ANNAMALAI UNIVERSITY

REGULATIONS FOR THE FIVE YEAR INTEGRATED POST GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

These Regulations are common to all the students admitted to the Five Year Integrated Master's Programmes in the Faculties of Arts, Science, Languages, Marine Sciences, and Education from the academic year 2019-2020 onwards.

1. Definitions and Nomenclature

1.1 **University** refers to Annamalai University.
1.2 **Department** means any of the academic departments and academic centres at the University.
1.3 **Discipline** refers to the specialization or branch of knowledge taught and researched in
1.4 Higher education. For example, Botany is a discipline in the Natural Sciences, while Economics is a discipline in Social Sciences.
1.5 **Programme** encompasses the combination of courses and/or requirements leading to a Degree. For example, M.A., M.Sc.
1.6 **Course** is an individual subject in a programme. Each course may consist of Lectures/Tutorials/Laboratory work/Seminar/Project work/Experiential learning/ Report writing/viva-voce etc. Each course has a course title and is identified by a course code.

1.7 **Curriculum** encompasses the totality of student experiences that occur during the educational process.

1.8 **Syllabus** is an academic document that contains complete information about an academic programme and defines responsibilities and outcomes. This includes course information, course objectives, policies, evaluation, grading, learning resources and course calendar.

1.9 **Academic Year** refers to the annual period of sessions of the University that comprises two consecutive semesters.

1.10 **Semester** is a half-year term that lasts for a minimum of 90 working days. Each academic year is divided into two semesters.

1.11 **Choice Based Credit System** A mode of learning in higher education that enables a student to have the freedom to select his/her own choice of elective courses across various disciplines for completing the Degree programme.

1.12 **Core Course** is mandatory and an essential requirement to qualify for the Degree.

1.13 **Elective Course** is a course that a student can choose from a range of alternatives.

1.14 **Value Added Courses** are optional courses that complement the students' knowledge and skills and enhance their employability.

1.15 **Experiential Learning** is a process of learning through experience. It is specifically defined as "learning through reflection on doing".

1.16 **Extension activities** are the activities that provide a link between the University and the community such as lab-to-land, literacy, population education, and health awareness programmes. These are integrated within the curricula with a view to sensitise the students about Institutional Social Responsibility (ISR).

1.17 **Credit** refers to the quantum of course work in terms of the number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.

1.18 **Credit Hour** refers to the number of class hours per week required for a course in a semester. It is used to calculate the credit value of a particular course.

1.19 **Programme Outcomes (POs)** are statements that describe crucial and essential knowledge, skills, and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.

1.20 **Programme Specific Outcomes (PSOs)** are statements that list what the graduate of a specific programme should be able to do at the end of the programme.

1.21 **Learning Objectives (also known as Course Objectives)** are statements that define the expected goal of a course in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.

1.22 **Course Outcomes (COs)** are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.

1.23 **Grade Point Average (GPA)** is the average of the grades acquired in various courses that a student has taken in a semester. The formula for computing GPA is given in Section 11.3.

1.24 **Cumulative Grade Point Average (CGPA)** is a measure of the overall cumulative performance of a student in all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters.

1.25 **Letter Grade** i**s** an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, and RA.

2. Programmes Offered and Eligibility Criteria

The Integrated Programmes offered by the University and the eligibility criteria are detailed below.

Faculty of Science	
M.Sc. Physics	A pass in H.S.E. (10+2 level) OR Equivalent thereto with a minimum aggregate of 40% marks under academic stream in the following subjects viz. Physics, Chemistry & Mathematics

2.1 In the case of SC/ST and Differently-abled candidates, a pass is the minimum qualification for all the above Programmes.

3. Reservation Policy

Admission to the various programmes will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. Programme Duration

4.1 The Five Year Master's Programmes consist of five academic years and ten semesters.

4.2 Each academic year is divided into two semesters, the first being from July to November and the second from December to April.

4.3 Each semester will have 90 working days (18 weeks).

5. Programme Structure

5.1 The Five Year Integrated Programme consists of Language Courses, Core Courses, Allied Courses, Elective Courses, Soft Skills, Experiential Learning and Project. Students shall also participate in Extension Activities as part of their curriculum.

5.2 Language Courses

5.2.1 Each student shall take two languages of four courses each, one in each semester for the first two years of the programme.

5.2.2 Language-I shall be Tamil or another language such as Hindi or French.

5.2.3 Language-II shall be English.

5.3 Core courses

5.3.1 These are a set of compulsory courses essential for each programme.

5.3.2 The core courses include both Theory (Core Theory) and Practical(Core Practical) courses.

5.4 Allied Courses

5.4.1 Each student shall take courses in two disciplines allied to the main subject (Allied-I and Allied-II) of the programme in the first four semesters.

5.4.2 In Science and Marine Sciences, there will be two Theory courses and one Practical course each for Allied-I and Allied-II.

5.5 Elective Courses

5.5.1 Departmental Electives (DEs) are the electives that students can choose from a range of Electives offered within the Parent Department offering the Programme.

5.5.2 Interdepartmental Electives (IDEs) are electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the departments of other faculties.

5.5.3 *Students shall take a combination of both DEs and IDEs.*

5.6 Soft Skills

5.6.1 Soft skills are intended to enable students to acquire attributes that enhance their performance and achieve their goals with complementing hard skills.

5.6.2 Soft skills include communication skills, computer skills, social skills, leadership traits, team work, and development of emotional intelligence quotients, among others.

5.6.3 Each student shall choose four courses on soft skills from a range of courses offered from the First to the Sixth Semester.

5.7 Value Education

All students shall take a course on Value Education that includes human values, sustainable development, gender equity, ethics and human rights.

5.8 Experiential Learning

5.8.1 Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.

5.8.2 In-plant training/field trips/internships/industrial visits (as applicable) fall under this category.

5.9 Extension Activities

5.9.1 It is mandatory for every student to participate in extension activities.

5.9.2 All the students shall enrol under NSS/NCC/YRC/RRC or any other Service Organisation in the University.

5.9.3 Students shall put in a minimum attendance of 40 hours in a year duly certified by the Programme Co-ordinator.

5.9.4 Extension activities shall be conducted outside the class hours.

5.10 Project

5.10.1 Each student shall undertake a Project in the final semester.

5.10.2 The Head of the Department shall assign a Project Supervisor to the student.

5.10.3 The Project Supervisor shall assign a topic for the project and monitor the progress of the student periodically.

5.10.4 Students who wish to undertake project work in recognised institutions/industry shall obtain prior permission from the University. The Project Supervisor will be from the host institute, while the Co-Supervisor shall be a faculty in the parent department.

5.11 Value Added Courses (VACs)

5.11.1 Students may also opt to take Value Added Courses beyond the minimum credits required for the award of the Degree. VACs are outside the normal credit paradigm.

5.11.2 VACs enhance the students' employability and life skills. VACs are listed on the University website and in the Handbook on Interdepartmental Electives and VACs.

5.11.3 Each VAC carries 2 credits with 30 hours of instruction, of which 60% (18 hours) shall be Theory and 40% (12 hours) Practical.

5.11.4 Classes for VACs are conducted beyond the regular class hours and preferably in the VIII and IX Semesters.

5.12 Online Courses

5.12.1 The Heads of Departments shall facilitate enrolment of students in Massive Open Online Courses (MOOCs) platform such as SWAYAM to provide academic flexibility and enhance the academic career of students.

5.12.2 Students who successfully complete a course in the MOOC platform shall be exempted from one elective course of the programme.

5.12.3 Credit Distribution

The credit distribution is detailed in the Table.

	Credits
Semester I to VI	
Language-I (Tamil or any other Language)	12
Language-II (English)	12
Core Courses	60-65
Allied-I	10
Allied-II	10
Electives	15
Soft skills	12
Environmental studies (UGC mandated)	2
Value Education	2
Experiential learning	4
Extension activities	1
Total Credits (Semester I to VI)	**140-145**
Semester VII to X	
Core Courses	65-75
Electives	15
Project	6-8
Total Credits (Semester VII to X)	**90-95**
Total Credits Semester I to X (Minimum requirement for the award of Degree)	***230-240**

**Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 230-240 credits.*

5.13 Credit Assignment

Each course is assigned credits and credit hours on the following basis:

1 Credit is defined as

1 Lecture period of one hour per week over a semester

1 Tutorial period of one hour per week over a semester

1 Practical/Project period of two or three hours (depending on the discipline) per week over a semester.

6 Attendance

6.1 Each faculty handling a course shall be responsible for the maintenance of Attendance *and Assessment Record for* students who have registered for the course.

6.2 The Record shall contain details of the students' attendance, marks obtained in the Continuous Internal Assessment (CIA) Tests, Assignments and Seminars. In addition the Record shall also contain the organisation of lesson plan of the Course Instructor.

6.3 The record shall be submitted to the Head of the Department once a month for monitoring the attendance and syllabus coverage.

6.4 At the end of the semester, the record shall be duly signed by the Course Instructor and the Head of the Department and placed in safe custody for any future verification.

6.5 The Course Instructor shall intimate to the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students.

6.6 Each student should earn a minimum of 75% attendance in the courses of the particular semester failing which he or she will not be permitted to write the End-Semester Examination. The student has to redo the semester in the next year.

6.7 Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness.

7. Mentor-Mentee System

7.1 To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.

7.2 The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.

7.3 The Mentors shall also help their mentees to choose appropriate electives and value-added courses, apply for scholarships, undertake projects, prepare for competitive examinations such as NET/SET, GATE etc., attend campus interviews and participate in extracurricular activities.

8. Examinations

8.1 The examination system of the University is designed to systematically test the student's progress in class, laboratory and field work through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

8.2 There will be two CIA Tests and one ESE in each semester.

8.3 The Question Papers will be framed to test different levels of learning based on Bloom's taxonomy, viz. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation/Creativity.

8.4 Continuous Internal Assessment Tests

8.4.1 The CIA Tests shall be a combination of a variety of tools such as class tests, assignments, seminars, and viva-voce that would be suitable for the course. This requires an element of openness.

8.4.2 The students are to be informed in advance about the assessment procedures.

8.4.3 The pattern of question paper will be decided by the respective faculty.

8.4.4 CIA Test-I will cover the syllabus of the first two units while CIA Test-II will cover the last three units.

8.4.5 CIA Tests will be for one to three hours duration depending on the quantum of syllabus.

8.4.6 A student cannot repeat the CIA Test-I and CIA Test-II. However, if for any valid reason, the student is unable to attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

8.5 End Semester Examinations (ESEs)

8.5.1 The ESEs for the odd semester will be conducted in November and for the even semester in May.

8.5.2 A candidate who does not pass the examination in any course(s) will be permitted to reappear in such course(s) in the subsequent semester/year.

8.5.3 The ESE will be of three hours duration and will cover the entire syllabus of the course.

9 Evaluation

9.1 Marks Distribution

9.1.1 Each course, both Theory and Practical as well as Project/Internship/Field work/In-plant training shall be evaluated for a maximum of 100 marks.

9.1.2 For the theory courses, CIA Tests will carry 25% and the ESE, 75% of the marks.

9.1.3 For the Practical courses, the CIA Tests will constitute 40% and the ESE 60% of the marks.

9.2. Assessment of CIA Tests

9.2.1 For the CIA Tests, the assessment will be done by the Course Instructor

9.2.2 For the Theory Courses, the break-up of marks shall be as follows:

	Marks
Test-I & Test-II	15
Seminar	5
Assignment	5
Total	25

9.2.3 For the Practical Courses (wherever applicable), the break-up of marks shall be as follows:

	Marks
Test-I	15
Test-II	15
Viva-voce and Record	10
Total	40

9.3 Assessment of End-Semester Examinations

9.3.1 Double Evaluation for the ESE is done by the University Teachers.

9.3.2 In case of a discrepancy of more than 10% between the two examiners in awarding marks, third evaluation will be resorted to.

9.4 Assessment of Project/Dissertation

9.4.1 The Project Report/Dissertation shall be submitted as per the guidelines laid down by the University.

9.4.2 The Project Work/Dissertation shall carry a maximum of 100 marks.

9.4.3 CIA for Project will consist of Review of literature, experimentation/field work, attendance etc.

9.4.4 The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.

9.4.5 The Project Evaluation Committee will comprise of the Head of the Department, Project Supervisor, and a senior faculty.

9.4.7 The marks shall be distributed as follows:

Continuous Internal Assessment (25 Marks)		End Semester Examination (75 Marks)	
Review-I 10	Review-II: 15	Project / Dissertation Evaluation	Viva-voce
		50	25

9.5 Assessment of Value Added Courses

9.5.1 VACs shall be evaluated completely by Internal Examiners.

9.5.2 Two CIA Tests shall be conducted during the semester by the Department(s) offering VAC.

9.5.3 A committee consisting of the Head of the Department, faculty handling the course and a senior faculty member shall monitor the evaluation process.

9.5.4 The grades obtained in VACs will not be included for calculating the GPA.

9.6 Passing Minimum

9.6.1 A candidate is declared to have passed in each course if he/she secures not less than 40% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.

9.6.4 A candidate who has not secured a minimum of 50% of marks in a course (CIA + ESE) shall reappear for the course in the next semester/year.

10. Conferment of the Master's Degree

A candidate who has secured a minimum of 50% marks in all courses prescribed in the programme and earned the minimum required credits shall be considered to have passed the Master's Programme.

11. Marks and Grading

11.1 The performance of students in each course is evaluated in terms of Grade Point (GP).

11.2 The sum total performance in each semester is rated by Grade Point Average (GPA) while Cumulative Grade Point Average (CGPA) indicates the Average Grade Point obtained for all the courses completed from the first semester to the current semester.

11.3 The GPA is calculated by the formula

$$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$$

where, C_i is the Credit earned for the Course i in any semester;

G_i is the Grade Point obtained by the student for the Course i and

n is the number of Courses passed in that semester.

11.4 CGPA is the Weighted Average Grade Point of all the Courses passed starting from the first semester to the current semester.

$$CGPA = \frac{\sum_{I=1}^{m} \sum_{I=1}^{n} C_i G_i}{\sum_{I=1}^{m} \sum_{I=1}^{n} C_i}$$

Where, C_i is the Credit earned for the Course i in any semester;

G_i is the Grade Point obtained by the student for the Course i and

n is the number of Courses passed in that semester.

m is the number of semesters.

11.5 Evaluation of the performance of the student will be rated as shown in the Table.

Letter Grade	Grade Points	Marks %
S	10	90 and above
A	9	80-89
B	8	70-79
C	7	60-69
D	6	55-59
E	5	50-54
RA	0	Less than 50
W	0	Withdrawn from the examination

11.6 Classification of Results. The successful candidates are classified as follows:

11.6.1 For **First Class with Distinction:** Candidates who have passed all the courses prescribed in the Programme *in the first attempt* with a CGPA of 8.25 or above within the programme duration. Candidates who have withdrawn from the End Semester Examinations are still eligible for First Class with Distinction (*See Section 12 for details*).

11.6.2 **For First Class:** Candidates who have passed all the courses with a CGPA of 6.5 or above.

11.6.3 For **Second Class:** Candidates who have passed all the courses with a CGPA between 5.0 to less than 6.5.

11.6.4 Candidates who obtain highest marks in all examinations at the first appearance alone will be considered for University Rank.

11.7 Course-Wise Letter Grades

11.7.1 The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

11.7.2 A candidate is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA.

11.7.3 A course completed successfully, cannot be repeated for the purpose of improving the Grade Point.

11.7.4 A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade card of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd/Even semester in which the student has re-appeared.

11.7.5 If a student secures RA grade in the Project Work/Field Work/Practical Work/Dissertation, he/she shall improve it and resubmit if it involves only rewriting/ incorporating the clarifications suggested by the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.

