesis and applications	Understand Apply	PSO – 1,9
CO – 4	Understand different Spectroscopic techniques	Understand	PSO – 1,9
CO – 5	Obtain the theoretical concept of working of various electronic circuits	Understand Apply	PSO – 1,9
CO –6	Obtain the knowledge about basics of Digital electronics and its applications	Understand Apply	PSO – 1,9 13

UNIT 1 - ATOMIC PHYSICS (12 hrs.) Book 1

Basic features of Bohr atom model-Bohr's correspondence principle -vector atom model-various quantum numbers-magnetic moment of orbital electrons -electron spin-Spin-Orbit coupling-Pauli's exclusion principle-periodic table

UNIT 2 - SUPERCONDUCTIVITY (8 hrs.) Book 1

Properties of superconductors-zero electrical resistance- Meissner effect- electrical magnetic field-Type I and Type II superconductors-isotope effect-high temperature ceramic superconductors-applications of superconductors.

UNIT 3 - QUANTUM MECHANICS (14 hrs.) Book 1

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

UNIT 4 - SPECTROSCOPIC TECHNIQUES (4 hrs.) Book 1

EM Spectrum- UV, Visible, IR, Radio and microwave regions-principle of various spectrometers used in specific regions of EM spectrum-absorption spectroscopy, emission spectroscopy

UNIT 5 – SEMICONDUCTOR DEVICES (12 hrs.) Book 2

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-transistor configurations current components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed bias, emitter feedback bias, voltage divider bias (qualitative study only). Transistor amplifier-basic features of an amplifier-gain, input and output resistances-frequency response and band width

UNIT 6 - NUMBER SYSTEMS AND LOGIC GATES (4 hrs.) Book 2

Number systems and codes-decimal numbers-binary arithmetic -1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers-binary coded decimal-digital codes-logic gates-NOT, OR, AND, NOR and NAND gates.

BOOKS FOR STUDY:

1. Modern Physics: R. Murugesan, S. Chand& Co. Ltd.
2. Principles of Electronics: V. K. Mehta.

SEMESTER 1

(STATISTICS MAIN)

PY1131.3: MECHANICS AND PROPERTIES OF MATTER
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the dynamics of rigid bodies of different shapes and their applications	Understand Apply	PSO – 1
CO – 2	Understand the basics of simple harmonic motion and mechanical waves and their applications	Understand	PSO – 1,9
CO – 3	Understand the concepts of moduli of elasticity and applications	Understand Apply	PSO – 1,9
CO – 4	Explain the properties of fluids such as surface tension and viscosity and their applications with examples	Understand Apply	PSO – 1,9

UNIT 1 - (28 hrs.)

DYNAMICS OF RIGID BODIES (7 hrs.) (Book 1 Chapter 8)

Theorems of MI with proof -Calculation of MI of bodies of regular shapes- rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid sphere-KE of a rotating body Determination of MI of a fly wheel (theory only)

OSCILLATIONS AND WAVES (13 hrs.) (Book 1 Chapter 9, 11)

Examples of SHM oscillator-compound pendulum-determination of g-torsion pendulum-oscillations of two particles connected by a spring
Wave motion-general equation of wave motion-plane progressive harmonic wave energy density of a plane progressive wave-intensity of wave and spherical wave- transverse waves in stretched string-modes of transverse vibrations of string longitudinal waves in rods and in gases

MECHANICS OF SOLIDS (8 hrs.) (Book1 Chapter 12)

Bending of beams-bending moment-cantilever-beam supported at its ends-and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

UNIT 2 – (8 hrs.)

SURFACE TENSION (5 hrs.) (Book1 Chapter 16)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger' method-equilibrium of a liquid drop over solid and liquid surfaces

VISCOSITY (3 hrs.) (Book2 Chapter 15)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula -limitations-Ostwald's viscometer-variation of viscosity with temperature

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya, Ram Prasad & Sons
2. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014
3. Oscillations & Waves: K. Rama Reddy, S. Badami& V. Balasubramanian (University Press)

SEMESTER 2
(STATISTICS MAIN)
PY1231.3: THERMAL PHYSICS AND STATISTICAL MECHANICS
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish the various process of heat transmission	Understand, Apply	PSO – 1,9
CO – 2	Recognize the different thermodynamic processes	Understand	PSO – 1,9
CO – 3	Recognize the difference of petrol and diesel engines	Understand	PSO – 1,9
CO – 4	Obtain the concept of entropy and apply it to physical situations	Understand Apply	PSO – 1,9
CO – 5	Identify different statistical distribution	Understand Apply	PSO – 1,8

UNIT 1 - TRANSMISSION OF HEAT (8 hrs.) Book 1

Thermal conductivity and thermometric conductivity-Lee's disc experiment Weidman and Franz law (statement only)-energy distribution in the spectrum of black body and results-Wien's displacement law**.**

UNIT 2- THERMODYNAMICS (8 hrs.) Book 1

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity Heat engines-Carnot's cycle-derivation of efficiency- second law of thermodynamics Kelvin and Clausius statements.

UNIT 3 - ENTROPY (8 hrs.) Book 1

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.

UNIT 4 - STATISTICAL MECHANICS (12 hrs.) Book 5

Concepts of phase-space-ensemble and statistical equilibrium-probability theorems in statistical thermodynamics-distribution laws-Maxwell-Boltzmann, Fermi -Dirac and Bose-Einstein distribution laws (no derivation)-comparison of three statistics- Molecular energies in an ideal gas-Quantum statistics-Rayleigh-Jeans formula Planck's radiation law-specific heat of solids-free electrons in metals-electron energy distribution.

BOOKS FOR STUDY:

1.
2. Heat & Thermodynamics: N. Subramaniam& Brijlal, S. Chand & Co
3. Heat & Thermodynamics: W. Zemansky, McGraw Hill
4. Heat & Thermodynamics: C. L. Arora.
5. Concepts of modern physics: Arthur Beiser (TMH).
6. Statistical Mechanics: Sinha (TMH).
7. Theoretical Chemistry: Samuel Gladstone, New York, D Van Nostrand Co., Inc.
8. Heat: Saha and Srivasthava.

SEMESTER 3
(STATISTICS MAIN)
PY1331.3: OPTICS, MAGNETISM AND ELECTRICITY
(54 HOURS- 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Differentiate the optical phenomena - interference and diffraction	Understand Apply	PSO – 1,9
CO – 2	Explain the principle behind the experiments -Newton's rings, air wedge and diffraction grating	Identify Apply	PSO – 1,9
CO – 3	Understand the working and application of laser in the field of Fiber Optics	Understand	PSO – 1,9
CO – 4	Distinguish different magnetic materials	Understand Apply	PSO – 1,9
CO – 5	Attain knowledge about the theory of magnetism	Understand Apply	PSO –1,6, 9
CO –6	Explain the production of ac and its characteristics and also about ac circuits	Understand	PSO –1, 9

UNIT I - (34 hrs.) Book 1

INTERFERENCE (12 hrs.)

Analytical treatment of interference-theory of interference fringes and 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 and refractive index of liquid

DIFFRACTION (14 hrs.)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer - Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge and circular aperture. Fraunhofer diffraction at a single slit, two slits and N slits (Derivation required only for single slit). Plane transmission grating-determination of wavelength-Resolving power of grating

LASER AND FIBER OPTICS (8 hrs.)

Principle of operation of laser-population inversion-optical pumping-ruby laser applications of lasers Light propagation in optical fibers-step index fiber-graded index fiber-applications.