12. Provision for Withdrawal from the End Semester Examination

12.1 The letter grade W indicates that a candidate has withdrawn from the examination.

12.2 A candidate is permitted to withdraw from appearing in the ESE for one or more courses in **ANY ONE** of the semesters **ONLY** for exigencies deemed valid by the University authorities.

12.3 Permission for withdrawal from the examination shall be granted only once during the entire duration of the programme.

12.3 Application for withdrawal shall be considered **only** if the student has registered for the course(s), fulfilled the requirements for attendance and CIA tests.

12.4 The application for withdrawal shall be made ten days prior to the commencement of the examination and duly approved by the Controller of Examinations. Notwithstanding the mandatory prerequisite of ten days notice, due consideration will be given under extraordinary circumstances.

12.5 Withdrawal is **not** granted for arrear examinations of courses in previous semesters (for which the student has secured RA Grade) and for the final semester examinations.

12.6 Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) in the subsequent semester.

12.7 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the student to qualify for First Class with Distinction.

13. Academic misconduct

Any action that results in an unfair academic advantage/interference with the functioning of the academic community constitutes academic misconduct. This includes but is not limited to cheating, plagiarism, altering academic documents, fabrication/falsification of data, submitting the work of another student, interfering with other students' work, removing/defacing department library or computer resources, stealing other students' notes/assignments, electronically interfering with other students'/ University's intellectual property. Since many of these acts may be committed unintentionally due to lack of awareness, students shall be sensitised on issues of academic integrity and ethics.

14. Transitory Regulations

Wherever there has been a change of syllabi, examinations based on the existing syllabus will be conducted for two consecutive years after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that, the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendation of the Head of the Department concerned.

15. *Notwithstanding anything contained in the above pages as Rules and Regulations governing the Five Year Integrated Master's Programmes at Annamalai University, the Syndicate is vested with the powers to revise them from time to time on the recommendations of the Academic Council.*

PROGRAM OUTCOMES (POs):

By the end of the program, the students will be able to

PO1	**Domain knowledge**: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.
PO2	**Resource Utilisation.** Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments.
PO3	**Analytical and Technical Skills:** Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.
PO4	**Critical thinking and Problem solving:** Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions.
PO5	**Project Management**: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organisational skills and the ability to manage time and resources.
PO6	**Individual and team work**: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.
PO7	**Effective Communication**: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.
PO8	**Environment and Society**: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.
PO9	**Ethics**: Commitment to professional ethics and responsibilities.
PO10	**Life-long learning:** Ability to engage in life-long learning in the context of the rapid developments in the discipline.

PROGRAM SPECIFIC OUTCOMES (PSOs):

By the end of the program, the students will be able to

PSO1	Understand principles of physics for the scientific phenomena in classical domain.
PSO2	Understand the mathematical techniques for describing in depth knowledge of physical concepts.
PSO3	Understand and apply statistical methods for describing the classical and quantum particles in various physical systems and processes.
PSO4	Understand and apply inter-disciplinary concepts and for understanding and describing the natural phenomena.
PSO5	Understand the principles of Quantum mechanics for knowing the physical systems in quantum arena.
PSO6	Provide exposure in various specializations of Physics (Solid State Physics/Nuclear Physics/Particle Physics).
PSO7	Provide exposure to modern experimental/theoretical methods for measurement, observation and fundamental understanding of physical phenomena/systems.
PSO8	Engage in research and life-long learning to adapt to changing environment.

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

By the end of the program, the students will be able to

Programme Specific Outcomes (PSOs)	**Programme Outcomes (POs)**									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10
PSO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSO2	✓	✓		✓						
PSO3	✓	✓								
PSO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P5O5	✓	✓		✓			✓	✓	✓	✓
PSO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSO7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSO8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

M. Sc. PHYSICS (Five Year) Programme

PROGRAMME CODE: SPHY51

Programme Structure

(For students admitted from the academic year 2019 - 2020)

DETAILS OF COURSE WITH CREDIT

Total Credits up to three years: 144

Total Credits up to five years: 237

Course Code	Course Title	L	P	C	Inter. Mark	Exter. Mark	Total
FIRST SEMESTER							
19ITAC11	Language – I: Course 1	3	-	3	25	75	100
19IENC12	Language – II: Course 1	3	-	3	25	75	100
19ICEC13	Civics, Environmental and Health Sciences	3	-	3	25	75	100
19IPHYC14	Properties of Matter	4	-	4	25	75	100
19IPHYE15	Elective 1: Department Elective	3		3	25	75	100
19IPHAM15	Ancillary Mathematics-I	5	-	5	25	75	100
	Total credits			**21**			
SECOND SEMESTER							
19ITAC21	Language – I: Course 2	3	-	3	25	75	100
19IENC 22	Language – II: Course 2	3	-	3	25	75	100
19ICAC23	Computer Applications - I	3	-	3	25	75	100
19IPHYC24	Heat and Thermodynamics	4	-	4	25	75	100
19IPHYP25	Practical – I	-	9	4	40	60	100
19IPHAM 26	Ancillary Mathematics-II	5	-	5	25	75	100
	Total credits			**22**			
THIRD SEMESTER							
19ITAC 31	Language - I: Course 3	3	-	3	25	75	100
19IENC 32	Language - II: Course 3	3	-	3	25	75	100
19IPHYC33	Mechanics	4	-	4	25	75	100
19IPHYC34	Oscillations, Waves and Acoustics	4	-	4	25	75	100
19IPHYE35	Elective 2: Department Elective	3		3	25	75	100
19IPHYP35	Practical – II	-	9	4	40	60	100
19IPHAC36	Chemistry -I	4	-	4	25	75	100
	Total credits			**25**			
FOURTH SEMESTER							
19ITAC 41	Language –I: Course 4	3	-	3	25	75	100
19IENC 42	Language –II: Course 4	3	-	3	25	75	100
19IPHYC43	Optics and Spectroscopy	4	-	4	25	75	100
19IPHYC44	Electricity and Magnetism	4	-	4	25	75	100
19IPHYP45	Practical – III	-	9	4	40	60	100
19IPHAC 46	Chemistry –II	3	-	4	25	75	100
19IPAPC 47	Ancillary Chemistry Practical - II	-	5	2	40	60	100
	Total credits			**24**			
FIFTH SEMESTER							
19IPHYC51	Atomic Physics	4	-	4	25	75	100
19IPHYC52	Laser and Fiber Optics	4	-	4	25	75	100

19IPHYC53	Analog Electronics	4	-	4	25	75	100
19IPHYC54	Energy Physics	4	-	4	25	75	100
19IPHYC55	Solid State Physics	4	-	4	25	75	100
19IPHYE56	Elective 3: Department Elective	3		3	25	75	100
19IPHYP56	Practical –IV	-	**9**	**4**	40	60	100
	Total credits			**27**			
SIXTH SEMESTER							
19IPHYC61	Numerical Methods of Analysis	4	-	4	25	75	100
19IPHYC62	Digital Electronics	4	-	4	25	75	100
19IPHYC63	Nuclear Physics	4	-	4	25	75	100
19IPHYC64	Relativity and Quantum Mechanics	4	-	4	25	75	100
19IPHYC65	Astrophysics	4	-	4	25	75	100
19IPHYP66	Practical – V	-	**9**	**5**	40	60	100
	Total credits			**25**			
SEVENTH SEMESTER							
19IPHYC71	Classical and Statistical Mechanics	4	-	4	25	75	100
19IPHYC72	Electronics	4	-	4	25	75	100
19IPHYC73	Mathematical Physics-I	4	-	4	25	75	100
19IPHYP74	Practical – VI	-	9	6	40	60	100
	Elective 4: Inter Department Elective	3	-	3	25	75	100
	Total credits			**21**			
EIGTH SEMESTER							
19IPHYC81	Mathematical Physics – II	4	-	4	25	75	100
19IPHYC82	Condensed Matter Physics – I	4	-	4	25	75	100
19IPHYC83	Electromagnetic Theory	4	-	4	25	75	100
19IPHYP84	Practical – VII	-	9	6	40	60	100
	Elective 5: Inter Department Elective	3	-	3	25	75	100
19IPHYE85	Elective 6: Department Elective	3	-	3	40	60	100
	Total credits			**24**			
NINTH SEMESTER							
19IPHYC91	Quantum Mechanics – I	4	-	4	25	75	100
19IPHYC92	Condensed Matter Physics - II	4	-	4	25	75	100
19IPHYC93	Nuclear and Elementary Particle Physics	4	-	4	25	75	100
19IPHYP94	Practical – VIII	-	9	6	40	60	100
	Elective 7: Inter Department Elective	3	-	3	25	75	100
19IPHYE95	Elective 8: Department Elective	3		3	25	75	100
	Total credits			**24**			
TENTH SEMESTER							
19IPHYC101	Quantum Mechanics – II	4	-	4	25	75	100
19IPHYC102	Spectroscopy	4	-	4	25	75	100
19IPHYE103	Physics of Nanomaterials	4	-	4	25	75	100
19IPHYP104	Practical – IX	-	9	6	40	60	100
19IPHYPJ105	Project	-	**9**	**6**	25	50	100
	Viva-Voce	-				25	
	Total credits			**24**			
	TOTAL CREDITS			**237**			
	1. Value Added Courses **2. Online Courses (SWAYAM, MOOC's and NPTEL)**						

DEPARTMENT ELECTIVE (DE) COURSES

Course Code	Course Title	Credit			Internal Assessment Marks	External Marks	Total Marks
		L	P	C			
19IPHYE15.1 (Elective 1)	Electrical Appliances	3	-	3	25	75	100
19IPHYE15.2 (Elective 1)	Physics of human anatomy	3	-	3	25	75	100
19IPHYE35.1 (Elective 2)	Basic electronic devices	3	-	3	25	75	100
19IPHYE35.2 (Elective 2)	Environmental Physics	3	-	3	25	75	100
19IPHYE56.1 **(Elective-3)**	Communication system	3	-	3	25	75	100
19IPHYE56.2 **(Elective-3)**	Audio and video systems	3	-	3	25	75	100
Elective-6 19IPHYE85.1	Microprocessor and Microcontroller	3	-	3	25	75	100
19IPHYE85.2	Physics of the Earth	3	-	3	25	75	100
19IPHYE85.3	Energy Physics	3	-	3	25	75	100
Elective-8 19IPHYE95.1	Instrumentation	3	-	3	25	75	100
19IPHYE95.2	Biomedical Instrumentation	3	-	3	25	75	100
19IPHYE95.3	Petrophysics	3	-	3	25	75	100
19IPHYE95.4	Medical Physics	3	-	3	25	75	100
19IPHYE95.5	Biophysics	3	-	3	25	75	100

ANCILLARY PHYSICS

Course Code	Theory	Credit			Internal Assessment Marks	End Semester Examination Marks	Total Marks
		L	P	C			
19IPHYA - I	Ancillary Physics-I	4	0	4	25	75	100
19IPHYA - II	Ancillary Physics-II	4	0	4	25	75	100
19IPHYAP – I	Ancillary Practical-I		3	4	40	60	100
19IPHYAP - II	Ancillary Practical-II		3	4	40	60	100

SEMESTER - I	19IPHYC14 - PROPERTIES OF MATTER	Credit : 4 Hours : 4

LEARNING OBJECTIVES:

- To know about the gravity and the laws of gravitation.
- To understand the concept of elasticity.
- To understand the behaviour of fluids.

UNIT– I: GRAVITY AND GRAVITATION

Kepler's laws - Newton's law of gravitation – Determination of 'G' by Boy's method - Simple pendulum, Bar pendulum - Variation of g with altitude and latitude - Gravitational potential and field due to a spherical shell - Solid sphere - Hollow sphere and thin circular plate.

UNIT– II: ELASTICITY

Poisson's ratio – Relation between elastic moduli and Poisson's ratio – Torsion pendulum – Bending of beams – Uniform and Non-uniform bending – Theory and experiment – Work done in bending – Expression for the period of oscillation of a cantilever – Determination of Young's modulus of a cantilever – Dynamic method – Theory and experiment – 'I' form of girders.

UNIT– III: SURFACE TENSION

Definition and dimensions of surface tension – Excess of pressure over curved surfaces – Variation of surface tension with temperature – Jaeger's experiment – Quincke's method– Vapour pressure over a liquid surface – Determination of surface tension by ripples method– Factors affecting surface tension.

UNIT– IV: VISCOSITY

Stream line and turbulent motion – Coefficient of viscosity and its dimensions – Rate of flow of liquid in a capillary tube – Poiseuille's formula – Correction for Poiseuille's method- Poiseuille's method for determination of coefficient of viscosity of liquid – Searle's Viscometer - Viscosity of gas - Rankine's method – Comparison of viscosities – Ostwald's viscometer.

UNIT–V: DIFFUSION AND OSMOSIS

Diffusion - Graham's law of diffusion – Fick's law – Experimental measurement of diffusivity - Transpiration and transfusion – Osmosis – Osmotic pressure - Laws of Osmotic pressure - Van't Hoff law – Osmosis and vapour pressure of solution - Osmosis and boiling point of a solution – Osmosis and freezing point of a Solution – Determination of molecular weight using boiling point.

TEXT BOOKS:

1. Brijlal and Subramanyam, Properties of Matter, S. Chand and Co., 2005.
2. R. Murugesan, Properties of Matter, S. Chand publications, 2010.
3. Subramania Iyer and Ranga Rajan, Properties of Matter, Viswanathan Publication (2002).

SUPPLEMENTARY READING:

1 D.S. Mathur, Elements of Properties of Matter, S.Chand & Co., New Delhi, 2005

2 B.H. Flowers, Properties of Matter, 1st ed., Wiley publishers, New Jersey, 1991

3 F.H. Newman and V.H.L.Searle, The General Properties of Matter, Edward Arhold Publisher, London, 1961.
4 H.R Galati , Fundamentals of General Properties of Matter, R.Chand and Co.(fifth edition), 2005.
5 David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, 6 th edition.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Acquire a practical knowledge about the gravity and the applications of the laws of gravitation.
CO2: Understand and apply the concept of elasticity.
CO3: Understand the behaviour of fluids and practical applications of the same in real life.
CO4: Recall the principles and basic equations and apply them to unseen problems

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓							✓		✓	✓		✓	✓	
CO2	✓	✓	✓	✓							✓			✓		✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - II	19IPHYC24 - HEAT AND THERMODYNAMICS	Credit : 4 Hours : 4

LEARNING OBJECTIVES:

- To gain in depth knowledge regarding the effects of heat and its applications.
- To study the aspects related to the measurement of temperature and heat
- To understand the concepts of thermodynamics.

UNIT– I: THERMOMETRY

Centigrade, Fahrenheit and Kelvin scale of temperature **-** constant volume Hydrogen thermometer **-** Platinum resistance thermometer **-** Callendar and Griffith's bridge **-** Thermoelectric effect – Seebeck effect **-** Thermoelectric thermometers**-** International temperature scale **-** Thermistor**.**

UNIT– II: CALORIMETRY

Specific heat capacity of solids – Regnault's method of mixtures(solid) – specific heat capacity of liquids – Callendar and Barnes method – Specific heat capacity of gases – C_p and C_v – Meyer's relation – C_v by Joly's differential steam calorimeter method – C_p by Regnault's method.

UNIT– III: TRANSMISSION OF HEAT

Conduction – coefficient of thermal conductivity – Rectilinear flow of heat along a bar – convection – lapse rate – Stability of the atmosphere – Newton's law of cooling – determination of specific heat capacity of liquid - Radiation - black body – Kirchhoff's law – Stefan – Boltzmann law

- energy distribution in black body spectrum - Wien's law – Rayleigh Jean's law– Planck's law - solar constant – water flow pyrheliometer.

UNIT – IV: KINETIC THEORY OF GASES AND LOW TEMPERATURE PHYSICS

Kinetic Theory of gases - assumptions - Molecular collisions – mean free path – expression for mean free path – Transport phenomenon – Brownian motion and its features - expression for viscosity of gas.

Joule Thomson effect – porous plug experiment – temperature of inversion – Joule-Thomson Cooling – Joule-Kelvin effect - Liquefaction of Air-Linde's Process – Liquefaction of Helium-K.Onnes method - Helium I and II - Properties of Helium I and II – super conductivity.

UNIT– V: THERMODYNAMICS

Zeroth and first law of thermodynamics – reversible and irreversible processes – second law of thermodynamics – Carnot's engine – its efficiency.

Entropy – change of entropy in reversible and irreversible processes – temperature – entropy diagrams – physical significance of entropy - change of entropy when ice converted into steam - third law of thermodynamics – Extensive and intensive thermodynamic variables – distinction between them – Maxwell thermodynamical relations – derivation and application.

TEXT BOOKS:

1. Brij Lal, N. Subrahmanyam and P.S.Hemne, Heat, Thermodynamics and Statistical Physics, S.Chand and Co, 2010.
2. R.Murugeshan and Kiruthiga Sivaprasath, Thermal Physics, S. Chand and Co., 2012.
3. D.S. Mathur, Heat and Thermodynamics, S. Chand and Co., 2002.

SUPPLEMENTARY READING:

1. Brij Lal and N. Subrahmanyam, Heat and Thermodynamics, S.Chand and Co., 2008.
2. Saha and Srivasatava, A Text book of Heat, Science Book Agency, 1967.
3. Le Roy D.Weld, A Text book of Heat, The Macmillan Company, New York, 1948.
4. Charles Kittel, and Herbert Kroemer, Thermal Physics, CBS Publishers, 1987.
5. Brij Lal and N.Subramanyam, Thermal and Statistical Physics, S.Chand and Co, 2009.
6. S.S.Singhal, J.P.Agarwal and Satya Prakash, Heat and Thermodynamics, Pragati Prakashan, 2001.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Gain in depth knowledge of heat and its effects.
CO2: Understand the behavior of thermal properties of materials.
CO3: Know the theory of heat and thermodynamics with applications.
CO4: Finding applications of the physical quantities.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓				✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - II	**19IPHYP25 - PRACTICAL – I**	**Credit : 4** **Hours : 9**

LEARNING OBJECTIVES:

- To gain in depth knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To provide hands-on learning experience such as in measuring the basic concepts in properties of matter, sound, heat and electricity.

(Any **Twelve** experiments)

1. Surface Tension – Capillary rise method.
2. Young's modulus – Non uniform bending (pin and microscope).
3. Young's modulus –uniform bending (pin and microscope).
4. Young's modulus – Koenig's method.
5. Potentiometer – Low range voltmeter.
6. Potentiometer – Internal resistance of a cell.
7. Compound pendulum- Determination of g and k.
8. Coefficient of viscosities- Hare's apparatus.
9. Lee's disc-Thermal conductivity of a bad conductor.
10. Thermal conductivity -Forbe's method.
11. Specific heat capacity of liquid by method of mixtures.
12. Specific heat capacity of liquid by method of cooling.
13. Quincke's drop – Surface tension of Mercury.
14. Drop weight method - Surface tension of a liquid.
15. Rigidity Modulus – Static torsion.
16. q, n, σ – Searle's method.

COURSE OUTCOMES (COs):

CO1: Apply knowledge of physics fundamentals and an instrumentation to arrive solution for various problems.
CO2: Understand the usage of basic laws and theories to determine various properties of the materials given.
CO3: Understand the application side of the experiments
CO4: Use of basic laws to study the thermal properties of materials.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - III	19IPHYC33 - MECHANICS	Credit : 4 Hours : 4

LEARNING OBJECTIVES:

- To educate the students related to the various aspects of mechanics.
- To understand the basic concepts of projectile motion, impulse, impact, rockets and satellites.
- To provide the concepts of dynamics of rigid bodies.
- To provide in depth knowledge about static, centre of gravity, hydrodynamics and basic concepts of classical mechanics.

UNIT– I: PROJECTILE, IMPULSE, AND IMPACT

Projectile – Range of a projectile in horizontal and inclined plane – Impulse – Impact – Impulsive force – Laws of impact – Impact of a smooth sphere on a smooth horizontal plane – Direct and oblique impacts –Loss in kinetic energy – Motion of two interacting bodies – Reduced mass.

UNIT – II: ROCKETS AND SATELLITES

Rockets and Satellites – Basic Principles of rocket motion – Rocket Equation, thrust and acceleration – Escape velocity, multistage rockets – liquid, solid and cryogenic – propellant rockets – space shuttle - Orbital velocity – launching of a satellite, types of satellite orbits.

UNIT–III: DYNAMICS OF RIGID BODIES

Rigid body - Moment of inertia - Radius of gyration - Moment of inertia - Solid cylinder - cylindrical shell - Solid sphere - Spherical shell - Hollow sphere - Compound pendulum - Theory - Equivalent simple pendulum - Reversibility of centers of suspension and oscillation - Determination of g and k - Kater's pendulum.

UNIT– IV: STATICS, CENTRE OF GRAVITY AND HYDRODYNAMICS

Centre of gravity of a solid and hollow cone – Solid and hollow hemisphere – Thrust – Centre of pressure – Vertical rectangular lamina.

Streamline and Turbulent flow - Equation of continuity of flow – Energy of a liquid in flow- Bernoulli's theorem – Velocity of efflux of a liquid - Torricelli's theorem – Venturimeter.

UNIT –V: BASIC CONCEPTS OF CLASSICAL MECHANICS

Mechanics of single and system of particles - Conservation law of linear momentum, angular momentum and mechanical energy for a particle and a system of particles - Centre of mass and equation of motion – Constraints - Classification - Degrees of freedom and Generalized coordinates – Principle of virtual work.

TEXT BOOKS:

1. H.S. Hans and S.P. Puri, Mechanics, Tata Mc Graw Hill, 2003.
2. D.S. Mathur, Mechanics, S.Chand, 2006.
3. Gupta, Kumar and Sharma, Classical Mechanics, Pragathi Prakashan, 2010.

SUPPLEMENTARY READING:

1. R.G. Takwale and P.S.Puranik, Introduction to Classical Mechanics, Tata Mc Graw Hill, New Delhi, 1979.
2. B.D.Gupta and Satya Prakash, Classical Mechanics, Keder Nath Publisher, Meerut, 2004.
3. C.L.Arora, Mechanics and Properties of Matter, S.Chand, 2006.
4. David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, John Wiley & Sons, 2010, 6 th edition.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand and define the laws involved in mechanics.
CO2: Understand the concepts of projectile motion, impulse and impact.
CO3: Understand the rockets and satellites and its importance for scientific developments.
CO4: Understand the concepts of dynamics of rigid bodies and the knowledge about static, centre of gravity, hydrodynamics and basic ideas of classical mechanics.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - III	19IPHYC 34 - OSCILLATIONS, WAVES AND ACOUSTICS	Credit : 4 Hours : 4

LEARNING OBJECTIVES:

- To gain knowledge about the wave motion and wave propagation.
- To know more about the basics of Acoustics.
- To get more exposure to the ultrasonic sound and its applications.

UNIT –I: OSCILLATIONS

Free, damped and forced vibrations – Expressions and derivations – Principle of resonance – Sharpness in Resonance - Expression for the velocity of longitudinal waves in a gaseous medium - Newton-Laplace's formula - Effect of temperature, pressure and humidity on the velocity of sound in air.

Unit– II: WAVE PROPAGATION AND VIBRATING SYSTEMS

Equation of simple harmonic waves - Differential equation of wave motion - Progressive waves –– Characteristics of progressive and stationary waves – Beats phenomenon – Expression for beats – Reflection & Refraction of sound waves- Expressions for velocity of transverse wave in a stretched string - Laws of transverse vibrations of string - Sonometer – Determination of AC frequency.

Unit I–III: ACOUSTICS

Characteristics of musical note – Intensity measurement – Pitch – Quality – Decibel – Sabine's empirical formula - Reverberation time – Measurement of absorption coefficient – Acoustic aspects for halls and auditoria – Doppler effect

Unit– IV: ULTRASONICS

Ultrasonics – Production of ultrasonic waves - Piezo electric method – Measurement of velocity of ultrasonic waves – Acoustic grating – Applications of ultrasonic waves –medical, industrial, scientific – Non-Destructive Testing (NDT)

Unit –V: FOURIER ANALYSIS

Fourier theorem – Fourier Series - Fourier coefficients – Definition - Evaluation of Fourier coefficients – Fourier Analysis of Square wave and Saw tooth wave

TEXT BOOKS:

1. Brijlal and Subramanyam, A Text book of Sound, Vikas publishing House Pvt. Ltd., 1994.
2. M.Ghosh, D.Bhattacharya, Oscillations, waves and Acoustics,S.Chand and Company Ltd., 2006.
3. Sathya Prakash, Waves and Oscillations, Pragati Prakashan, 2010.

SUPPLEMENTARY READING:

1. Berkley, Waves and Oscillations, Vol.III, Mc Graw-Hill Publishers, 1968.
2. H.J.Pain, The Physics of vibrations and waves, McMillan, 1975.
3. P.K Mittal, Oscillations, waves and Acoustics, I.K International Pvt Ltd, 2010
4. R.N Choudhri , Waves and Oscillations, New Age International (P) Ltd Publishers.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Thorough understanding about the terms such as frequency, wavelength and amplitude

CO2: Involving personally doing the sonometer experiment and determining the frequency of a given tuning fork

CO3: Having personal experience in identifying the difference between the reverberation, and reflection of sound waves or echo.

CO4: Gain deeper understanding of ultrasonics and its applications.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓		✓	✓					✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓								✓	✓	✓	✓				
CO3	✓	✓	✓								✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓					✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - III	19IPHYP 35 - PRACTICAL –II	Credit : 4 Hours :9

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To providing a hands-on learning experience such as in measuring the basic concepts in properties of matter, sound, heat, optics and electricity.

(Any **Twelve** experiments)

1. Viscosity – Stokes method.
2. Sonometer – Verification of laws.
3. Spectrometer – Refractive index of a solid prism.
4. Spectrometer – Dispersive power of a prism.
5. Spectrometer – Hollow prism.
6. Spectrometer – Refractive index of a Prism (Minimum deviation).
7. Spectrometer – Hollow Prism – Refractive index of a liquid.
8. Spectrometer – Grating – Normal incidence – λ determination.
9. Potentiometer – Low range voltmeter.
10. Potentiometer – Internal resistance of a cell.
11. Coefficient of viscosities- Ostwald's apparatus.
12. Rigidity modulus by torsional pendulum (with symmetric masses).
13. Potentiometer – Comparison of e.m.f of the cells.
14. Young's modulus – cantilever optical method.
15. Latent heat of Ice (Half time cooling correction)
16. Latent heat of Steam (Half time cooling correction)

COURSE OUTCOMES (COs):

CO1: Apply knowledge of physics fundamentals and an instrumentation to arrive solution for various problems.

CO2: Understand the usage of basic laws and theories to determine various properties of the materials given.

CO3: Understand the application side of the experiments

CO4: Use of basic laws to study the spectral properties and optical properties of the given prism.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓

SEMESTER - IV	19IPHYC43 - OPTICS AND SPECTROSCOPY	Credit : 4 Hours : 4

LEARNING OBJECTIVES:

- To understand and acquire an indepth knowledge regarding the behaviour of light and also the essential concepts of geometrical optics.
- To understand the theoretical explanation of the phenomenon of interference, diffraction and polarization.
- To educate the students about the fundamental aspects of molecular spectroscopy.

UNIT– I: GEOMETRICAL OPTICS

Lens – Spherical aberration in lenses – Methods of minimizing spherical aberration – chromatic aberration in lenses – condition for achromatism of two thin lenses (in and out of contact) –Aplanatic lens –Dispersion – Angular and Chromatic dispersion – combination of prisms to produce i)dispersion without deviation ii) deviation without dispersion –Direct vision spectroscope –Eyepieces – Ramsden's and Huygens's eyepieces – simple microscope (magnifying glass)– compound microscope.

UNIT– II: INTERFERENCE

Conditions for interference – Theory of interference fringes – determination of thickness of thin transparent sheet- interference due to reflected light (thin films) – colours of thin films – wedge shaped thin film – theory – determination of diameter of a thin wire by Air wedge – test for optical flatness – Newton's rings by reflected light – Determination of wavelength of light – Michelson's Interferometer – theory and its Application (Measurement of wavelength).

UNIT – III: DIFFRACTION

Fresnel's diffraction –Rectilinear propagation of light – Zone plate –action of zone plate - diffraction at circular aperture – opaque circular disc – Fraunhofer diffraction at single slit – Double slit – Plane diffraction grating – theory of plane transmission grating - experiment to determine wavelength(Normal incidence method) –resolving power– Rayleigh's criterion for resolution – resolving power of a telescope – resolving power of a microscope – resolving power of a prism - resolving power of grating.

UNIT– IV: POLARISATION

Double refraction –Nicol Prism – Nicol Prism as polarizer and analyzer – Huygens's explanation of double refraction in uniaxial crystals– Plane, elliptically and circularly polarized light– Quarter wave plates and Half wave plates – Production and detection of plane, circularly and elliptically polarized light- Optical activity– Fresnel's explanation of optical activity – Specific rotatory power –Laurent's half shade polarimeter.

UNIT– V: SPECTROSCOPY

Infrared spectroscopy – sources and detector – uses – ultraviolet spectroscopy – sources – quartz spectrograph **-** applications **-** Raman Spectroscopy **–** Quantum theory of Raman effect – applications – Nuclear magnetic resonance – theory and its applications – Nuclear quadrupole resonance - instrumentation and application– Electron spin resonance spectroscopy theory and application.

TEXT BOOKS:

1. N. Subramanyam Brijlal, M.N. Avadhanulu, A Text Book of Optics, S. Chand & Co Ltd., 2018.
2. R. Murugesan and Kiruthiga Sivaprasath, Optics and Spectroscopy, S. Chand & Co Ltd., 2010.
3. P.K. Chakrabarti, Geometrical and Physical Optics, New Central Book Agency (P) Ltd., 2005.
4. Colin N. Banwell, Elaine M. McCash, Fundamentals of Molecular Spectroscopy Tata McGraw-Hill Publishing Company Ltd, 1995, (Fourth Edition).

SUPPLEMENTARY READING:

1. Jerkins A. Francis and Harvey E. White, Fundamentals of Optics, Tata McGraw Hill Ltd., 2011.
2. Colin N. Banwell, Elaine M. McCash, Fundamentals of Molecular Spectroscopy (Fourth Edition) Tata McGraw-Hill Publishing Company Ltd, 1995.
3. J.D. Graybeal, Molecular Spectroscopy, McGraw-Hill, New York, 1988.
4. R.P Straughen, S.Walker, Spectroscopy Vols.I, II and III, Chapman & Hall, London, 1976.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand and acquire an in-depth knowledge regarding the behaviour of light and also the essential concepts of geometrical optics.

CO2: Understand the phenomenon of interference, diffraction and polarization.

CO3: Use of tools needed to formulate problems in optics and spectroscopy.