UNIT 2 - (20 hrs.)

MAGNETISM (10 hrs.)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M Magnetic susceptibility and permeability Magnetic properties-diamagnetism-paramagnetism-ferromagnetism-antiferromagnetism Electron theory of magnetism-explanation of ferromagnetism.

ELECTRICITY (10 hrs.)

EMF induced in a coil rotating in a magnetic field-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 and choke coil-transformers.

BOOKS FOR STUDY:

1.A text book of optics – Brijlal & Subramaniam
2.Electricity and Magnetism – R. Murugeshan, S. Chand & Co Ltd.

SEMESTER 4
(STATISTICS MAIN)

PY1431.3: MODERN PHYSICS AND SEMICONDUCTOR PHYSICS
(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize different atomic models	Understand	PSO – 1,
CO – 2	Identify radioactive process and its applications	Understand Apply	PSO – 1,9
CO – 3	Understand the concepts Quantum Mechanics, Planck's hypothesis and applications	Understand Apply	PSO –1, 9
CO – 4	Obtain the theoretical concept of working of various electronic circuits	Understand Apply	PSO – 1,9
CO – 5	Obtain the knowledge about basics of Digital electronics and its applications	Understand Apply	PSO –1, 9 13

UNIT I - (34 hrs.)

MODERN PHYSICS (20 hrs.) Book 1

Basic features of Bohr atom model-Bohr's correspondence principle -vector atom model-various quantum numbers-magnetic moment of orbital electrons -electron spin-Spin-Orbit coupling-Pauli's exclusion principle-periodic table

Atomic nucleus-basic properties of nucleus-charge, mass, spin, magnetic moment-binding energy and packing fraction-nuclear forces-salient features-radioactivity-radioactive decay-decay laws-decay constant-half life and mean life-
Radioactive equilibrium-secular and transient equilibrium-measurement of radioactivity

QUANTUM MECHANICS (14 hrs.) Book 1
Inadequacies of classical physics-experimental evidences-evidences for quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function and probability density-Schrodinger equation-time dependent and time independent-particle in a potential box

UNIT 2 - (20 hrs.)

SEMICONDUCTOR DEVICES (12 hrs.)

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-transistor configurations current components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed bias, emitter feedback bias, voltage divider bias (qualitative study only).
Transistor amplifier-basic features of an amplifier-gain, input and output resistances-frequency response and band width.

NUMBER SYSTEMS AND LOGIC GATES (8 hrs.) Book 2

Number systems and codes-decimal numbers-binary arithmetic -1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers-binary coded decimal-digital codes-logic gates-NOT, OR, AND, NOR and NAND gates. Boolean algebra-Boolean operations -logic expressions-laws of Boolean algebra-de Morgan's theorem-Boolean expression for gate network-simplification of Boolean expression

BOOKS FOR STUDY:

1. Modern Physics – Murugeshan, S. Chand& Co. Ltd.
2. Principles of Electronics – V. K. Mehta.

SEMESTER 1
(GEOLOGY MAIN)

PY1131.4: MECHANICS AND PROPERTIES OF MATTER
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the Rotational dynamics of rigid bodies of different shapes and their applications	Understand Apply	PSO – 1,2
CO – 2	Understand the basics of simple harmonic motion and mechanical waves and their applications	Understand	PSO – 1,9
CO – 3	Understand the concepts of moduli of elasticity and their applications	Undersatnd Apply	PSO – 1,9
CO – 4	Explain the properties of fluids such as surface tension and viscosity and their applications with examples	Understand Apply	PSO – 1,9

UNIT I - (29 hrs.)

DYNAMICS OF RIGID BODIES (7 hrs.) Book 1

Theorems of M. I with proof -Calculation of M.I of bodies of regular shapes- rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid cylinder, solid sphere-K.E of a rotating body- Determination of MI of a flywheel(Theory only).

OSCILLATIONS AND WAVES (15 hrs.) Book 2

Examples of S H oscillator- compound pendulum- determination of g-torsion pendulum-oscillations of two particles connected by a spring- vibrational state of diatomic molecule -damped and forced harmonic oscillators-damping force-damped harmonic oscillator -examples-power dissipation-Q factor. Wave motion-general equation of wave motion-plane progressive harmonic wave intensity of wave and spherical waves-waves in solids-longitudinal waves –transverse waves- torsional waves-common characteristics-reflection and transmission of waves- reflection and transmission of energy- flexural vibrations-applications of geophysics characteristics-reflection and transmission of waves-reflection and transmission of energy-flexural vibrations-applications in geophysics.

MECHANICS OF SOLIDS (7 hrs.) Book 1

Bending of beams-bending moment-cantilever-beam supported at its ends-and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

UNIT 2 - (7 hrs.)

SURFACE TENSION (4 hrs.) (Book 1)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger' method-equilibrium of a liquid drop over solid and liquid surfaces

VISCOSITY (3 hrs.) (Book 2)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula -limitations-Ostwald's viscometer-variation of viscosity with temperature

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya, Ram Prasad & Sons
2. Oscillations & Waves: K. Rama Reddy, S. B. Badami &V. Balasubramanian (University Press)

SEMESTER 2
(GEOLOGY MAIN)
PY1231.4: THERMAL PHYSICS AND PHYSICS OF THE EARTH
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish the various process of heat transmission	Understand Apply	PSO – 1,5 9
CO – 2	Recognize the different thermodynamic processes	Understand	PSO – 1,5 9
CO – 3	Recognize the difference of petrol and diesel engines	Understand	PSO – 1,9
CO – 4	Obtain the concept of entropy and apply it to physical situations	Understand Apply	PSO – 1,9
CO – 5	Obtain an idea about the underlying Physics that could explain the structure, climatic changes and behavior of atmosphere of Earth	Understand Apply	PSO – 1

UNIT 1 - TRANSMISSION OF HEAT (9 hrs.) Book 1

Thermal conductivity and thermometric conductivity-Lee's disc experiment Wiedemann and Franz law (statement only)-energy distribution in the spectrum of black body and results-Wien's displacement law-Rayleigh-Jeans law-their failure and Planck's hypothesis-Planck's law - comparison-solar constant-temperature of sun.

UNIT 2 - THERMODYNAMICS (9 hrs.) Book 1

Isothermal and adiabatic process- work done -isothermal and adiabatic elasticity
Heat engines-Carnot's cycle -derivation of efficiency-petrol and diesel engine cycles-efficiency in these two cases-second laws of thermodynamics-Kelvin and Clausius statements-Carnot's theorem with proof

UNIT 3 - PHYSICS OF THE EARTH (18 hrs.) Book 4

The solar system-origin of solar system-the dynamic earth-continental drift-earth's structure-earth's size and shape-gravitation-gravitational field and potential equipotential surfaces-gravitational field and potential due to a thin spherical shell and solid sphere-gravitational self-energy-gravity measurements-free fall method-rise and fall method-gravity anomalies. The tide-tidal effect of sun-earth quakes-causes seismic wave propagation-seismographs Atmospheric physics-atmospheric structure and composition-atmospheric pressure, density and temperature-measurement of air temperature-daily cycle of air temperature-atmospheric radiation-ionosphere-magnetosphere

BOOKS FOR STUDY:

1. Heat & Thermodynamics: N. Subramaniam & Brijlal, S. Chand& Co
2. Heat & Thermodynamics: W. Zemansky, McGraw Hill
3. Heat & Thermodynamics: C. L. Arora.
4. Fundamentals of Geophysics: William Lowrie, Cambridge University Press.
5. Applied Physics: G. Aruldhas et al., Rajam publishers.

SEMESTER 3
(GEOLOGY MAIN)
PY1331.4: OPTICS AND ELECTRODYNAMICS
(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Differentiate the optical phenomena - interference diffraction and polarization	Understand Apply	PSO – 1,9
CO – 2	Explain the physics behind the experiments -Newton's rings, air wedge and diffraction grating	Understand Apply	PSO – 1,9
CO – 3	Distinguish different magnetic materials	Understand	PSO – 1,9
CO – 4	Attain knowledge about the theory of magnetism and the reason for Earth's magnetism	Understand Apply	PSO – 1,6 9
CO – 5	Explain the production of ac and its characteristics and also about ac circuits	Understand Apply	PSO –1, 9

UNIT I - (34 hrs.) Book 1

INTERFERENCE (12 hrs.)

Analytical treatment of interference-theory of interference fringes and 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 and refractive index of liquid

DIFFRACTION (14 hrs.)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer, Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge and circular aperture Fraunhofer diffraction at a single slit, two slits and N slits (Derivation- single slit alone), Plane transmission grating-determination of wavelength-Resolving power of grating

POLARISATION (8 hrs.)

Experiments showing the transverse nature of light-plane polarized light-polarization by reflection-Brewster's law-double refraction-Nicol prism-propagation of light in uni-axial crystals-positive and negative crystals-principal refractive indices-half wave plate and quarter wave plate-elliptically and circularly polarized light-optical activity-Fresnel's theory and applications.

UNIT 2 - (20 hrs.) Book 2

MAGNETISM (12 hrs.)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability Magnetic properties-diamagnetism-Para magnetism-ferromagnetism-anti-ferro magnetism. Electron theory of magnetism-Explanation of ferromagnetism

Earth's magnetism-dip- inclination -vertical components-magnetic maps -magnetographs -cause of earth's magnetism geomagnetic prospecting

ELECTRICITY (8 hrs.)

EMF induced in a coil rotating in a magnetic field-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 and choke coil-transformers.

BOOKS FOR STUDY:

1. A text book of optics – Brijlal & Subramaniam
2. Electricity and Magnetism – Murugeshan, S. Chand& Co Ltd.

SEMESTER 4
(GEOLOGY MAIN)

PY1431.4: MODERN PHYSICS, SEMICONDUCTOR PHYSICS AND CRYSTALLOGRAPHY
(54HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Recognize different atomic models	Identify	PSO – 1,
CO – 2	Identify radioactive process and its applications	Identify, Apply	PSO – 1,9
CO – 3	Understand the structure of crystals and technique used to determine the crystal structure	Identify Apply	PSO – 1, 9
CO – 4	Obtain the theoretical concept of working of various electronic circuits	Identify Apply	PSO – 1,9
CO – 5	Obtain the knowledge about basics of Digital electronics and its applications	Identify, Apply	PSO – 1, 9

UNIT 1 - Book 1

MODERN PHYSICS (20 hrs.)

Basic features of Bohr atom model-Bohr's correspondence principle -vector atom model-various quantum numbers-magnetic moment of orbital electrons -electron spin-Spin-Orbit coupling-Pauli's exclusion principle-periodic table

Atomic nucleus-basic properties of nucleus-charge, mass, spin, magnetic moment-binding energy and packing fraction-nuclear forces-salient features-radioactivity-radioactive decay-decay laws-decay constant-half life and mean life-radioactive equilibrium-secular and transient equilibrium-measurement of radioactivity-radio carbon dating-age of the earth-biological effects of radiation.

CRYSTALLOGRAPHY (16 hrs.)

Crystal structure-crystal lattice and translation vectors-unit cell-symmetry operations point groups and space groups-types of lattices-lattice directions and planes interplanar spacing-simple crystal structures-close packed structures-structure of diamond-zinc blend structure-sodium chloride structure. X-ray crystallography-diffraction of x -rays-Bragg's law-x-ray diffraction methods rotating crystal method-powder diffraction method.

UNIT 2 - (18 hrs.) Book 2

SEMICONDUCTOR DEVICES (10 hrs.)

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-transistor configurations current components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed bias emitter feedback bias, voltage divider bias (qualitative study only).
Transistor amplifier-basic features of an amplifier-gain, input and output resistances-frequency response and band width-small signal CE amplifier-circuit and its operation

NUMBER SYSTEMS AND LOGIC GATES (8 hrs.)

Number systems and codes-decimal numbers-binary arithmetic -1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers-binary coded decimal-digital codes-logic gates-NOT, OR, AND, NOR and NAND gates. Boolean algebra-Boolean operations -logic expressions-laws of Boolean algebra-de Morgan's theorem-Boolean expression for gate network-simplification of Boolean expression

BOOKS FOR STUDY:

1. Modern Physics – Murugeshan, S. Chand& Co. Ltd.
2. Principles of Electronics – V. K. Mehta.

SEMESTER 1
(HOME SCIENCE MAIN)
PY1131.5 MECHANICS AND PROPERTIES OF MATTER
(36 HOURS- 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the dynamics of rigid bodies of different shapes and their applications	Understand Apply	PSO – 1
CO – 2	Understand the basics of simple harmonic motion, mechanical waves and their applications	Understand	PSO – 1,9
CO – 3	Understand the concepts of moduli of elasticity and applications	Understand Apply	PSO – 1,9
CO – 4	Explain the properties of fluids such as surface tension and viscosity and their applications with examples	Understand Apply	PSO – 1,9

UNIT I - (26 hrs.)

DYNAMICS OF RIGID BODIES (8 hrs.)

Theorems of MI with proof -Calculation of M.I of bodies of regular shapes- uniform bar of rectangular cross section, annular disc, circular disc, solid cylinder, solid sphere-K.E of a rotating body-Determination of MI of fly wheel(Theory alone)

OSCILLATIONS AND WAVES (12 hrs.)

Examples of S.H M oscillator- oscillations of two particles connected by a spring vibration state of a diatomic molecule Wave motion-general equation of wave motion-plane progressive harmonic wave - energy density of a plane progressive wave-intensity of wave and spherical waves.

MECHANICS OF SOLIDS (6 hrs.)

Bending of beams-bending moment-cantilever-beam supported at its ends-and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear

UNIT 2 - (10 hrs.)

SURFACE TENSION (5 hrs.)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger's method-equilibrium of a liquid drop over solid and liquid surfaces

VISCOSITY (5 hrs.)

Flow of liquid through a capillary tube -derivation of Poiseuille's formula-limitations - variation of viscosity with temperature-Stoke's formula-determination of viscosity of a highly viscous liquid by Stoke's method.

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya, Ram Prasad & Sons
2. Oscillations & Waves: K. Rama Reddy, S. Badami& V. Balasubramanian (University Press)

SEMESTER 2
(HOME SCIENCE MAIN)

PY1231.5: THERMAL PHYSICS
(36 HOURS- 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish the various process of heat transmission	Understand Apply	PSO –1, 9
CO – 2	Recognize the different thermodynamic processes	Understand	PSO –1,9
CO – 3	Recognize the difference between petrol and diesel engines	Understand	PSO – 1,9
CO – 4	Obtain the concept of entropy and apply it to physical situations	Understand Apply	PSO – 1,9
CO – 5	Identify different statistical distribution	Understand Apply	PSO –1,8

UNIT I - DIFFUSION (4 hrs.)