CO4: Understand the fundamental aspects of molecular spectroscopy.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓				✓				✓			✓		✓	✓	
CO2	✓	✓	✓	✓			✓			✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - IV	19IPHYC44 - ELECTRICITY AND MAGNETISM	Credit :4 Hours:4

LEARNING OBJECTIVES:

- Fundamental laws viz, Gauss's law in electro & magnetostatics, Faraday's law and Ampere's law are emphasised.
- Basics of electrostatics, magnetostatic and time varying fields from the fundamentals of electromagnetic theory.
- Galvanometer, thermocouple, transformer principle are discussed.

UNIT– I ELECTROSTATICS

Columb's law-Electric field and intensity-Electric dipole- P.E of dipole in an electric field-field due to a dipole.

Gauss's law-differential and integral form-Application of Gauss's law-field due to a uniformly charged sphere, plane charged conductor and uniform charged cylinder-field due to two parallel sheets of charge.

UNIT– II DIELECTRICS

Introduction-parallel plate capacitor with a dielectric-Dielectric constant, polarization and polarization vector- Displacement vector-boundary conditions satisfied by E and D. at the interface of homogenous dielectrics- Capacity of a spherical, parallel and cylindrical capacitor-Energy of a charged capacitor.

UNIT– III MAGNETOSTATICS

Magnetic poles-Fundamental vectors-force on a magnet in a uniform magnetic field – magnetic dipole-magnetic vector and scalar potential-Electric field vector in scalar and vector potential –force on a moving charge-Lorentz force –force on a conductor carrying current-torque on a current loop-Ballistic galvanometer theory and uses. Biot and savarat's law-calculation of H in different conditions.

UNIT– IV ELECTROMAGNETIC INDUCTION

Faradays lay of electromagnetic induction-expression for induced electromagnetic force-self and mutual induction- Co-efficient of coupling-determination of self and mutual inductance-A.C.bridges-Anderson's and Owen's bridges.

Growth and decay of charge in a circuit containing L, C and R-condition for discharge to be oscillatory-frequency of oscillator- theory, construction and working of transformers-skin effect.

UNIT– V THERMOELECTRICITY

Definition of ampere and the value of permeability of free space-emf and internal resistance of a cell – Calibration of ammeter and voltmeter (high and low range).

Thermoelectricity-Measurement of thermo emf using potentiometer-Peltier and Thomson coefficients-applications of thermodynamics to thermocouple-determination of the coefficients-Thermoelectric diagrams.

TEXT BOOKS FOR STUDY:

1. Electricity and Magnetism.Sehagal and Chopra. S.Chand and Sons,2005.
2. Electricity and Magnetism,D.N.Vaudeva,S.Chand and Co.,2012.
3. Electricity and Magnetism, Brijlal and Subramaniyam, Ratan Prakashan Mandir,Agra.1966.

SUPPLEMENTARY READING:

1. Physics, Vol. III - Resnic and Halliday, Willey Eastern Limited, 1988.
2. Electricity and Magnetism, R. Murugesan, S. Chand and Co, 2004.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Recognize basic terms in electricity and magnetism.
CO2: Basic of electrostatics and magnetostatics can be very well understood.
CO3: Concepts of e.m.theory could be enlightened.
CO4: Various equipments (B.G,transformers, thermocouples) principles and working are very well perceived.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓				✓				✓			✓		✓	✓	
CO2	✓	✓	✓	✓			✓			✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

SEMESTER - IV	**19IPHYP45 - PRACTICAL – III**	**Credit : 4** **Hours: 9**

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To providing a hands-on learning experience such as in measuring the basic concepts in Electricity and Magnetism.

(Any **Twelve** experiments)

1. Spectrometer – Cauchy's constant.
2. Air wedge - Diameter of a thin wire.
3. Newton's rings.
4. B.G. – Figure of merit.
5. Field along the axis of a circular coil - Determination of H (Using Vibration Magnetometer).
6. Carey Foster bridge – Temperature co-efficient of resistance of a coil.
7. Potentiometer – Calibration of an Ammeter.
8. Internal resistance of a cell –using B.G.
9. Thermo e.m.f using B.G.
10. Series and parallel resonance circuits.
11. B.G. – comparison of mutual inductance.
12. B.G. – Absolute capacity of a condenser.
13. Potentiometer – High range voltmeter.
14. Anderson's bridge.
15. Resistance by Post Office box.
16. Resistance by Meter Bridge.
17. Dead beat (aperiodic) Galvanometer – figure of merit.
18. Field along the axis of a circular coil – deflection magnetometer.

COURSE OUTCOMES (COS):

CO1: Apply knowledge of physics fundamentals and an instrumentation to arrive solution for various problems.
CO2: Understand the usage of basic laws and theories to determine various properties of the materials given.
CO3: Understand the application side of the experiments
CO4: Acquire in depth knowledge regarding the basic concepts in electricity and magnetism.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓

SEMESTER - V	19IPHYC51 - ATOMIC PHYSICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To study the aspects related to discharge of electricity through gases.
- To study the principles, applications of photoelectric effect and various atomic models and their importance.
- To understand the concepts of the production and characterization of X-rays.

UNIT– I: **CATHODE RAYS AND POSITIVE RAYS**

Discharge of electricity through Gases – Cathode rays – Properties - Specific charge of an electron -Dunnington's method-Millikan's oil drop method-free electron theory of metals-expressions for electrical conductivity-electron microscope-positive rays-Thomson's parabola method-mass spectrograghs.

UNIT– II: STRUCTURE OF ATOM

Bohr atom model –Bohr's theory of Hydrogen atom- Bohr - Sommerfeld theory – Somerfield's relativistic atom model – Critical potentials- Experimental determination Davis and Goucher's experiment- Explanation for the fine structure of $H_\alpha$line- Relativistic variation of atomic mass– Vector atom model– Quantum numbers – coupling schemes – Pauli's exclusion principle – Arrangement of electrons in atoms- Magnetic dipole moment due to orbital motion of the electron – magnetic dipole moment due to electron spin - Stern and Gerlach experiment.

UNIT – III: FINE STRUCTURE OF SPECTRAL LINES

Optical spectra – spectral terms and notations – selection rules -Fine structure of sodium D lines–Zeeman effect – theory and experiment – quantum theory of Zeeman effect – anomalous Zeeman effect – stark effect.

UNIT– IV: **PHOTO ELECTRIC EFFECT**

Einstein's photoelectric equation-Photoelectric cells-photo emissive cells-photovoltaic cells-photoconductive cells-Applications of photoelectric cells

UNIT – V: **X-RAYS**

Properties-production-Coolidge tube - absorption of X-rays- crystal lattice-Interplanar spacing – X- Ray spectra- Duane and Hunt law- Moseley's law- Bragg's law- Bragg's X-ray spectrometer- measurement of wave length-Laue's method-Rotating crystal method-Compton effect- theory and experimental verification.

TEXT BOOKS:

1. Modern Physics, R. Murugeshan, Kiruthiga Sivaprasath, S.Chand and Co, 2008
2. Atomic Physics, J. B. Rajam, 20th Edition, S. Chand and Co, 2008.
3. Atomic and Nuclear Physics, N. Subrahmanyam, Brij Lal, JivanSeshanS. Chand and Co. Ltd.,New Delhi – 110055.

SUPPLEMENTARY READING:

1. A.K.Saxena, Principales of Modern Physics, Narosa Publishing House, 2010
2. B. L. Theraja, Modern Physics, 16th Revised Edition, S.Chand, 2008.
3. S.N. Ghoshal. Atomic Physics [Modern Physics], S. Chand & Company Ltd. Ram Nagar, New Delhi.
4. K. Gopala Krishnan, Atomic and Nuclear Physics, Macmillan Ltd, India.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Explain the concept of discharge of electricity through the gases.
CO2: Describe the various atomic model and fine structure of spherical lines.
CO3: Understand the photoelectric effect and its important applications.
CO4: Understand the central concepts of X-ray production, properties and theory.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
CO2	✓	✓					✓				✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - V	19IPHYC52 - LASERS AND FIBRE OPTICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

This paper aims to provide in depth knowledge about

- Laser Principle.
- Types of Lasers and its applications.
- Fibre optics and its communications.

UNIT– I: BASIC THEORY

Introduction to Laser – Basic principle of Laser - Absorption, Spontaneous emission and stimulated emission - Relation between Einstein's A and B coefficients - Population inversion - Pumping – Types of pumping – Main components of laser.

UNIT– II: LASER BEAM CHARACTERISTICS

Introduction – Directionality – Divergence - Intensity – Coherence – Temporal coherence – Spatial coherence - Monochromaticity – Polarization – Speckles – Active medium and active centre – Metastable state.

UNIT –III: TYPES OF LASERS

Solid State Lasers: Ruby Lasers - Nd : YAG laser – Gas lasers: Helium – Neon laser – CO_2 laser – Semiconductor lasers – Hetero junction laser - Liquid Dye laser – Excimer laser.

UNIT– IV: APPLICATIONS OF LASERS

Laser in material processing – Laser in electronic industry – Laser in nuclear energy – Medicine and surgery – Applications in dentistry – Laser angioplasty – Endoscopy - LIDAR - Holography – Optical communication using laser.

UNIT– V: FIBRE OPTICS

Basic characteristics of optical fibre – Acceptance angle – Numerical aperture – Propagation of light through optical fibre – Classification of fibres – Step index and graded index fibres – Single mode and multi mode fibres – Losses in fibres – Design consideration of a fibre optic communication system.

TEXT BOOKS:

1. M.N. Avadhanulu and P.S. Hemne, An introduction to Lasers theory and applications, S. Chand and Co. Ltd., 2011.
2. K. Thyagarajan and Ajoy Ghatak, Laser theory and applications, Cambridge University Press, 1999.

SUPPLEMENTARY READING:

1. Laser fundamentals, W.T.Silfvast, Cambridge University Press, 2008.
2. Optical Fiber Communications by John M. Senior, Cambridge University Press, 1996.
3. Fiber-Optic Communication Systems, Govind P. Agarwal, John-Willey & Sons.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand the basic principles of laser.
CO2: How to construct various types of lasers and its functions.
CO3: Applications of fiber optic communication.
CO4: Acquire in depth knowledge related to the applications of laser.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓		✓	✓			✓		✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓

SEMESTER - V	19IPHYC53 - ANALOG ELECTRONICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To impart knowledge about the linear circuit analysis.

- To provide the basic ideas of semiconductor devices.
- To enable the students to know about the basic ideas of analog operations for various analog circuit problems.

UNIT-I: LINEAR CIRCUIT ANALYSIS

Constant voltage source-constant current source- Maximum power transfer theorem - Thevanin's theorem - Norton's theorem – two port network and h-parameters.

UNIT-II: SEMICONDUCTOR DIODES

Characteristics and applications of PN Junction diode - Zener diode - Gunn diode - Tunnel diode - photo diode LED - schottkey diode - Impatt diode. Diode voltage doubler and multipliers - filters - regulated power supply.

UNIT-III: AMPLIFIERS

Introduction to transistors: PNP, NPN - V-I characteristics (CE,CB and CC configuration). RC coupled amplifier - classification of amplifiers -Class A and Class B amplifiers - Push pull amplifier – Emitter follower.

UNIT-IV: OPERATIONAL AMPLIFIER AND OSCILLATORS

Operational Amplifier- characteristics-parameters-applications- Inverting amplifier - Non inverting amplifier - Voltage follower- Adder - Subtractor - Integrator – Differentiator- Low pass, High pass, Band pass filters and Band reject filter.

UNIT-V: OSCILLATORS AND WAVE SHAPING CIRCUITS

Feedback principle and Barkhaussen criterion - Hartley, Colpitt's, and Phase shift oscillators using transistors – Astable - Monostable and Bistable multi vibrators using transistors - Schmitt trigger.

TEXT BOOKS:

1 Jacob Millman and Grabel,Microelectronics, McGraw Hill, 2nd Edn. 1987.
2 Jacob Millman and Halkias, Integrated Electronics, McGraw Hill, 1972.
3 Bapat, Electronic Circuits, Linear and Digital, Tata McGraw Hill, 1991.
4 R.P.Jain, Modern Digital Electronics, Tata McGraw Hill, 1991.

SUPPLEMENTARY READING:

1. S.M.Sze, Physics of Semiconductor Devices, Wiley Interscience, 1969.
2. Satnam P.Mathur, Electronic Devices - Applications and Integrated Circuits, John Wiley and Sons, 1986.
3. Millman and Halkias, Integrated Electronics, Tata McGraw Hill Publications, 1972.
4. Bhotkar, Integrated Circuits, Khanna Publishers, 2010.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Be familiar with the basic concepts of construction and working of electronic devices.

CO2: Acquire an in-depth knowledge about the linear circuit analysis.
CO3: Understand the basic ideas of semiconductor devices.
CO4: Enable the students to know the basic ideas of analog operations for various analog circuit problems.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓		✓	✓			✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - V	19IPHYC54 - ENERGY PHYSICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To create an awareness among the students regarding the forms of energy and the availability of their resources
- To educate regarding the utilization and conservation of energy
- To impart a knowledge about the Sustainable forms of energy

UNIT– I: CONVENTIONAL ENERGY SOURCES

Energy sources and their availability – Various forms of energy – Renewable and conventional energy systems – Comparison – Coal, oil and natural gas.

UNIT – II: SOLAR ENERGY

Solar Energy - Thermal application and solar radiation – Energy alternatives – Devices for thermal collection and storage – Thermal applications – Water heating – Space heating – Power generation – Instruments for measuring solar radiation and sun shine.

UNIT – III: THERMAL ENERGY STORAGE

General characteristics - Definitions - Methods of classifications - Thermal energy storage - Sensible heat storage - Liquids - Solids – Latent heat storage - Thermal chemical storage.

UNIT – IV: PHOTO CONVERSION

Photovoltaic conversion - Principle and working of solar cells - Conversion efficiency - Single crystal and Polycrystalline silicon - Cadmium sulphide - Cadmium telluride.

UNIT – V: SUSTAINABLE FORMS OF ENERGY

Reserves of Energy Resources – Environmental aspects of energy extraction, conversion and utilization – challenges associated with the non-sustainable energy sources with regard to future Supply and the environment

Hydrogen: principle of operation and system components-comparisons among energy uses, resources, and technologies-technical and economic challenges in the integration of sustainable energy form-potential solutions and application.

TEXT BOOKS:

1. P. Sukhatme, Solar energy, Tata McGraw-Hill, (Second edition), 2008.
2. D.P. Kothari, K.C. Singal and Rakesh Ranjan, Renewable energy sources and emerging Technologies, Prentice Hall of India, 2008.
3. S.A. Abbasi and Nasema Abbasi, Renewable Energy sources and their Environmental Impact, PHI Learning Pvt. Ltd., 2008.
4. M.P.Agarwal, Solar Energy, S.Chand & Co, 1983.
5. S.P.Sukhatme, Solar Energy,TMH, 1996.
6. G.D.Rai, Non-conventional Energy Sources, Khauna Publication, 2004.

SUPPLEMENTARY READING:

1. John Twidell & Tony Weir, Renewable Energy Resources - Taylor & Francis Group, 2006.
2. Kreith and Kreider, Principles of Solar Engineering, McGraw Hill Pub, 1978.
3. A.B.Meinel and A.P.Meinal, Applied Solar Energy - 1976.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Be aware of various forms of energy and the effective utilization of their resources.
CO2: Be exposed to the practical usage of solar energy.
CO3: Be exposed to the practical usage of thermal energy.
CO4: Acquire an in-depth knowledge about the sustainable forms of energy.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - V	19IPHYC55 - SOLID STATE PHYSICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- This paper provides the elementary ideas about the crystalline solids and their physical properties.
- To understand the basic concept of superconductors and their applications.
- To know the basic facts of bond formation, ionic distribution and magnetic behavioural characters of solids.