Graham's law of diffusion in liquids-Fick's law-analogy between liquid diffusion and heat conduction-methods of estimating concentrations-determination of coefficient of diffusivity

UNIT 2 - TRANSMISSION OF HEAT (14 hrs.)

Thermal conductivity and thermometric conductivity-Lee's disc experiment- Weidman and Franz law (statement only) -Radiation of heat-black body radiation - absorptive power-emissive power-Stefan's law (no derivation) -energy distribution in the spectrum of black body and results-Wien's displacement law -Rayleigh-Jeans law - their failure and Planck's hypothesis-Planck's law-comparison-solar constant temperature of sun.

UNIT 3 - THERMODYNAMICS (10 hrs.)

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity Heat engines-Carnot's cycle -derivation of efficiency-petrol and diesel engine cycles-efficiency in these two cases- second laws of thermodynamics- Kelvin and Clausius statements
Phase transition- first order and second order-liquid helium-super fluidity.

UNIT 4 - ENTROPY (8 hrs.)

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.

BOOKS FOR STUDY:

1. The general Properties of matter: F. H. Newman & V. H. L. Searle
2. Heat & Thermodynamics: N. Subramaniam& Brijlal, S. Chand & Co
3. Heat & Thermodynamics: W. Zemansky, Mc Graw Hill
4. Heat & Thermodynamics: C. L. Arora.

SEMESTER 3
(HOME SCIENCE MAIN)

PY1331.5: OPTICS AND ELECTRICITY
(54 HOURS- 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Differentiate the optical phenomena - interference diffraction	Understand Apply	PSO – 1,9
CO – 2	Explain the principle behind the experiments - diffraction grating	Understand Apply	PSO – 1,9
CO – 3	Understand the working and application of laser in the	Understand	PSO – 1,9

	field of Fiber Optics		
CO – 4	Explain the production of ac and its characteristics and also about ac circuits	Understand	PSO – 1,9
CO – 5	Explain the working of some of the electrical appliances	Understand	PSO – 1,9

UNIT I - (34 hrs.)
INTERFERENCE (10 hrs.) (Book 1)

Analytical treatment of interference-theory of interference fringes and bandwidth. Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness.

DIFFRACTION (16 hrs.) (Book 1)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge. Fraunhofer diffraction at a single slit- two slits and N slits (Derivation is required only for single slit). Plane transmission grating-determination of wavelength.

LASER AND FIBRE OPTICS (8 hrs.) (Book 2)
Principle of operation of laser-population inversion-optical pumping-ruby laser-applications of lasers. Light propagation in optical fibers-step index fiber-graded index fiber-applications.

UNIT 2 - (20 hrs.)
ELECTRICITY (Book 3, Book 4)
EMF induced in a coil rotating in a magnetic field-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 and choke coil-transformers.

Electric motors- principles of working- Devices working with electric motors-Electric fan- wet grinder, Mixer grinder, Microwave oven – principle – technical specifications - applications – advantages

BOOKS FOR STUDY:

1. A text book of optics: Brijlal & Subramaniam
2. Optics: Ajoy Ghatak
3. Electricity and Magnetism: R. Murugeshan, S. Chand & Co Ltd.
4. Electrical Technology (Vol I & II): B. L. Theraja.

SEMESTER 4
(HOME SCIENCE MAIN)

PY1431.5: ATOMIC PHYSICS AND SEMICONDUCTOR PHYSICS
(54 HOURS - 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Recognize different atomic models	Understand	PSO – 1,
CO – 2	Identify radioactive process and its applications	Understand Apply	PSO – 1,9
CO – 3	Obtain the idea about superconductors and phase transitions	understand Apply	PSO – 1, 9
CO – 4	Understand different spectroscopic techniques	Understand Apply	PSO – 1,9
CO – 5	Recognize different electronic components, devices and their applications	Understand Apply	PSO –1,9, 13
CO – 6	Understand basics of digital electronics	Understand	PSO –1,13

UNIT I - MODERN PHYSICS (18 hrs.) (Book 1)

Basic features of Bohr atom model-Bohr's correspondence principle -vector atom model-various quantum numbers-magnetic moment of orbital electrons -electron spin-Spin-Orbit coupling, Pauli's exclusion principle-periodic table.
Atomic nucleus-basic properties of nucleus -charge, mass, spin magnetic moment- binding Energy and packing fraction-nuclear forces-salient features-radioactivity- radioactive decay, decay laws-decay constant-half life and mean life, radioactive equilibrium-secular and transient equilibrium-measurement of radioactivity.

UNIT 2 - SUPERCONDUCTIVITY (6 hrs.) (Book 2)

Properties of superconductors-zero electrical resistance-Meissner effect-critical magnetic field, Type I and Type II superconductors-isotope effect-high temperature ceramic superconductors, applications of superconductors.

UNIT 3 - SPECTROSCOPIC TECHNIQUES (8 hrs.) (Book 1)

EM spectrum-UV, Visible, IR, Radio and microwave regions-principles of various spectrometers used in specific regions of EM spectrum-absorption spectroscopy-emission spectroscopy, Qualitative ideas of ESR & NMR spectrometer.

UNIT 4 - (22 hrs.)

SEMICONDUCTOR DEVICES (13 hrs.) (Book 3)
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-transistor configurations, characteristics of common emitter configuration, load line-Q point-AC load line-transistor biasing-need for biasing-bias stabilization-biasing circuit- voltage divider bias (qualitative study only).

NUMBER SYSTEMS AND LOGIC GATES (9 hrs.) (Book 1)
Number systems and codes-decimal numbers-binary arithmetic -1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers-binary coded decimal-digital codes, logic gates-NOT, OR, AND, NOR and NAND gates. Boolean algebra-Boolean operations -logic expressions-laws of Boolean algebra-de Morgan's theorem.

BOOKS FOR STUDY:

1. Modern Physics: R. Murugeshan, S. Chand & Co. Ltd.
2. Concepts of modern physics: Arthur Beiser
3. Principles of Electronics: V. K. Mehta.

COMPLEMENTARY ELECTRONICS FOR PHYSICS MAIN SEMESTER 1

EL 1131: ELECTRONICS I

(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO-1	Understand and differentiate between different passive circuit elements.	Understand	PSO – 1
CO-2	Have a good knowledge about the Network Theorems and solving complex circuits	Analyze Apply	PSO – 1, 6,9
CO-3	Have an idea about Magnetic materials and transformers	Remember	PSO – 1,6,
CO-4	Gain knowledge about AC Wave forms and circuits.	Analyze	PSO – 1,9
CO-5	To understand about the charging and discharging of capacitors and the basis of transient currents, Tuning circuits and filters Understand the network theorems	Understand	PSO – 1,9

UNIT 1 - PASSIVE CIRCUIT ELEMENTS AND FUNDAMENTALS (9 hrs.)
(Book 1 Chapters 2, 5)

Resistors: Linear and non-linear Resistors, Resistor types- (Wire wound, Carbon composition, Carbon film, Metal film), Resistor Colour code, Resistor Colour bands, Resistors under 10Ω**,** Potentiometers and Rheostats.

Resistive circuits: Series circuits (Characteristics, Proportional voltage formula, Series voltage dividers, 'Opens' and 'shorts' circuits), Parallel circuits (Laws of parallel circuits, Proportional current formula, 'Opens' and 'shorts' circuits), Analysing Series-Parallel Circuits.

Inductors: Inductor Types (Air-core, Iron-core, Ferrite-core), Self-Inductance, Mutual Inductance, Coefficient of Coupling, Inductors in Series or Parallel without M, Series combination with M, Coil (Reactance, Impedance and Q factor).