UNIT–I: **BONDING IN SOLIDS**

Types of bonds in crystals - Ionic, covalent, Metallic, Vander waal's and Hydrogen Bonding - Bond energy of sodium chloride molecule - variation of inter atomic force with inter atomic spacing -cohesive energy - cohesive energy of ionic solids - application to sodium chloride crystal - evaluation of Madelung constant for sodium chloride.

UNIT– II: CRYSTAL STRUCTURE AND CRYSTAL DIFFRACTION

Lattice planes and Miller Indices – Separation between lattice planes in simple FCC and BCC cubic lattice – Atomic Packing – Atomic radius – Lattice constant and density - Crystal Diffraction – Bragg's law – Reciprocal lattice – Properties – Diffraction of X-rays by a crystal – crystal structure - Simple cubic, Face centered cubic, Body centered cubic and Hexagonal close packed structure -Sodium Chrloride, Zinc Blende and Diamond Structures.

UNIT – III: MAGNETIC PROPERTIES

Spontaneous Magnetization – Weiss Theory – Temperature dependence of Magnetization - classical Theory of Diamagnetism – Weiss theory of Para magnetism – Ferromagnetic domains – Bloch wall – Basic ideas of anti-ferromagnetism – Ferrimagnetisms – Ferrites in computer Memories.

UNIT – IV: DIELECTRIC PROPERTIES

Band theory of solids –classification of insulators, Semiconductors, conductors – intrinsic and extrinsic semiconductor – Carrier concentration for electron - Barrier Potential Calculation – Rectifier Equation.

Dielectrics - Polarization – frequency and temperature effects on polarization-dielectric loss-Clausius Mosotti relation-determination of dielectric constants.

UNIT–V: **SUPER CONDUCTIVITY**

Introduction - General Properties of Superconductors - effect of magnetic field -Meissner effect - effect of current - thermal properties - entropy - specific heat -energy gap - isotope effect - London equations - AC & DC Josephson effects - applications - Type–I and Type–II Superconductors - Explanation for the Occurrence of Super Conductivity - BCS theory - Application of Superconductors - High T_C superconductors.

TEXT BOOKS:

1. B. S. Saxena, R. C. Gupta and P. N. Saxena. Solid State Physics, PragathiPrakashan,1970
2. S.L.Gupta, V. Kumar, Solid State Physics, Kedar Nath and Ram Nath Co, Ltd, 5th Edition, 1970.
3. C. Kittel, Introduction to Solid State Physics, 4th Edition, Wiley Eastern Ltd.1971.

SUPPLEMENTARY READING:

1. S.O. Pillai, Solid State Physics, 3rd Edition, New Age Internationals, 2006.
2. M. M. Woolfson, X-Ray Crystallography, Cambridge University Press, 1970.
3. Adrianus. J, Dekker, Solid State Physic, Macmillan India Limited, 1986.
4. L. Singhal, Solid State Physics, RKedar Nath and Ram Nath Co, Ltd, 2000.
5. C.M. Kachhava, Solid State Physics, Tata McGraw Hill, 1992.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Explore the relationships between chemical bonding and crystal structure.

CO2: Get the concrete idea about the superconductivity, high temperature superconductors and applications.

CO3: Inculcate the core concept of bond formation, ionic transition and variation of magnetic behaviour of elements by the ionic contribution.

CO4: Discuss logically the region for variation of dielectric behaviours of the elements.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓						✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

SEMESTER - V	**19IPHYP56 - PRACTICAL –IV**	**Credit : 4** **Hours: 9**

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To providing a hands-on learning experience such as in measuring the basic concepts in Electronic circuits.

(Any **Twelve** experiments)

1. V-I characteristics of junction diode.
2. Characteristics of Transistor CB and CE Configuration.
3. Characteristics of UJT.
4. R-C Coupled amplifier- Single stage.
5. Characteristics of FET.
6. Hartley oscillator- BJT.
7. Colpitt's oscillator - BJT.
8. Logic gates – Discrete components.
9. Half wave and full wave rectifier.
10. Bridge rectifier.
11. Regulated power supply - Zener diode.
12. V-I Characteristics of Zener diode.
13. Op- Amp - Mathematical operations.
14. Basic logic gates using transistors.
15. NAND and NOR as universal building blocks.
16. Adder and Subtractor.

COURSE OUTCOMES (COS):

By the end of the course, the students will be able to

CO1: Basic laws and theories involving diodes, transistors, etc.,
CO2: Understand the given concepts and its physical significance

CO3: Apply the theory to design the basic electrical circuits
CO4: Use of these basic circuits to create amplifier circuits, oscillator, regulated power supplies etc.,

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - VI	19IPHYC61 - NUMERICAL METHODS OF ANALYSIS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To be familiar with numerical solution of equations.
- To get exposed to finite difference and interpolation.
- To be familiar with the numerical differentiation and integration.
- To find numerical solution of ordinary and partial differential equations.

UNIT– I: ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

Solutions of algebraic and transcendental equations – Bisection method – Regula falsi method – Newton Raphson method – Gauss elimination – Gauss-Jordan – Gauss-Seidel methods of iteration.

UNIT– II: INTERPOLATION

Gregory-Newton Forward and Backward interpolation formula – Theory and problems Central difference interpolation formula – Stirlings and Bessel's formula – Theory and problems – Relative accuracy of the interpolation formula – Lagrange's interpolation formula for unequal intervals.

UNIT– III: NUMERICAL DIFFERENTIATION AND INTEGRATION

Newton's forward difference formula – Newton's backward difference formula – Newton's divided difference formula – Theories and problems - Numerical Integration – Trapezoidal rule – Romberg's method – Simpson's one third rule – Theory and Problems.

UNIT– IV: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Ordinary differential equations – Taylor series method – Merits and Demerits – Theory and Problems – Euler's method, Improved Euler's method, Modified Euler's method - Runge – Kutta methods - Second and fourth order.

UNIT– V: CURVE FITTING

Empirical laws and Curve fitting – The principle of least squares – Fitting a straight line – Parabola and power curve - Normal equations - Errors and their types – Propagation of errors – Approximations and residuals.

TEXT BOOKS:

1. B.S. Grewal,Numerical methods in Engineering and Science, Khanna Publishers,42nd Edition, 2012.
2. Dr. M.K.Venkataraman, Numerical methods in science and Engineering, National Publishing co., 2005.
3. Conte,S.D. and De Boor,C."Elementary Numerical Analysis", Mc Graw Hill Publisher.

SUPPLEMENTARY READING:

1. S.S.Sastry, Introductory Methods of Numerical Analysis, 4th edition, 2005.
2. E.Balagurusamy, Computer oriented statistical and numerical methods- Tata McGraw Hill,2000.
3. M.K.Jain, SRK Iyengar and R.L.Jain, Numerical methods for scientific and Engineering computation, Wiley Eastern Ltd, 4th edition, 2003.
4. M.K.Jain, Numerical solution of Differential Equations, (Reprint), 2nd edition 2002
5. P.Kandasamy et al., Numerical methods, S.Chand & Co., New Delhi, 2003.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Appreciate the numerical techniques of interpolation in various intervals.
CO2: Apply the numerical techniques of differentiation and integration for engineering problems.
CO3: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO4: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓				✓				✓		✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓				✓						✓	
CO3	✓	✓	✓	✓	✓	✓	✓				✓	✓				✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓				✓	✓			✓	✓	✓	✓

SEMESTER - VI	19IPHYC62 - DIGITAL ELECTRONICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To provide the students a sound understanding of Number system, coding, and Boolean algebra for designing the digital circuits.
- To make the students understand the characteristics of basic logic gates, flip flops, Registers and counters. To give exposure in understanding digital instruments with the help of logic gates.
- To highlights the concept of digital electronics and functioning of various digital devices.

UNIT– I: BINARY SYSTEMS AND BOOLEAN ALGEBRA

Binary numbers - Number base conversions - Octal and Hexa decimal numbers - Complements -1's and 2's complement addition and subtraction –Binary codes - BCD code - Excess-3 code - Gray codes - Binary logic - Boolean algebra - Basic definitions and properties of Boolean algebra-Demorgan's theorem-proof.

UNIT–II: DIGITAL LOGIC GATES AND BOOLEAN FUNCTIONS

Digital logic gates - IC digital logic families - Boolean functions - SOP - POS - Minterms and Maxterms.- Karnaugh Map method - Two and Three variable maps - Four variable map - Product of sums simplification –sum of product simplification-Don't care conditions.

UNIT –III: **COMBINATIONAL LOGIC**

Introduction - Design procedure - Half and Full adders - Half and Full Subtractors - Code conversion, BCD-to-Excess-3 code - Universal gates - Ex-OR gate - BCD adder - Magnitude comparator - Decoders - Demultiplexers - Encoders – Multiplexers.

UNIT– IV: FLIP FLOPS AND REGISTERS

Flip flops - Basic flip flop circuit - Clocked RS flip flop - D flip flop –race around condition - JK flip flop – T-Flip flop - Timing diagram - Master slave flip flops - Registers - Shift registers - Serial transfer - Serial addition.

UNIT– V: COUNTERS

Design of counters - Ripple counters - Binary ripple counter – design of modulo N counter - BCD Ripple counter - Synchronous counters - Binary up-down counter.

TEXT BOOKS:

1. Albert Paul Malvino, Digital Computer Electronics, Tata- McGraw Hill, 1983.
2. Tokhein, Digital Electronics, Schaum Series, 1994.
3. R.P.Jain, Modern Digital Electronics, Tata McGraw Hill, 2006.
4. Gothmann, Digital integrated Electronics, McGraw Hill, 2008.
5. Solid state electronic devices By Ben G. Streetman & Sanjay Banerjee, Pearson Prentice Hall, 2006.
6. Basic Electronics & Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha & SC Gupta, Tata McGrawHill, 2006.
7. Semiconductor Physics and Devices by Donald A. Neamen (Tata McGraw-Hill), 2004.

SUPPLEMENTARY READING:

1. Electronic Devices (Conventional Current Version), by T. L. Floyd, Pearson, 10th Edition, (2017).
2. Electronics Fundamentals: Circuits, Devices and Applications, by Thomas L. Floyd, David M. Buchla, Prentice Hall, 8th Edition, (2009).
3. Electronic Principles, by A. P. Malvino, D. J. Bates, McGraw-Hill, 8th Edition, (2015).
4. Electronic Devices and Circuit Theory, by R. L. Boylestad, L. Nashelsky, Pearson, 11th edition, (2012).
5. Digital Fundamentals, by T. L. Floyd, Pearson, 11th Edition, (2014).

COURSE OUTCOMES (COs):

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

CO1: Construct simple electronics circuit using logic gates.
CO2: Understand the concepts of number systems and conversion and logical reasons based on Boolean theorems.
CO3: Understand the working of various flip flops, registers and counters.
CO4: Apply the principles of electronics in day to life

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓		✓	✓			✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - VI	19IPHYC63 - NUCLEAR PHYSICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To grasp knowledge and understanding on the general properties of Nucleus, Nuclear force and Nuclear models.
- To study the phenomena of radioactivity, nuclear fission and fusion reactions.
- To impart the basic knowledge about various detectors and cosmic rays.

UNIT– I: PROPERTIES AND STRUCTURE OF NUCLEI

General properties of nucleus**-** binding energy – BE/A curve - significance -proton electron theory- proton neutron theory -Nuclear forces –characteristics –Meson theory of nuclear forces – Yukava Potential- Nuclear models

UNIT– II: RADIO ACTIVITY

Fundamental laws of radio activity –theory of α ,β and ϒ decay- properties of alpha, beta and gamma rays - neutrino and its properties-electron capture. - nuclear isomers- Mossabauer effect - applications- Radio carbon dating- radio isotopes – uses.

UNIT– III: NUCLEAR REACTIONS

Kinematics of nuclear reaction-Nuclear fission –Nuclear fusion – Nuclear reactor-uses - atom bomb - hydrogen bomb-fusion reactor –plasma confinement –artificial transmutation-Q value of nuclear reaction-types of nuclear reaction.

UNIT– IV: NUCLEAR DETECTORS AND PARTICLE ACCELERATORS

Neutron sources and properties- Detectors-G.M.Counter-scintillation counter-bubble chamber-Wilson cloud chamber-Accelerators-Cyclotron-synchrocyclotron-Betatron-Synchrotrons.

UNIT– V: **COSMIC RAYS AND ELEMENTARY PARTICLES**

Cosmic rays-introduction-discovery-lattitude,altitude and azimuth effects-longitudinal effect-north –south effect-seasonal and diurnal changes-primary and secondary cosmic rays-nature of cosmic rays- cosmic ray showers-Van Allen belt- origin of cosmic radiation.

Elementary particles-introduction-particles and antiparticles-antimatter-the fundamental interaction-elementary particle quantum numbers-conservation laws and symmetry-the quark model.

TEXT BOOKS FOR STUDY:

1. Elements of Nuclear Physics , M.L. Pandaya and P.R.S. Yadav, Kedar Nath Ram Nath Publications, Meerut, 2016.
2. Nuclear Physics, D.C. Tayal, Himalaya Publishing House Pvt.Ltd. (V^{th}) Edition 2018.
3. Basic Nuclear Physics and Cosmic Rays, B.N Srivastava, Pragati Prakashan Publications, Meerut, Edition: XVII, 2016.
4. Modern Physics, R. Murugesan, S.Chand and Co, 2005.
5. Atomic Physics, J.B. Rajam, S.Chand and Co, 2005.
6. Nuclear Physics, K. Ilangovan, MJP Publication, Chennai, 2012.

SUPPLEMENTARY READING:

1. P.R. Roy and B.P. Nigam, Nuclear Physics, Wiley, Eastern Ltd, 1993.
2. S.N Ghoshal, Nuclear Physics, S.Chand and Co, II^{nd} Edition, 1994.
3. S. Yatramohan Jana, An Introduction to Nuclear Physic Narosa Publishing House, 2015.
4. V.K. Mittal, R.C. Verma and S.C. Gupta, Introduction to Nuclear and Particle Physics, PHI Learning Ltd, Edition IV, 2011.

COURSE OUTCOMES (COs):

By the end of the course, students will be able to

CO1: Acquire knowledge of the fundamental physics underspinning nuclear physics.
CO2: Understand the nuclear structure and radioactivity and its applications.
CO3: Understand the fission and fusion reactors and how these are used for production of the energy as well as weapons.
CO4: Understand the fundamental concepts of cosmic rays and elementary particles.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	
CO2	✓	✓	✓	✓	✓						✓	✓		✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	

SEMESTER - VI	19IPHYC64 - RELATIVITY AND QUANTUM MECHANICS	Credit : 4 Hours : 4

LEARNING OBJECTIVES:

- To understand relativity and its consequences
- To classify the velocities associated with wave packets
- To formulate the Schrodinger's equation for the given problem
- To solve the simple quantum mechanical problems

UNIT– I: RELATIVITY

Frames of reference - Galilean transformation - Michelson - Morley experiment -Postulates of special theory of relativity - Lorentz transformation - length Contraction – time dilation - Relativity of simultaneity - addition of velocities - variation of mass with velocity– Mass energy relation - Elementary ideas of general relativity.

UNIT– II: WAVE NATURE OF MATTER

Phase and group velocity - wave packet - expression of De Brogile's wave length - Davisson and Germer's experiment - G.P.Thompson's experiment - Heisenberg's uncertainty principle and its consequences.

UNIT– III: SCHRODINGER EQUATION

Inadequacy of classical mechanics - Basic postulates of quantum mechanics -Schrodinger equation - Properties of wave function - Probability interpretation of wavefunction - linear operators - self adjoint operators - expectation value - eigenvalues andeigenfunctions - commutativity and compatibility.