Capacitors: Capacitance-controlling factors, Types of Capacitors (Fixed Capacitors, Variable Capacitors), Capacitors in Series and Parallel, Capacitive Reactance.

UNIT 2 - NETWORK THEOREMS (7 hrs.) (Book 1 Chapters 3, 4 Book 2 Chapters 1.)

Kirchhoff's voltage and current Laws and assumed direction of current flow, Ideal constant voltage and current sources, Super position theorem, Thevenin's theorem, Thevenize a circuit, Norton's theorem, Nortonize a circuit, Maximum Power Transfer Theorem and proof.

UNIT 3 - MAGNETISM AND ALTERNATING CURRENT (10 hrs.)
(Book 1 Chapters 7, 8, 9)

Magnetic materials, Types of Magnets, Magnetic Terms and Units, Ohm's Law in Magnetic circuits, Transformers- Working principle, Types (AF, RF and power transformers), Autotransformer, Transformer Impedance and Impedance Matching.

Types of alternating waveforms, Characteristics of a sine wave, Different values of sinusoidal voltage and current, Phase and Phase difference of AC, AC through Resistor, Inductor and Capacitor, Non-sinusoidal waveform, Harmonics, Series AC circuits (L-R, R-C and LCR circuits), Skin effect, Resonance in LCR circuits (Characteristics, Bandwidth, sharpness and Q factor, radio tuning), Resonance in parallel LCR circuits.

UNIT 4 - TRANSIENT CURRENT (6 hrs.) (Book 1 Chapters 10)

Rise and fall of current in pure resistance, Time constant of an L-R Circuit, Inductive Kick, Time constant of an R-C Circuit, Charging and Discharging of capacitor, Decreasing Time Constant, Flasher, Pulse Response of an R-C Circuit, Effect of Long and Short Time Constants.

UNIT 5 - TUNING CIRCUITS AND FILTERS (4 hrs.) (Book 1 Chapter 11)

Tuned circuit and its operating characteristics, tuned transformer, double tuned transformer, coupled circuits, simple coupled circuits, coefficient of coupling

Filters: Definitions, types (low pass, high pass, band pass and band stop filter), uses of filters

BOOKS FOR STUDY:

1. Basic Electronics Solid State B. L. Theraja S. Chand & Co. Ltd.
2. Principles of Electronics: V. K. Mehta and Rohit Mehta, S. Chand & Co. Ltd

BOOKS FOR REFERENCE:

1. Basic electronics: Devices, Circuits and IT fundamentals: Santiram Kal, PHI
2. Electricity and Magnetism: K. K. Tewari

SEMESTER 2

EL1231: ELECTRONICS II
(36 HOURS- 2 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO-1	Have a good knowledge about the different types of PN junction diodes	Remember	PSO – 1, 13
CO-2	Have a good knowledge about DC Power Supplies	Apply	PSO – 1,9
CO-3	Gain knowledge about the fundamentals of a Transistor, transistor characteristics and approximations.	Understand	PSO – 1,13
CO-4	Have an idea about DC and AC load lines and different biasing circuits.	Analyze	PSO – 1
CO-5	To understand the basics of Hybrid Parameters.Understand and differentiate between different passive circuit elements.	Apply	PSO – 1

UNIT 1 - THE P-N JUNCTION AND THE P-N JUNCTION DIODE (6 hrs.)
(Book 1 Chapter 14)

The P-N junction (formation, barrier voltage – effect of temperature on barrier voltage), Biasing of P-N junction and I-V characteristics, Junction breakdown mechanisms, Junction capacitance, Equivalent circuit of a P-N junction.

The ideal diode – real diode – diode parameters, diode ratings, Applications of semiconductor diode.

Diode wave shaping circuits: Clippers and Clampers

UNIT 2 - SPECIAL PURPOSE DIODES AND OPTOELECTRONIC DEVICES (6 hrs.)
(Book 1 Chapters 15, 16)

Zener diode: (Voltage regulation, Peak clipper, Meter protection, Tunnelling effect), Tunnel diode, Varactor, PIN diode, Schottky diode, Step recovery diode

Light emitting diode (theory, construction and applications), Photodiodes (P-N junction photodiode, PIN photodiode and Avalanche photodiode).

UNIT 3 - DC POWER SUPPLIES (6 hrs.) (Book 1 Chapter 17, Book 2 Chapter 6)
Unregulated and regulated power supply, Steady and pulsating DC voltages, Rectifiers: half wave, full wave (centre-tapped and bridge) rectifiers (working, Average Value**,** form factor, PIV, ripple factor, efficiency)

Filters: (Series inductor, shunt capacitor, LC, CLC/pi), Bleeder resistor

UNIT 4 - BASIC TRANSISTORS (3 hrs.) (Book 1 Chapter 18)
BJT: Transistor biasing and biasing rule – transistor currents – configurations (CB, CE and CC) – relation between transistor current gains – leakage current in a transistor – thermal runaway.

UNIT 5 - TRANSISTOR CHARACTERISTICS AND APPROXIMATIONS (6 hrs.) (Book 1 Chapter 19)

Transistor static characteristics (input, output and current transfer characteristic, formulae for voltage and current) of CB, CE and CC configurations – The beta rule – importance of V_{CE}, Cut-off and saturation points – normal DC voltage transistor indications – transistor fault location – solving universal stabilization circuit – applying AC to a DC biased transistor.

UNIT 6 - LOAD LINES AND DC BIAS CIRCUITS (5 hrs.) (Book 1 Chapter 20)

DC load line – Q point and maximum undistorted output – need for biasing a transistor – factors affecting bias variations – stability factor – beta sensitivity- stability factor of CB and CE circuits – different methods of transistor biasing – base bias – base bias with emitter feedback - base bias with collector feedback - base bias with emitter and collector feedback – voltage divider bias – load line and output characteristics – ac load line.

UNIT 7 - HYBRID PARAMETERS (4 hrs.) (Book 1 Chapter 21)

The h-parameters of an ideal transistor and notations, The h-parameters of ideal CB and CE transistors, hybrid formulae and approximate hybrid formulae for transistor amplifier.

BOOKS FOR STUDY:

1. Basic Electronics Solid State: B. L. Theraja, S. Chand & Co. Ltd.
2. Principles of Electronics: V. K. Mehta and Rohit Mehta, S. Chand & Co. Ltd.

BOOKS FOR REFERENCE:

1. Basic electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI

SEMESTER 3

EL 1331: ELECTRONICS III
(54 HOURS- 3 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO-1	Have a good knowledge about the Single stage and multistage transistor Amplifiers.	Understand	PSO – 1, 13
CO-2	Gain knowledge about the fundamentals of Decibels and Frequency response.	Understand	PSO – 1,9
CO-3	Understand the feedback amplifiers and Field effect transistors and various Break down devices.	Understand	PSO – 1,13
CO-4	Understanding about various Sinusoidal and non-sinusoidal oscillators	Understand	PSO – 1,13

UNIT 1 - SINGLE STAGE TRANSISTOR AMPLIFIERS (13 hrs.) (Book 1 Chapter 22)

Amplifier Classifications in CB, CE and CC configurations (Gain, Characteristics and uses), Comparison of Amplifier Configurations, Classification of Amplifiers Based on Biasing Conditions and graphical representation, Class A Amplifier (Power distribution, Power rectangle, Power efficiency, Maximum AC power in load), Transformer Coupled Class A Amplifier and power diagram, Class B Amplifier (Power relations, Maximum Values) - Class B Push Pull Amplifier, Cross Over Distortion, Power efficiency in Push-Pull Amplifier, Complimentary Symmetry Push Pull Class B Amplifier, Class C Amplifier (qualitative idea only), Distortion in Amplifiers, Noise.