UNIT– IV: ANGULAR MOMENTUM IN QUANTUM MECHANICS

Orbital angular momentum operators and their commutation relations - separation ofthree dimensional Schrodinger equation into radial and angular parts - Elementary ideas ofspin angular momentum of an electron - Pauli matrices.

UNIT– V: SOLUTIONS OF SCHRODINGER EQUATION

Free particle solution - Particle in a box - Potential well of finite depth (one dimension) - linear harmonic oscillator - rigid rotator and hydrogen atom.

TEXT BOOKS:

1. R. Murugeshan, Kiruthiga Sivaprasath, Modern Physics, S. Chand and Co., 2008.
2. A.K. Saxena, Principles of Modern Physics, Narosa Publishing House, 2010.
3. V. Devanathan, Quantum Mechanics, Wiley Eastern, 2005
4. V.K Thankappan, Quantum Mechanics, New Age International (P) Ltd., 2nd edition, 1999.
5. G.Aruldas, Quantum Mechanics, Prentice Hall of India Pvt. Ltd.,2002.

SUPPLEMENTARY READING:

1. Claude Cohen-Tannoudji, Bernard Diu, Franck Laloë , Quantum Mechanics (Vol .I) – John Wiley Interscience Publications, First Edition, 1991.
2. Pauling & Wilson, Quantum Mechanics - Dover Publications, New Edition, 1985.
3. R. Shankar, Principle of Quantum Mechanics - Plenum US Publication, Second Edition, 1994.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand relativity and its consequences.

CO2: Classify the velocities associated with wave packets.

CO3: Formulate Schrodinger's equation for the given problem.
CO4: Solve simple quantum mechanical problems.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓							✓	✓	✓		✓		✓	✓
CO2	✓	✓		✓							✓	✓	✓		✓		✓	
CO3	✓	✓		✓	✓		✓				✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓		✓				✓	✓	✓		✓	✓	✓	

SEMESTER - VI	19IPHYC65 – ASTROPHYSICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To understand the basics of Astrophysics with respect to our universe.
- To facilitate the students to understand about the sun and stars.
- To provide knowledge about the stellar structure and origin of universe.

UNIT –I: UNIVERSE

Planets – interior planets – exterior planets - crust, mantle and core of the earth - different region of earth's atmosphere – rotation of the earth – Magnetosphere -Van Allen belts – Aurora.

UNIT – II: SUN

Structure of photosphere, chromospheres, corona - sunspots - solar flares - solar prominences - solar piages - satellites of planets – structure, phases and their features of moon.

UNIT-III: STARS

Constellations - Binary stars – their origin and types - star clusters - Globular clusters - types of variable stars - types of galaxies, Milky way galaxy – origin & morphology - evolution of Galaxy - quasars.

UNIT-IV: STELLAR STRUCTURE

Equations of stellar structure – Solution to Equations of Stellar Structure, Toy Stellar Models: Homologous Stellar Models, the Radiative Stellar Envelope, Fully Convective Stars with H - Opacity, Observational Aspects of Stellar Atmospheres, Continuum Radiation, Lines.

UNIT-V: ORIGIN OF UNIVERSE

Big bang theory – pulsating theory - steady state theory - composition of universe expansion.

TEXT BOOKS FOR STUDY:

1. K.D.Abyankar, Astrophysics of the solar system. University Press India. (2012).
2. Baidyanath Basu, An Introduction to Astrophysics, Prentice Hall of India, New Delhi. (2010).
3. S.Chandrasekar, An introduction to the study of stellar structure. Dover Publication (1967).

SUPPLEMENTARY READING:

1. P.Devadas, The Fascinating Astronomy, Devadas Telescopies, Chennai (2010).
2. Frank Shu, The Physical Universe. University of California (1982).
3. K.D.Abhyankar, Astrophysics (Stars and Galaxies), Tata McGraw Hill. (1992).

COURSE OUTCOMES (COs):

By the end of the course, students will able to:

CO1: Understand the basics of Astrophysics with respect to our universe.
CO2: Understand the Universe and its constituents.
CO3 : Explain about the structure of sun and types of stars.
CO4 : Describe about the stellar structure and the origin of universe.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - VI	19IPHYP66 - PRACTICAL – V	Credit : 5 Hours: 9

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To providing a hands-on learning experience such as in measuring the basic concepts in Electronic circuits.

(Any **Twelve** experiments)

1. RC coupled amplifier – Two stage - BJT.
2. Feedback amplifier – BJT.
3. Mathematical operations –II. IC 741.
4. Solving Simultaneous equations using IC 741.
5. BCD-counter –Decode Seven Segment Display.
6. Schmitt Trigger.
7. Multivibrator - Astable, Monostable - IC 555.
8. Multivibrator - Astable - IC 741.
9. Multivibrator - Monostable – IC 555.
10. D/A Converter (Two methods).
11. Arithmetic Logic Unit - IC 74181.
12. Study of Flip-flops.
13. Synchronous and Asynchronous counter - IC 7473.
14. Multiplexers and Demultiplexers.
15. Shift Registers - IC 7474.
16. Ring counter and Ripple counter – IC 7474.

COURSE OUTCOMES (COS):

CO1: Basic laws and theories involving amplifiers, integrated circuits, converters and flip flops etc.,
CO2: Understand the given concepts and its physical significance

CO3: Apply the theory to design the basic electrical circuits

CO4: Use of these basic circuits to create amplifier, integrated circuits, convereters and flip flops etc.,

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - VII	19IPHYC71 - CLASSICAL AND STATISTICAL MECHANICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To develop familiarity with the physical concepts and facility with the mathematical methods of classical mechanics
- The main goal of this course is to acquire fundamental knowledge of classical and quantum statistical mechanics.
- Construct a bridge between macroscopic thermodynamics and microscopic statistical mechanics by using mathematical methods and fundamental physics for individual particles.

UNIT-I: MECHANICS OF A PARTICLE AND SYSTEM OF PARTICLES

Mechanics of a Particle and System of particles – Constraints – Degrees of freedom – Generalized coordinates and its advantages – Hamilton's variational principle – Lagrange's equation of motion – D'Alembert's principle – Applications of Lagrange's equation of motion – Linear harmonic oscillator and simple pendulum. Cyclic co-ordinates – Equivalence of Lagrange's and Newton's equations – Principle of least action.

UNIT-II: CANONICAL TRANSFORMATIONS

Canonical transformation and Conditions for transformation to be canonical with examples – Hamilton-Jacobi method. Hamilton's principal function – Solution of harmonic oscillator problem by Hamilton-Jacobi method – Poisson brackets, Properties and Invariance of Poisson brackets, Equation of motion in Poisson bracket – Small oscillations – Normal modes and Normal Coordinates – Free vibrations of a linear triatomic molecule.

UNIT-III: MAXWELL – BOLTZMANN STATISTICS

Postulates of kinetic theory of gases – Maxwell-Boltzmann distribution of velocities – Derivation of Maxwell – Boltzmann distribution equation – Significance of Maxwell-Boltzmann equation – Phase Space – Ensembles and their types – Liouville's theorem – Statement and Proof.

UNIT-IV: EQUIPARTITION OF ENERGY AND PARTITION FUNCTION

Principle of equipartition of energy – Partition function and their properties – Connection between the partition function and thermodynamic quantities – Mean values obtained from

distribution law – Gibb's paradox – Explanation and proof for occurrence of paradox – Sackur – Tetrode equation and its significance.

UNIT-V: QUANTUM STATISTICS

Differentiation of B-E and F-D particles – Derivations of B-E and F-D distributions – Comparison of M-B,B-E and F-D statistics – Black body radiation and the Planck radiation law – Derivation with explanation – Ideal Bose gas – Gas degeneracy – Derivation - Bose Einstein Condensation – Derivation with explanation (Example: Liquid Helium)

TEXT BOOKS:

1. R.G. Takwale and P.S.Puranik,Introduction to classical mechanics, Tata Mc Graw Hill, New Delhi,1979.
2. B.D.Gupta and Satya Prakash, Classical Mechanics, Keder Nath publisher, Meerut,2004.
3. H.Goldstein, Classical Mechanics, Addision Wesley Publishing Company, Masssachusetts, 1961.

SUPPLEMENTARY READING:

1. Kiran C.Guta, Classical mechanics of Rigid Bodies, New Age Publication,1997
2. R.K.Agarwal and Melvin Eisner Statistical Mechanics, , New Age publisher,2011
3. E.S.R Gopal, Statistical Mechanics and Properties of Matter, The McMillan Company of India Ltd.,1976.

COURSE OUTCOMES (COs):

By the end of the course, the students will able to

CO1: Formulate scientific questions about the mechanics of a particle and system of particles.

CO2: Use D'Alembert's principle to derive the Lagrange equations of motion.

CO3: Identify the differences of Bose -Einstein, Fermi-Dirac and Maxwell – Boltzmann statistics.

CO4: Describe the relationship between the statistical mechanics with thermodynamics.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓							✓	✓	✓	✓	✓		✓	
CO2	✓	✓		✓							✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓		✓				✓	✓	✓	✓	✓		✓	
CO4	✓	✓		✓	✓		✓				✓	✓	✓	✓	✓		✓	

SEMESTER - VII	19IPHYC72 - ELECTRONICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To gain in depth knowledge about semiconductor devices.
- To learn amplifiers, oscillators using transistors.
- To study the applications of operational amplifiers.
- To familiarise various classifications of Semiconductor Memories and
- To know the fabrication concepts of Integrated circuits.

UNIT - I: SEMICONDUCTOR DEVICES

UJT, JFET, MOSFET - Operation and static characteristics. SCR - Two transistor analogy, static characteristics, Half wave , full wave and bridge rectifier. DIAC, TRIAC - static characteristics.

UNIT - II: AMPLIFIERS AND OSCILLATORS

Transistor h - parameters - analysis of amplifiers using h - parameters. RC coupled amplifier- single stage - two stage - push pull amplifier - feedback principle and Barkhausen criterion - Hartley, Colpit's and Phase shift oscillators using transistors.

UNIT - III: OPERATIONAL AMPLIFIERS APPLICATIONS

Operational Amplifier - Characteristics - Instrumentation amplifier with its applications. Differential input and differential output amplifier- V to I and I to V converter. Op. amp. stages- Equivalent circuits - sample and Hold circuits. Solving simultaneous and differential equation. Applications of IC 741: monostable, bistable Multivibrators, Oscillators - wein bridge, voltage controlled oscillators, waveform generators - square wave, triangular wave, saw tooth wave.

UNIT - IV: SEMICONDUCTOR MEMORIES

Classification of memories: ROM - RAM. Sampling theorem. DAC-weighted resistor network, binary ladder network. ADC - successive approximation, dual slope, counter method, voltage to frequency conversion method. Programmable Logic Array. Charge Coupled Device memory.

UNIT - V: INTEGRATED CIRCUITS

Basic monolithic ICs - epitaxial growth - masking and etching - diffusion of impurities. Transistors for monolithic circuit, monolithic diodes, resistors, capacitors and Inductors. Monolithic circuit layout.

Logic families - RTL, TTL, CMOS, interfacing CMOS and TTL.

TEXT BOOKS:

1. Satnam P.Mathur, Electronic Devices - Applications and Integrated Circuits, John Wiley and Sons, 1986.
2. Jacob Millman and C.Halkias, Electronic Devices and Circuits, Jacob Millman and C.Halkias, Tata McGraw Hill Publications, 1991.
3. Bhotkar,Integrated Circuits, Khanna Publishers, 2010.
4. R.P.Jain, Modern Digital Electronics, Tata McGraw Hill, 1991.

SUPPLEMENTARY READING:

1. Jacob Millman and Grabel, Microelectronics, McGraw Hill, 2nd Edn., 1987.
2. Jacob Millman and Halkias, Integrated Electronics, McGraw Hill, 1972.
3. Bapat, Electronic Circuits, Linear and Digital, Tata McGraw Hill, 1991

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand the concept of various semiconductor devices by learning their characteristics.

CO2: Analyze the parameters of amplifiers, oscillators using transistors and familiarise with applications of operational amplifiers.

CO3: Understand the classifications of Semiconductor Memories.

CO4: Understand the concepts of Integrated circuits.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓			✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓			✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓			✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓											

SEMESTER - VII	19IPHYC73 - MATHEMATICAL PHYSICS – I	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To develop knowledge in mathematical physics and its applications.
- To develop expertise in mathematical techniques required in physics.
- To enhance problem solving skills.
- To enable students to formulate, interpret and draw inferences from mathematical solutions.

UNIT-I: VECTOR ANALYSIS AND VECTOR SPACES

Concept of gradient, divergence and curl - Gauss's divergence theorem, Green's theorem and Stoke's theorem (statement and proof) - Orthogonal curvilinear coordinates - Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates (Theory).

Linearly dependent and independent sets of vectors - Inner product (problems)- Schmidt's orthogonalization process.

UNIT-II: MATRICES

Types of Matrices and their properties, Rank of a Matrix, Eigenvalue Equations and their solutions, Theorems on Matrices; Diagonalisation and Diagonalisation of different matrices; Cayley-Hamilton's theorem; Problems.

UNIT–III: TENSOR ANALYSIS

Definition of Tensors – Contravariant, covariant and mixed tensors – addition and subtraction of Tensors – Summation convention- Symmetry and Anti-symmetry Tensor – Contraction and direct product – Quotient rule- Pseudo tensors, Levi-Civita Symbol - Dual tensors, irreducible tensors-Metric tensors-Christoffel symbols – Geodesics.

UNIT-IV: COMPLEX VARIABLE

Functions of complex variable-Analytic functions-Cauchy- Riemann equations- integration in the Complex plane-Cauchy's theorem- Cauchy's integral formula-Taylor and Laurent expansions- Singular Points- Cauchy's residue theorem - poles - evaluation of residues - evaluation of definite integrals.

UNIT-V: GROUP THEORY

Definition - Subgroups - Cyclic groups and abelian groups - Homomorphism and isomorphism of groups - Classes - Symmetry operations and symmetry elements - Representations of groups - Reducible and irreducible representations - Character tables for simple molecular types (C_{2v} and C_{3v} point group molecules).

TEXT BOOKS:

1. B.D. Gupta, Mathematical Physics, Vikas Publishing House Pvt. Ltd, 1995.
2. B.S.Rajput, Mathematical Physics, Pragati Prakashan, 20th Edition, 2008.
3. H.K. Dass and Rama Verma, Mathematical Physics, S.Chand and Company Ltd, 2010.
4. P.K. Chattopadhyay, Mathematical Physics, Wiley Eastern Limited, 1990.

SUPPLEMENTARY READING:

1. Charlie Harper, Introduction to Mathematical Physic, Prentice Hall of India Pvt. Ltd, 1993.
2. L.A. Pipes and L.R. Havevill, Applied Mathematics for Engineers and Physicists, McGraw Hill Publications Co., 3rd Edition, 1971.
3. Murray R. Spigel, Theory and Problems of Laplace Transforms, Schaum's outline series, McGraw Hill, 1986.
4. A.W. Joshi, Matrices and Tensors in Physics, Wiley Eastern Limited, 3rd Edition, 1995.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Develop knowledge in mathematical physics and its applications.
CO2: Understand the use of complex variables for solving definite integral.
CO3: Understand the applications of group theory in all the branches of Physics problems.
CO4: Enable students to formulate, interpret and draw inferences from mathematical solutions.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓		✓	✓					✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓								✓	✓	✓	✓				
CO3	✓	✓	✓								✓	✓	✓	✓				
CO4	✓	✓	✓		✓	✓					✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - VII	19IPHYP74- PRACTICAL – VI	Credit : 6 Hours: 9

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To providing a hands-on learning experience such as in measuring the basic concepts and applications of microprocessor.