UNIT 2 - MULTI STAGE AMPLIFIERS (7 hrs.) (Book 1 Chapter 23)
(Necessary: working Principle and advantages)

Amplifier Coupling: RC Coupled Two Stage Amplifier, Transformer Coupled Two Stage Amplifier, Direct Coupled Two Stage Amplifier Using Similar Transistors, Darlington pair.

UNIT 3 - DECIBELS AND FREQUENCY RESPONSE (3 hrs.) (Book 1 Chapter 24)

Decibel System and characteristics, Frequency Response, cut off Frequencies - Alpha and Beta Cut off Frequencies, Gain Bandwidth Product.

UNIT 4 - FEEDBACK AMPLIFIERS (4 hrs.) (Book 1 Chapter 25)

Feedback Principle, Types of Feedback, Negative Feedback and its Properties, Forms of Negative Feedback (qualitative ideas only).

UNIT 5 - FIELD EFFECT TRANSISTORS (6 hrs.) (Book 1Chapter 26)

FET, JFET (Structure, Construction, Working, Static Characteristics), JFET Parameters, MOSFET - DE MOSFET and E only MOSFET: Working and Characteristics - FET Applications and advantages (Qualitative only).

UNIT 6 - BREAKDOWN DEVICES (7 hrs.) (Book 1 Chapter 27)

Unijunction Transistor (UJT) - UJT Relaxation Oscillator - Silicon Controlled Rectifier (Construction, working, IV characteristics, two transistor analogy, SCR in 90° phase control circuit) - Triac - Diac - Silicon Controlled Switch.

UNIT 7 - SINUSOIDAL OSCILLATORS (9 hrs.) (Book 1 Chapter 28)
(Necessary: working principles, advantages and disadvantages)

Difference between Amplifier and Oscillator - Classification of Oscillators - Types of Sinusoidal Oscillations - Oscillatory Circuit and its Frequency - Essentials of Transistor LC Oscillator - Barkhausen Criterion for Oscillator - Tuned Base Oscillator - Tuned Collector Oscillator - Hartley Oscillator - Colpitts's Oscillator - Clapp Oscillator - Phase Shift Oscillator - Wien Bridge Oscillator - Crystal Controlled Oscillator.

UNIT 8 - NONSINUSOIDAL OSCILLATORS (5 hrs.) (Book 1 Chapter 29)

Non-sinusoidal Waveforms – Pulse definitions, Classification of Non-sinusoidal Oscillators- Multivibrators (Astable and Monostable, and Bistable), Schmitt Trigger.

BOOKS FOR STUDY:

1. Basic Electronics Solid State: B. L. Theraja, S. Chand & Co. Ltd.
2. Principles of Electronics: V. K. Mehta and Rohit Mehta, S. Chand & Co. Ltd.

BOOKS FOR REFERENCE:

1.Basic electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI,2009

SEMESTER 4

EL1431 ELECTRONICS IV
(54 HOURS- 3 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO-1	Have a good knowledge about Amplitude modulation.	Understand	PSO – 1, 14
CO-2	Gain a good knowledge about Number systems and different logic gates and the basics of Boolean Algebra.	Apply	PSO – 1, 13
CO-3	Gain knowledge about some basic logic families.	Understand	PSO – 1,13
CO-4	Have knowledge about transducers and electronic instruments.	Understand	PSO– 1,9 13

UNIT 1 - MODULATION AND DEMODULATION (10 hrs.) (Book 1 Chapter 30, Book 2 Chapter 16)

Need for modulation and Detection, Types of modulation, Amplitude modulation (AM), Modulation factor, Mathematical analysis of AM carrier wave and side bands, Power relations in AM wave, Transistor AM Modulator, Limitations of AM, Frequency Modulation (FM), Frequency deviation and carrier swing, modulation index, deviation ratio and percent modulation, FM sidebands, modulation index and number of sidebands

Demodulation: – Essentials of AM detection, Diode detector for AM signal, Comparison between AM and FM.

UNIT 2 - INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER (7 hrs.) (Book 1 Chapter 31)

Integrated circuit, advantages and drawbacks, scales of integration, classification of ICs by structure and function, linear and digital integrated circuits, Application of ICs

Operational Amplifier (Op-Amp), Ideal Op-Amp, Virtual Ground and Summing point, Op-Amp applications (linear amplifier, unity follower, adder, subtractor, integrator, differentiator and comparator)

UNIT 3 - NUMBER SYSTEMS (5 hrs.) (Book 1 Chapter 32)

Number systems – decimal number system – binary system – binary to decimal conversion – binary fractions – Double-add method – decimal to binary conversion – binary operations (addition, subtraction, multiplication and division) complement of a number – 1's complemental subtraction - 2's complemental subtraction – octal number system – octal to decimal and decimal to octal conversion – octal to binary and binary to octal conversion – advantages of octal number system – hexadecimal number system – binary to hexadecimal and hexadecimal to binary conversion.

UNIT 4 - LOGIC GATES (7 hrs.) (Book 1 Chapter 33)

Positive and negative logic, the OR gate, equivalent relay circuit of an OR gate, diode OR gate, transistor OR gate, three input OR gate, Exclusive OR gate, AND gate, equivalent relay circuit of an AND gate, diode AND gate, transistor AND gate, the NOT gate, equivalent circuit for a NOT gate, Bubbled gates, the NOR gate, NOR gate is a universal gate, the NAND gate, NAND gate is a universal gate, the XNOR gate, Adders and Subtractors- Half Adder, Full Adder, Half Subtractor, Full Subtractor.

UNIT 5 - BOOLEAN ALGEBRA (4 hrs.) (Book 1 Chapter 34)

Unique feature of Boolean Algebra, laws of Boolean Algebra, equivalent switching circuits, De Morgan's Theorems

UNIT 6 - LOGIC FAMILIES (5 hrs.) (Book 1 Chapter 35)

Important Logic Families, Saturated and Non- Saturated Logic Circuits, Characteristics of Logic Families, Circuit operations of RTL- DTL- TTL-ECL and I^2L.

UNIT 7 - TRANSDUCERS (8 hrs.) (Book 1 Chapter 36)

Transducers, Classification, Resistive Position Transducer, Resistive Pressure Transducer, Inductive Pressure Transducer, Capacitive Pressure Transducer, LVDT, Piezoelectric Transducer, Strain Gauge, Temperature Transducers (Resistance Temperature Detectors, Thermistors, Thermocouples), Various Types of Microphones (Qualitative idea about working principle only), Loudspeaker.

UNIT 8 - ELECTRONIC INSTRUMENTS (8 hrs.) (Book 1 Chapter 37)

Analog and Digital Instruments, Essentials of an Electronic Instrument, The Basic Meter Movement, Characteristics of Moving Coil Meter Movement, Conversion of Basic Meter to DC Ammeter and DC Voltmeter, Loading Effect of Voltmeter, Cathode Ray Oscilloscope, CRT (Construction, Deflection Sensitivity), Lissajous Figures and Frequency Determination.

BOOKS FOR STUDY:

1. Basic Electronics Solid State: B. L. Theraja, S. Chand & Co. Ltd.
2. Principles of Electronics: V. K. Mehta

BOOKS FOR REFERENCE:

1. Electronic measurements and Instrumentation: Lal Kishore, Dorling Kindersley (India) Pvt Ltd.
2. Electronic Instrumentation and measurement Techniques: W.D. Cooper, A.O. Helfrik and H. Albert, PHI.