(Any Sixteen Experiments)

1. Young's modulus of a specimen plate- by Newton's interference method.
2. Bi-prism on spectrometer- Wavelength (λ) and Refractive index (μ) of a liquid-using Laser source.
3. Charge of an electron- Spectrometer
4. Study of Hall effect in semiconductors.
5. Polarizability of Liquids- Hollow prism on spectrometer.
6. Hg-Cu spectrum- Hartmann's constants and wavelength.
7. Planck's constant.
8. Zeeman Effect.
9. Thermoluminescence
10. Krishnan Torsion Balance.
11. Microprocessor 8085 - Addition, Subtraction, Multiplication & Division
12. Microprocessor 8085 - Logical operation
13. Microprocessor 8085 - Solving expression, Factorial of N Numbers
14. Microprocessor 8085 - Code conversion
15. Microprocessor 8085 – Flashing and Rolling of Name display
16. Microprocessor 8085 – Stepper Motor
17. Microprocessor 8085 – ADC Interfacing
18. Microprocessor 8085 – DAC Interfacing
19. Microprocessor 8085 – Biggest and Smallest Numbers
20. Microprocessor 8085 – Ascending and Descending Order

COURSE OUTCOMES (COS):

CO1: Basic laws and theories involving amplifiers, integrated circuits, converters and flip flops etc.,
CO2: Understand the given concepts and its physical significance

CO3: Apply the theory to design the basic electronic circuits
CO4: Provide a hands-on learning experience and understand the basic concepts and applications of microprocessor.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓

SEMESTER - VIII	19IPHYC81- MATHEMATICAL PHYSICS – II	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To develop knowledge in mathematical physics and its applications.
- To develop expertise in mathematical techniques required in physics.
- To enhance problem solving skills.

- To enable students to formulate, interpret and draw inferences from mathematical solutions.

UNIT-I: DIFFERENTIAL EQUATIONS

Homogeneous linear equations of second order with constant coefficients and their solutions – ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods – extended power series method for indicial equations.

UNIT-II: SPECIAL FUNCTIONS - I

Gamma and Beta function- Legendre's differential equation: Legendre polynomials - Generating functions - Recurrence relation - Rodrigue's formula - Orthogonality; Bessel's differential equation: Bessel polynomials - Generating functions - Recurrence relation -Rodrigue's formula – Orthogonality.

UNIT-III: SPECIAL FUNCTIONS - II

Hermite differential equation – Generating functions – Hermite polynomials - Recurrence relations – Rodrigue's formula - Orthogonality: Laguerre differential equations – Generating functions - Laguerre polynomials - Recurrence relation - Rodrigue's formula – Orthogonality.

UNIT-IV: PARTIAL DIFFERENTIAL EQUATIONS

Solution of Laplace Differential Equation - Two dimensional flow of heat in cartesian and cylindrical co-ordinates. Solution of heat flow equation in one dimension - Solution of wave equation - Transvers e vibrations of a stretched string (Theory).

UNIT - V: INTEGRAL TRANSFORMS

Fourier transforms - cosine and sine transforms - Linearity theorem - Parseval's theorem - solution of differential equation. Laplace transforms - Definition - Linearity, shifting and change of scale properties. Inverse Laplace transforms – Definition - Problems - Solution of differential equation (problems using the above methods).

TEXT BOOKS:

1. B.D. Gupta, Mathematical Physics, Vikas Publishing, 1995.
2. B.S. Rajput, Mathematical Physics, Pragati Prakashan, 20th Edition, 2008.
3. H.K. Dass and Rama Verma, Mathematical Physics, Chand and Company Ltd, 2010.
4. P.K. Chattopadhyay, Mathematical physics, Wiley Eastern Limited, 1990.

SUPPLEMENTARY READING:

1. Charlie Harper, Introduction to Mathematical Physics, Prentice Hall of India Pvt. Ltd, 1993.
2. L.A. Pipes and L.R. Havevill, Applied Mathematics for Engineers and Physicists, 3rd Edition, McGraw Hill, 1971.
3. Murray R. Spigel Theory and problems of Laplace Transforms, International edition, McGraw Hill, 1986.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Develop knowledge in mathematical physics and its applications.
CO2: Develop expertise in mathematical techniques required in physics.

CO3: Use differential equations and special functions to solve mathematical problems of interest in Physics.

CO4: Enable students to formulate, interpret and draw inferences from mathematical solutions.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓		✓	✓					✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓								✓	✓	✓	✓				
CO3	✓	✓	✓								✓	✓	✓	✓				
CO4	✓	✓	✓		✓	✓					✓	✓	✓	✓	✓	✓	✓	✓

SEMESTER - VIII	19IPHYC82- CONDENSED MATTER PHYSICS - I	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- This course gives an insight into the basic elements of the physics of solid and in particular the study of the structure of crystalline solids and their physical properties.
- To develop a deep understanding of how condensed matter is characterized on the atomic scale.
- Understanding of Lattice vibrations, approximations, phonons and heat capacity to know the correlation between the structure and thermal properties of the materials.

UNIT-I: CRYSTAL PHYSICS: CRYSTAL STRUCTURE

Lattice representation - Simple symmetry operations - Bravais Lattices, Unit cell, Wigner - Seitz cell - Miller planes and spacing - Characteristics of cubic cells - Structural features of NaCl, CsCl, Diamond, ZnS – Close packing.

Crystal Binding*:* Interactions in inert gas crystals and cohesive energy – Lennard – Jones potential - Interactions in ionic crystals and Madelung energy - Covalent bonding – Heitler – London Theory – Hydrogen bonding – metallic bonding.

UNIT-II: DIFFRACTION OF WAVES AND PARTICLES BY CRYSTALS

X-rays and their generation - Moseley's law – Absorption of X-rays (Classical theory) – Absorption Edge – X-ray diffraction – The Laue equations – Equivalence of Bragg and Laue equations – Interpretation of Bragg equation – Ewald construction - Reciprocal lattice – Reciprocal lattice to SC, BCC and FCC crystals- Important properties of the Reciprocal lattice – Diffraction Intensity - The Powder method – Powder Diffractometer - The Laue method -The Rotating Crystal method - Neutron Diffraction - Electron diffraction.

UNIT-III: CRYSTAL IMPERFECTIONS AND ORDERED PHASES OF MATTER

Point imperfections – Concentrations of Vacancy, Frenkel and Schottky imperfections – Line Imperfections – Burgers Vector – Presence of dislocation – surface imperfections- Polorans – Excitons.

Ordered phases of matter: Translational and orientation order - Kinds of liquid crystalline order - Quasi crystals - Superfluidity.

UNIT-IV: LATTICE DYNAMICS

Theory of elastic vibrations in mono and diatomic lattices - Phonons – Dispersion relations - Phonon momentum.

Heat Capacity

Specific heat capacity of solids – Dulong and Petit's law - Vibrational modes - Einstein model - Density of modes in one and three dimensions - Debye Model of heat capacity.

Anharmonic Effects

Explanation for Thermal expansion, Conductivity and resistivity – Umklapp process.

UNIT-V: THEORY OF ELECTRONS

Energy levels and Fermi-Darac distribution for a free electron gas – Periodic boundary condition and free electron gas in three dimensions – Heat capacity of the electron gas – Ohm's law, Matthiessen's rule – Hall effect and magnetoresistance – Wiedemann – Franz law.

Nearly free electron model and the origin and magnitude of energy gap – Bloch functions - Bloch theorem - Motion of an electron in a periodic potential – Kronig – Penney model - Approximate solution near a zone boundary –Metals, semiconductors and insulators – effective mass – Limitations of K-P model – Tight binding approach - Construction of Fermisurfaces: Reduced and periodic zone schemes of construction- de Haas – van Alphen effect.

TEXT BOOKS:

1. Charles Kittle, Introduction to solid state physics, Wiley India Pvt. Ltd., New Delhi, 7th Edition, 2004.
2. M.A. Wahab, Solid State Physics, Structure and Properties of the Materials. Narosa, New Delhi, 1999.
3. S.O. Pillai, Problems and Solutions in Solid State Physics, New Age International Publishers, New Delhi, 1994.

SUPPLEMENTARY READING:

1. Rita John, Solid State Physics, Tata Mc Graw Hill Publications, 2014.
2. J.D. Patterson, B.C. Bailey, Solid -State Physics: Introduction to the Theory, Springer Publication, 2007.
3. M.Ali Omar, Elementary Solid -State Physics – Principle and Applications, Persion, 1999.
4. N.W. Aschroft and N.D., Mermin, Solid -State Physics, Rhinehart and Winton, New York. 1976.
5. A.J. Dekker, Electrical Engineering Materials, Prentice Hall of India, 1975.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Describe different types of crystal structures.
CO2: Understand the types of lattice vibrations and heat conduction.
CO3: Describe and understand the various imperfections in crystal.
CO4: Understand the band-structure of the solid.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓						✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

SEMESTER - VIII	19IPHYC83 - ELECTROMAGNETIC THEORY	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To understand the nature of electric and magnetic fields and the intricate connection between them.
- To develop a strong background in electromagnetic theory, understand and use various mathematical tools to solve Maxwell equations in problems of wave propagation and radiation.
- To develop skills on solving analytical problems in electromagnetism.

UNIT - I: ELECTROSTATICS

Coulomb's law; the electric field – line, flux and Gauss's Law in differential form - the electrostatic potential; conductors and insulators; Gauss's law - application of Gauss's law – curl of E - Poisson's equation; Laplace's equation – work and energy in electrostatics – energy of a point charge distribution – energy of continuous charge distribution – induced charges – capacitors.Potentials: Laplace equation in one dimension and two dimensions – Dielectrics – induced dipoles – Gauss's Law in the presence of dielectrics.

UNIT- II: MAGNETOSTATICS

Lorentz force – magnetic fields – magnetic forces – currents – Biot-Savart Law – divergence and curl of B – Ampere's Law – Electromagnetic induction - comparison of magnetostatics and electrostatics – Magnetic vector potential.Magnetization: effect of magnetic field on atomic orbit – Ampere's Law in magnetized materials – ferromagnetism.

UNIT - III: ELECTROMOTIVE FORCE

Ohm's Law – electromotive force – motional emf – Faraday's Law – induced electric field – inductance – energy in magnetic field – Maxwell's equation in free space and linear isotrophic media – continuity equation – Poynting theorem.

Electromagnetic waves in vacuum: Waves in one dimension – wave equation – sinusoidal waves – reflection and transmission – Polarization.

UNIT - IV: ELECTROMAGNETIC WAVES

The wave equation for E and B – Monochromatic Plan waves – energy and momentum in electromagnetic waves – electromagnetic waves in matters –TE waves in rectangular wave guides

– the co-axial transmission line. Potentials: potentials and fields – scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form.

UNIT - V: APPLICATION OF ELECTROMAGNETIC WAVES

Boundary conditions at the surface of discontinuity – Reflection and refraction of E.M waves at the interface of non – Conducting media – Kinematic and dynamic properties – Fresnel's equation – Electric field vector 'E' parallel to the plane of incidence and perpendicular to the plane of incidence – Reflection and transmission co-efficients at the interface between two non– Conducting media – Brewster's law and degree of polarization – Total internal reflection.

TEXT BOOKS:

1. SathyaPrakash, Electromagnetic Theory and Electrodynamics, KedarNath RamNath and Co, 2017.
2. B.B Laud, Electromagnetics, Wiley Eastern Company, 2000.
3. Wazed Miah, Fundamentals of Electromagnetic, Tata Mc Graw Hill, 1980.

SUPPLEMENTARY READING:

1. John R.Reitz, Frederick J Milford and Robert W.Christy, Fundamentals of Electromagnetic Theory, Narosa Publishing House, New Delhi, Third edition, 1998.
2. J.D. Jackson, Classical Electrodynamics, Wiley Eastern Limited, II Edition, 1993.
3. Narayana rao Basic Electromagnetics with Application, , (EEE) Prentice Hall, 1997.
4. David J.Griffths, Introduction to Electrodynamics –Pearson, 4th Edn, 2000 .

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Applying vector calculus operations and developing knowledge of vector fields and scalar fields

CO2: Describing the fundamental nature of static fields, including steady current, static electric and magnetic fields

CO3: Formulating potential problems within electrostatics, magnetostatics and stationary current distributions in linear, isotropic media etc.,

CO4: Applying Maxwell's equations and their application to boundary conditions, wave equations, and Poynting's power-balance theorem.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓												✓		✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓						✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓						✓		✓	✓	✓
CO4	✓	✓												✓		✓	✓	

SEMESTER - VIII	**19IPHYP84- PRACTICAL – VII**	**Credit : 6** **Hours: 9**

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments

- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To providing a hands-on learning experience such as in measuring the basic concepts and applications of laser and microprocessor.

(Any Sixteen Experiments)

1. Michelson Interferometer – Wavelength Determination.
2. Energy gap – Four Probe Apparatus.
3. Elastic constants of Glass- Cornu's interference method (Hyperbolic fringes).
4. Solar Spectrum
5. Thermistor characteristics-Band gap energy
6. Reflection grating-Spectrometer
7. Ultrasonic diffractometer – Velocity and compressibility of liquids
8. Characteristics of He-Ne Laser.
9. Diffraction at straight edge using Laser.
10. Magnetostriction
11. Numerical Aperture and Acceptance Angle-Fibre Optics
12. Microprocessor 8086 I – Addition and Subtraction (16 & 32 bits)
13. Microprocessor 8086 II –Multiplication and Division (16 & 32 bits)
14. Microprocessor 8086 - Biggest and Smallest Numbers
15. Microprocessor 8086 - Code conversion
16. Microprocessor 8086 - Solving expression, Factorial of N Numbers
17. Microprocessor 8086 – Sum of elements in an array and factorial
18. Microprocessor 8086 – Sorting of N Elements (Ascending and Descending Order)
19. Microprocessor 8086 – String Operations
20. Wave form generations using 8086.

COURSE OUTCOMES (COS):

CO1: Basic laws and theories involving amplifiers, integrated circuits, converters and flip flops etc.,
CO2: Understand the given concepts and its physical significance

CO3: Apply the theory to design the basic electrical circuits
CO4: provide a hands-on learning experience and understand the basic concepts and applications of laser and microprocessor.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓

SEMESTER - IX	19IPHYC91 - QUANTUM MECHANICS - I	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To study the fundamentals of wave mechanics.
- To study the stationary state and eigen spectrum of systems using time dependent Schrodinger equation.
- To solve the exactly soluble eigen value problems.
- To know the matrix formulation of quantum theory and how it can be used to understand the equation of motion.
- To understand the theory of identical particles and Angular momentum.

UNIT-I: FOUNDATIONS OF WAVE MECHANICS

Postulates of wave mechanics -adjoint and self-adjoint operators-degeneracy-eigen value, eigen functions-Hermitian operator- parity - observables - Physical interpretation-expansion coefficients-momentum eigen functions-Uncertainty principle-states with minimum value-commuting observables.

Matter waves- Equation of motion- Schrodinger equation for the free particle – physical interpretation of wave function-normalised and orthogonal wave functions-expansion theorem-admissibility conditions- stationary state solution of Schrodinger wave equation - expectation values-probability current density- Ehrenferts theorem.

UNIT-II: STATIONARY STATE AND EIGEN SPECTRUM

Time independent Schrodinger equation - Particle in a square well potential – Bound states – eigen values, eigen functions –Potential barrier – quantum mechanical tunnelling- alpha emission.

Identical Particles – symmetry and antisymmetric wave functions – exchange degeneracy – Spin and statistics: Pauli's exclusion principle-Slater determinant-spin and Pauli's matrices.