SEMESTER 1
(POLYMER CHEMISTRY MAIN)

PY1131.7: MECHANICS AND FLUID DYNAMICS
(36 HOURS- 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the dynamics of rigid bodies of different shapes and their applications	Identify, Apply	PSO – 1
CO – 2	Understand the basics of simple harmonic motion and mechanical waves and their applications	Identify	PSO – 1,9
CO – 3	Understand the concepts of moduli of elasticity and applications	Recognize, Apply	PSO – 1,9
CO – 4	Explain the properties of fluids such as surface tension and viscosity and their applications with examples	Identify Apply	PSO – 1,9

UNIT I - (18 hrs.)

DYNAMICS OF RIGID BODIES (8 hrs.) Book 1

Theorems of M.I with proof -Calculation of MI of bodies of regular shapes- rectangular lamina, uniform bar of rectangular cross section, circular disc, annular ring solid cylinder, solid sphere-spherical shell, K.E of a rotating body

OSCILLATIONS AND WAVES (10 hrs.) Book1

Examples of S.H oscillator- oscillations of two particles connected by a spring, vibration state of a diatomic molecule- wave motion-general equation of wave motion-plane progressive harmonic wave - energy density of a plane progressive wave-intensity of wave and spherical waves,

superposition principle-

UNIT 2 - (18 hrs.)

MECHANICS OF SOLIDS (8 hrs.) Book 1

Bending of beams-bending moment-cantilever-beam supported at its ends-and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear- Torsional rigidity (Qualitative study)

SURFACE TENSION (5 hrs.) Book 1

Excess of pressure on a curved surface- force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension of a liquid by Jaeger' method- temperature dependence of surface tension.

VISCOSITY (5 hrs.) Book 2

Equation of continuity, Bernoulli's theorems- venturi meter, - Flow of liquid through a pipe - derivation of Poiseuille's formula-limitations – variation of viscosity with temperature-Stokes formula

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya, Ram Prasad & Sons
2. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014
3. Oscillations & Waves: K. Rama Reddy, S. Badami& V. Balasubramaniam (University Press)

SEMESTER 2
(POLYMER CHEMISTRY MAIN)

PY1231.7: THERMAL PHYSICS
(36 HOURS- 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish the various process of heat transmission	Understand Apply	PSO – 1,9
CO – 2	Recognize the different thermodynamic processes	Understand	PSO – 1,9
CO – 3	Recognize the difference of petrol and diesel engines	Understand	PSO – 1,9
CO – 4	Obtain the concept of entropy and apply it to physical situations	Understand Apply	PSO – 1,9
CO – 5	Identify different statistical distribution	Understand	PSO –

		Apply	1,2, 8

UNIT I - BEHAVIOR OF REAL GASES (4 hrs.) Book 2

Joule Thomson effect- Theory and experiment, Phase transition- first order and second order- liquid helium-super fluidity

UNIT 2 - TRANSMISSION OF HEAT (14 hrs.) Book 2

Thermal conductivity and thermometric conductivity-Lee's disc experiment Wiedemann and Franz law (statement only) -Radiation of heat-black body radiation - absorptive power-emissive power-Stefan's law (no derivation) -energy distribution in the spectrum of black body and results-Wien's displacement law -Rayleigh-Jeans law - their failure and Planck's hypothesis-Planck's law-comparison-solar constant, temperature of sun.

UNIT 3 - THERMODYNAMICS (10 hrs.) Book 2

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity Heat engines-Carnot's cycle -derivation of efficiency-petrol and diesel engine cycles-efficiency in these two Cases- second laws of thermodynamics- Kelvin and Clausius statements

UNIT 4 - ENTROPY (8 hrs.) Book 2

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.

BOOKS FOR STUDY:

1. The General Properties of Matter: F. H. Newman& V. H. L. Searle
2. Heat & Thermodynamics: N. Subramaniam& Brijlal, S. Chand & Co
3. Heat & Thermodynamics: W. Zemansky, McGraw Hill
4. Heat & Thermodynamics: C. L. Arora.

SEMESTER 3
(POLYMER CHEMISTRY MAIN)

PY1331.7: MODERN OPTICS AND ELECTRICITY
(54 HOURS- 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Differentiate the optical phenomena - interference diffraction and Polarization	Understand Apply	PSO – 1,9
CO – 2	Explain the principle behind the experiments -Newton's rings, air wedge and diffraction grating	Understand Apply	PSO – 1,9
CO – 3	Understand the working and application of laser in the field of Fiber Optics	Understand	PSO – 1,9
CO – 4	Explain the production of ac and its characteristics and also about ac circuits	Understand	PSO – 1,9
CO – 5	Explain the working of electric motors	Understand	PSO – 1,9

UNIT I - (18 hrs.)
INTERFERENCE (8 hrs.) Book 1

Analytical treatment of interference-theory of interference fringes and bandwidth Interference in thin films-reflected system-colour of thin films- Newton's rings-reflected system-measurement of wavelength and refractive index of liquid

DIFFRACTION (10 hrs.) Book 1
Phenomenon of diffraction- classification-Fresnel and Fraunhofer diffraction Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge Fraunhofer diffraction at a single slit, double slits (Derivation required only for single slit). Plane transmission grating-determination of wavelength

UNIT 2 - (18 hrs.)
POLARIZATION (10 hrs.) Book 1

Experiments showing the transverse nature of light-plane polarized light-polarization by reflection-Brewster's law-double refraction-Nicol prism-propagation of light in uni-axial crystals-positive and negative crystals-principal refractive indices-half wave plate and quarter wave plate-elliptically and circularly polarized light-optical activity-Fresnel's theory and applications.

LASER AND FIBER OPTICS (8 hrs.) Book 2
Principle of operation of laser-population inversion-optical pumping-ruby laser-applications of

lasers -Light propagation in optical fiber -step index fiber-graded index fiber-single mode and multi-mode fiber (qualitative ideas only)

UNIT 3 - ELECTRICITY (18 hrs.) Book 3

EMF induced in a coil rotating in a magnetic field-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 and choke coil-transformers,

Electric motors principle of working Devices working with electric motors – electric fan wet grinder.

BOOKS FOR STUDY:

1. A text book of optics: Brijlal & Subramaniam
2. Optics: Ajoy Ghatak
3. Electricity and Magnetism: R. Murugeshan, S. Chand & Co. Ltd.
4. Electrical Technology: B. L. Theraja, (Vol I & II)

SEMESTER 4
(POLYMER SCIENCE MAIN)

PY1431.7: ATOMIC PHYSICS AND SEMICONDUCTOR PHYSICS
(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Recognize different atomic models	Understand	PSO – 1
CO – 2	Identify radioactive process and its applications	Understand Apply	PSO – 1,9
CO – 3	Obtain the idea about superconductors and phase transitions	understand Apply	PSO – 1, 9
CO – 4	Develop an idea about the evolution of quantum mechanics and its applications in real situations	Understand Apply	PSO – 1,9
CO – 5	Recognize different electronic components, devices and their applications	Understand Apply	PSO – 1, 9

UNIT I - MODERN PHYSICS (18 hrs.) Book 1

Basic features of Bohr atom model-Bohr's correspondence principle -vector atom model-various quantum numbers-magnetic moment of orbital electrons -electron spin-Spin-Orbit coupling-

Pauli's exclusion principle-periodic table Atomic nucleus-basic of nucleus -charge, mass, spin magnetic properties moment- binding energy and packing fraction-nuclear forces-salient features-Radioactivity radioactive decay-decay laws-decay constant-half life and mean life-radioactive equilibrium-secular and transient equilibrium-measurement of radioactivity

UNIT 2 - SUPERCONDUCTIVITY (8 hrs.) Book 1

Properties of superconductors-zero electrical resistance-Meissner effect-critical magnetic field-Type I and Type II superconductors-isotope effect-high temperature ceramic superconductors-applications of superconductors.

UNIT 3 - QUANTUM MECHANICS (10 hrs.) Book 1

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

UNIT 4 - SEMICONDUCTOR DEVICES (18 hrs.) Book 2

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-transistor configurations-current components-transistor characteristics-DC load line-Q point-AC load line-transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed bias, emitter feedback bias, voltage divider bias (qualitative study only).
Transistor amplifier-basic features of an amplifier-gain, input and output resistances-frequency response and band width-small signal CE amplifier-circuit and its operation

BOOKS FOR STUDY:

1. Modern Physics – R. Murugeshan, S. Chand & Co. Ltd.
2. Principles of Electronics – V. K. Mehta.

COMPLEMENTARY PRACTICAL (PHYSICS)

(Common for all complementary subjects)

PY1432: Practical
List of Experiments (Minimum 18 experiments to be done)

1. Torsion Pendulum- n by torsional oscillations
2. Torsion Pendulum- n and I using equal masses
3. Fly Wheel
4. Cantilever- Y by pin and microscope method
5. Uniform bending- Y by pin and microscope
6. Symmetric bar pendulum - g and radius of gyration
7. Surface tension- capillary rise method
8. Coefficient of viscosity- capillary flow method
9. Specific heat-method of mixtures applying Barton's correction
10. Lee's disc- Thermal conductivity of cardboard
11. Melde's string- frequency of tuning fork
12. Method of parallax- optical constants of convex lens using
    i) mirror and mercury ii) mirror and water
13. 13.Method of parallax- refractive index of liquid.
14. Spectrometer- A, D and n
15. Spectrometer- dispersive power of a prism
16. Spectrometer- Grating-normal incidence
17. Deflection and vibration magnetometer- M and Bh
18. Circular coil- magnetization of a magnet
19. Carey Foster's bridge - Resistivity
20. Potentiometer- Resistivity
21. Potentiometer- Calibration of ammeter
22. Mirror galvanometer- Current and Voltage sensitivity
23. Diode Characteristics (for Ge and Si diodes)
24. Half wave rectifier-Measurement of ripple factor with and without filter capacitor
25. Full wave rectifier- Measurement of ripple factor with and without filter capacitor

COMPLEMENTARY ELECTRONICS PRACTICAL

EL1432: Practical
List of Experiments (Minimum 18 experiments to be done)

1. Semiconductor diode (IN 4001/ IN 4007) characteristics; To
   (i) trace and construct the circuit,

(ii)to draw the forward V-I characteristic curve and

(iii) to determine the static and dynamic resistances of the diode at a particular operating point.

2. Zener diode characteristics: To (i) trace and construct the circuit (ii) to plot the V-I characteristic under reverse biased condition and (iii) to calculate the dynamic resistance of the diode under reverse bias when conducting.

3. LED and photo diode characteristics: To (i) study the variations in resistance with varying current and (ii) to study the output characteristics of a photo diode.

4. Thevenin and Norton equivalent circuits: To (i) determine Thevenin's and Norton's equivalent circuits of Wheatstone's bridge and (ii) to verify the power transfer theorem.

5. R-C resonant circuits: To (i) study the input-output characteristics of an R -C circuit as a function of frequency and (ii) to study the square wave response of R-C circuits.

6. Transistor characteristics; CE configuration: (i) Construct the circuit, (ii) To plot the input characteristics (IB-VBE graph for constant V CE) and to calculate the dynamic resistance at an operating point (iii) To study the output characteristics (IC-VCE graph for constant I B) and to calculate the output ac resistance, dc gain and ac current gain at a given operating point.

7. Transistor characteristics; CB configuration: (i) Construct the circuit (ii) Plot the input characteristics (IE-VEB graph for constant VCB) and to calculate the dynamic resistance at an operating point (iii) To study the output characteristics (IC-VCB graph for constant I C) and to calculate the output dynamic resistance, dc current gain and ac current gain at a given operating point.

8. FET characteristics: (i) Trace the circuit (ii) To plot the static drain characteristics of FET (iii) To calculate the FET parameters (drain dynamic resistance, mutual conductance and amplification factor at a given operating point).

9. Fixed-bias circuit with and without emitter resistor i) Trace the circuit (ii) To measure the Q-Point (IC and VCE) with and without emitter resistor RE. (iii) To note the variation of Q -point by increasing the temperature of the transistor in fixed bias circuit with and without emitter resistor (iv) To note the variation of Q-point by changing the base resistor in bias circuit with and without emitter resistor

10. Collector-to-base feedback bias circuit: (i) Trace the circuit (ii) To measure the Q-Point (IC and VCE) (iii) To note the variation of Q-point by increasing the temperature of the transistor

11. Potential -divider biasing circuit: (i) Trace the circuit (ii) To measure the Q-Point (IC and VCE) (iii) To note the variation of Q-point by increasing the temperature of the transistor (iv) To measure the operating point when one of the bias resistor changes

12. Half-wave rectifier: (i) To draw the input and output wave shapes (ii) To verify Vdc = Vm/p and ripple factor = 1.21(Observe for different load resistances)

13. Full-wave rectifier – Centre tapped: (i) To draw the input and output wave shapes (ii) To verify Vdc = 2Vm/p and ripple factor = 0.482 (Observe for different load resistances)

14. Bridge rectifier: (i) To draw the input and output wave shapes (ii) To verify Vdc = 2Vm/p and ripple factor = 0.482 (Observe for different load resistances)

15. Filter circuits (shunt capacitor, LC and CLC filters): (i) To plot the output wave shapes with and without shunt capacitor (ii) To find the ripple factor with and without different filters

16. Single stage RC coupled amplifier: (i) To measure the Q-point (IC and VCE) (ii) To measure the maximum signal that can be amplified by the amplifier without clipping (iii) To measure the voltage gain at 1 KHz. (iv) To plot the frequency response (v) To find the voltage gain for different values of load resistance

17. FET amplifier: (i) To measure the frequency response (ii) To measure voltage gain, BW and gain-BW product

18. Hartley oscillator: (i) Trace the circuit (ii) To measure the Q-point of the transistor (iii) To observe the output wave form and to measure the frequency of oscillations

19. Phase shift oscillator: (i) Trace the circuit (ii) To measure the frequency from the output wave form (iii) To observe the phase shift at different points

20. Clipping circuits: (i) To observe the output wave form corresponding to different clipping circuits

21. Clamping circuits: (i) To observe the output wave form corresponding to different clamping circuits

22. OP amp. - Inverting amplifier using IC 741 (i) Trace the circuit (ii) To construct an inverting amplifier using IC 741 and determine its voltage gain for different input voltage

23. OP amp. - Non inverting amplifier using IC 741 (i) Trace the circuit (ii) To construct a Non inverting amplifier using IC 741 and determine its voltage gain for different input voltage

24. OP amp. - Unity gain buffer using IC 741 (i) Trace the circuit and (ii) To construct a unity gain buffer using IC 741 and to find the voltage gain.