UNIT-III: EXACTLY SOLUBLE EIGENVALUE PROBLEMS

One dimensional linear harmonic oscillator – properties of stationary states- abstract operator method - Angular momentum operators- commutation relation- spherical symmetry systems -Particle in a central potential – radial wave function – Hydrogen atom: solution of the radial equation – stationary state wave functions – bound states-the rigid rotator: with free axis-in a fixed plane-3-Dimentional harmonic oscillator.

UNIT-IV: MATRIX FORMULATION OF QUANTUM THEORY, EQUATION OF MOTION & ANGULAR MOMENTUM

Quantum state vectors and functions- Hilbert space-Dirac's Bra-Ket notation-matrix theory of Harmonic oscillator –Equation of motions-Schrodinger, Heisenberg and Interaction representation.

Angular momentum -commutation relation of J_Z, J_+, J_- - eigen values and matrix representation of J^2, J_Z, J_+, J_- – Spin angular momentum – spin ½ , spin-1- addition of angular momenta- Clebsch-Gordan coefficients.

UNIT-V: SCATTERING THEORY

Kinematics of scattering process - wave mechanical picture- Green's functions – Born approximation and its validity –Born series – screend coulombic potential scattering from Born approximation.

Asymptotic behavior – phase shift – scattering amplitude in terms of phase shifts – differential and total cross sections – optical theorem – low energy scattering – resonant scattering – non-resonant scattering-scattering length and effective range– Ramsauer-Townsend effect – scattering by square well potential.

TEXT BOOKS:

1. G. Aruldhas, A Text book of Quantum Mechanics, Prentice Hall of India Pvt., Ltd., 2002
2. Satya Prakash, Quantum Mechanics, Kedar Nath Ram Nath and Co. Publications, 2018.
3. V. K. Thankappan Quantum Mechanics, New Age International (P) Ltd. Publication, Second Edition, 2003.

SUPPLEMENTARY READING:

1. A. K. Ghatak and Lokanathan, Quantum Mechanics – Theory and applications, Macmillan India Ltd Publication, Fifth Edition, 2015.
2. Leonard I. Schiff, Quantum Mechanics, McGraw-Hill International Publication, Third Edition, 1968.
3. E. Merzbacher, Quantum Mechanics, John Wiley Interscience Publications, Third Edition, 2011.
4. Claude Cohen-Tannoudji, Bernard Diu, Franck Laloë , Quantum Mechanics (Vol .I), JohnWiley Interscience Publications, First Edition, 1991.
5. Pauling & Wilson, Quantum Mechanics, Dover Publications, New Edition, 1985.
6. R. Shankar, Principle of Quantum Mechanics, Plenum US Publication, Second Edition, 1994.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Study the stationary state and eigen spectrum of systems using time dependent Schrodinger equation.
CO2: Know to solve the exactly soluble eigen value problems.
CO3: Know the matrix formulation of quantum theory and how it can be used to understand the equation of motion.
CO4: Understand the theory of identical particles and Angular momentum.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓							✓	✓	✓		✓		✓	✓
CO2	✓	✓		✓							✓	✓	✓		✓		✓	
CO3	✓	✓		✓	✓		✓				✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓		✓				✓	✓	✓		✓	✓	✓	

SEMESTER - IX	19IPHYC92 - CONDENSED MATTER PHYSICS - II	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- This course develops analytical thinking to understand the phenomenon that decides various properties of solids.
- Provides a valuable theoretical introduction and overview of the fundamental application of physics of solids.
- To impart the basic knowledge about superconductors and high temperature super conductors.

UNIT – I: THEORY OF DIELECTRICS

Dipole moment – Polarization – The electric field of a dipole – Local electric field at an atom – Clausius –Mosotti equation - Dielectric constants and its measurements - Polarizability – The Classical theory of electronic polarizability – Ionic polarizabilities - Orientational polarizabilities - The polarizability catastrophe - Dipole orientation in solids - Dipole relaxation and dielectric losses – Debye Relaxation time - Relaxation in solids - Complex dielectric constants and the loss angle - Frequency and temperature effects on Polarization – Dielectric breakdown and dielectric loss.

UNIT – II: THEORY OF FERROELECTRICS AND PIEZO ELECTRICS

Ferroelectric Crystals – Classifications of Ferroelectric crystals - Dipole theory of ferroelectricity – Landau Theory of the phase transition – Second order Transition – First Order Transition - Ferroelectric Transition - One-Dimensional Model of the Soft Mode of Ferroelectric Transitions – Antiferroelectricity - Ferroelectric domains – Ferroelectric domain wall motion – Piezoelectricity - Phenomenological Approach to Piezoelectric Effects - Piezoelectric Parameters and Their Measurements - Piezoelectric Materials

UNIT – III: MAGNETIC PROPERTIES OF MATERIALS

Terms and definitions used in magnetism – Classification of magnetic materials – Atomic theory of magnetism – The quantum numbers- The origin of permanent magnetic moments – Langevin's classical theory of diamagnetism – Sources of paramagnetism – Langevin's classical theory of paramagnetism – Quantum theory of paramagnetism – Paramagnetism of free electrons - Ferromagnetism – The Weiss molecular field – Temperature dependence of Spontaneous magnetization – The physical origin of Weiss Molecular field - Ferromagnetic domains - Domain theory – Antiferromagnetism – Ferrimagnetism – Structure of Ferrite.

UNIT – IV: SUPERCONDUCTIVITY

Occurence of super conductivity - Destruction of super conductivity by magnetic fields - Meissner Effect – Type I and Type II Super conductors - Heat Capacity - Energy gap - Microwave and infrared properties - Isotope effect - Thermodynamics of the superconducting transition - London equation - Coherence Length - BCS theory of superconductivity, BCS ground state - Flux quantisation in a super conduction ring - Duration of persistence currents - Single particle

tunnelling - DC Josephson effect - AC Josephson effect - Macroscopic quantum interference – High temperature super conductors – Applications.

UNIT – V: PHYSICS OF NANOSOLIDS

Definition of nanoscience and nanotechnology – Preparation of nanomaterials – Surface to volume ratio – Quantum confinement – Qualitative and Quantitative description – Density of states of nanostructures – Excitons in Nano semiconductors – Carbon in nanotechnology – Buckminsterfullerene – Carbon nanotubes – Nano diamond – BN nano tubes – Nanoelectronics – Single electron transistor – Molecular machine – nano biometrics.

TEXT BOOKS:

1. Charles Kittle, Introduction to solid state physics, Wiley India Pvt. Ltd., New Delhi, 7th Edition, 2004.
2. K.K.Chattopadhyay, A.N.Banerjee, Introduction to Nanoscience and Nanotechnology, PHI Learning Private Ltd., Delhi 2014.
3. S.O. Pillai, Problems and Solutions in Solid State Physics, New Age international publishers, New Delhi, 1994.

SUPPLEMENTARY READING:

1. Rita John, Solid State Physics, Tata Mc Graw Hill Publications, 2014.
2. M.A. Wahab, Solid State Physics, structure and properties of the materials. Narosa, New Delhi, 1999.
3. M.Tinkham, Introduction to Superconductivity, Tata McGraw Hill, New Delhi, 1996.
4. A.J. Dekker, Electrical Engineering Materials, Prentice Hall of India, 1975.
5. Kwan Chi Kao, Dielectric Phenomena in solids with emphasis on physical concepts of electronic processes, Elsevier Academic press, 2004.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand the dielectric properties of the solid systems.
CO2: Understand the ferroelectric and piezoelectric properties of the solid systems and its application.
CO3: Understand deeply the electrical and magnetic properties of crystalline solids with theoretical background.
CO4: Understand the theoretical basis of nanotechnology and carbon in nanotechnology.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓						✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

SEMESTER - IX	19IPHYC93 - NUCLEAR AND ELEMENTARY PARTICLE PHYSICS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To understand the forces of binding the nucleons in detail and the perspective of various models proposed with dipole and quadropole moments of the nucleus
- To make them realize the cause of various nuclear particles in the strong short range interaction among the nucleons.
- To understand the concepts of elementary particles.

UNIT-I: NUCLEAR FORCES

Characteristics of Nucleus Forces – Exchange forces and tensor forces – charge independence-Spin dependence of Nucleus Forces - Meson theory of nuclear forces- Ground state of deuteron- Nucleon-nucleon scattering singlet and triplet parameters – Nucleon-Nucleon scattering: Cross-section, Differential Cross-section, Scattering Cross-sections – magnetic moment- Quadrupole moment –S and D state admixtures - Effective range theory of n-p scattering at low energies.

UNIT-II: NUCLEAR MODELS

Binding energy & mass defect – Weizacker's formula – mass parabola - Liquid drop model - Bohr -Wheeler theory of fission- Activation energy for fission- Shell model- Spin –Orbit coupling- Spins of nuclei- Magnetic moments – Schmidt lines- Electric quadrupole moments - Collective model of Bohr and Mottelson: Nuclear vibration – Nuclear rotation –Nelson model.

UNIT-III: NUCLEAR REACTIONS

Nuclear reaction - Q- value – Nuclear reaction cross section – Direct Nuclear Reactions: Knock out reaction, Pick-up reaction, Stripping reaction – Compound nucleus theory – Formation – Disintegration energy levels – Partial wave analysis of Nuclear reaction cross-section - Resonance Scattering and Reaction cross-section (Breit-Wigner dispersion formula) – Scattering matrix - Reciprocity theorem – Breit -Wigner one level formula – Resonance scattering – Absorption cross section at high energy.

UNIT – IV: NUCLEAR FISSION AND FUSION

Nuclear fission- Energy release in fission reaction - Distribution of fission products- neutron emission in fission - Fissile and fertile materials - Bohr Wheeler theory. Nuclear chain reaction - Four factor formula - Nuclear reactors - Classification of reactors - Critical size of a reactor - Reactor materials.

Nuclear fusion – nuclear reaction in stars – Fusion reactors – Pinched discharge - Stellarator – Magnetic mirror systems.

UNIT-V: ELEMENTRY PARTICLE PHYSICS

Classification of elementary particles - Types of interaction between elementary particles – Hadrons and leptons – Symmetry and conservation laws – Strangeness and associate production - CPT theorem – classification of hadrons – Quark model - Isospin multiples - SU(2)- SU(3) multiplets- Gell-Mann - Okubo mass formula for octet and decuplet hadrons – Phenomenology of

weak interaction hadrons and leptons - Universal Fermi interaction – Elementary concepts of weak interactions.

TEXT BOOKS:

1. B. B. Cohen, Concepts of Nuclear Physics, TMGH, Bombay, 1971.
2. K. Krane, Introductory Nuclear Physics, Wiley, New York, 1987.
3. V. Devanathan Nuclear Physics, , Narosa Publishing house.
4. D. Griffiths, Introduction to Elementary Particles, Wiley-Vch, 2nd Ed., 2008
5. S.N. Ghoshal, Nuclear Physics, S. Chand and Co., II edition, 1994.
6. D.C. Tayal, Nuclear Physics, Himalaya Publishing House Pvt., Ltd., V edition, 2018.
7. Irving Kaplan, Nuclear Physics, Narosa Publishing House, 2012.
8. B.N. Srivatsava,Basic Nuclear Physics and Cosmic Rays, Pragati Prakashan publications, Meerut, Edition: XVII, 2016.
9. M.L. Pandya and P.R.S Yadav, Elements of Nuclear Physics, Kedar Nath Ram Nath publications, Meerut, 2016.

SUPPLEMENTARY READING:

1. R. D. Evans, Atomic Nucleus, Mcgraw-Hill NY.1955.
2. J. M. Blatt and V. F. Weisskopf, Theoretical Nuclear Physics, Berlin 1979.
3. H. Enge, Addision-Wesley, Introduction to Nuclear Physics, Reading MA., 1975
4. R. R. Roy and B. P. Nigam, Nuclear Physics, Wiley Eastern, Madras, 1993.
5. A. Bohr andVol B. R. Mottelson, Nuclear Structure,. I (1969) and Vol.II (1975),

COURSE OUTCOMES (COs):

By the end of the Course, the student will be able to

CO1: Understand about nuclear forces and their dependence on various parameters.
CO2: Compare various nuclear models and properties of the nucleus.
CO3: Understand the Nuclear energy sources through various nuclear reactions with are realized.
CO4: Know the causes for short range interaction inside the nucleons with mathematical formulations.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	
CO2	✓	✓	✓	✓	✓						✓	✓		✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	

SEMESTER - IX	19IPHYP94 PRACTICAL – VIII	Credit : 6 Hours: 9

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.

- To providing a hands-on learning experience such as in measuring the basic concepts and applications of microcontroller.

(Any Sixteen Experiments)

1. Low field Hysterisis
2. Susceptibility of liquids using Guoy-Balance
3. Susceptibility of liquids by Quinke's method
4. Photo elastic constant
5. Hysterisis loop tracer
6. Cu-Salt (visible) Spectrum
7. Molecular constants-CN Band
8. Channel Spectrum
9. R.F.Oscillator- construction and determination of dielectric constant.
10. Ultrasonic velocity of liquid mixtures- Interferometer
11. Phase diagram of single component-using Potentiometer.
12. G.M. Counter characteristics
13. Microcontroller 8051 Experiment-I (Addition and Subtraction and Logical operations)
14. Microcontroller 8051 Experiment-II(Multiplication and Division and Solving expressions)
15. Microcontroller 8051 Experiment-III (Logical operations, 1's and 2's compliment)
16. Array Operations-I Microcontroller 8051(Sum of elements, biggest and smallest numbers)
17. Array Operations-II Microcontroller 8051(Ascending and descending order)
18. Microcontroller 8051 - Code conversion
19. Microcontroller 8051 – ADC interfacing
20. Microcontroller 8051 - Stepper motor interfacing

COURSE OUTCOMES (COS):

CO1: Basic laws and theories involving amplifiers, integrated circuits, converters and flip flops etc.,
CO2: Understand the given concepts and its physical significance
CO3: Apply the theory to design the basic electrical circuits
CO4: Provide a hands-on learning experience and understand the basic concepts and applications of microcontroller.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓

SEMESTER - X	19IPHYC101 - QUANTUM MECHANICS - II	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To learn about the approximation methods for time independent and time dependent perturbation theory.
- To understand the kinematics of scattering process and partial wave analysis.
- To study the theory of relativistic quantum mechanics and field quantization.
- To study the quantum theory of atomic and molecular structures.

UNIT-I: APPROXIMATION METHODS FOR TIME INDEPENDENT PROBLEMS

Time independent perturbation theory – stationary theory- Non-degenerate case: first and second order-Normal Helium atom– Zeeman effect without electron spin – Stark effect in hydrogen molecule - Degenerate case: Energy correction- Stark effect in hydrogen atom.

UNIT-II: APPROXIMATION METHODS FOR TIME DEPENDENT PERTURBATION THEORY

Time dependent Perturbation theory - first order transitions – constant perturbation-transition probability: Fermi Golden Rule –Periodic perturbation –harmonic perturbation – adiabatic and sudden approximation.

Semi-classical theory of radiation: Application of the time dependent perturbation theory to semi-classical theory of radiation – Einstein's coefficients – absorption - induced emission- spontaneous emission – Einstein's transition probabilities- dipole transition - selection rules – forbidden transitions.

UNIT-III: VARIATION METHOD

Variation method: Variation Principle – upper bound states- ground state of Helium atom – Hydrogen molecule-WKB approximation - Schrodinger equation-Asymptotic solution-validity of WKB approximation-solution near a turning point – connection formula for penetration barrier – Bohr-Summer field quantization condition- tunneling through a potential barrier.

UNIT–IV: QUANTUM THEORY OF ATOMIC AND MOLECULAR STRUCTURE

Central field approximation: Residual electrostatic interaction-spin-orbit interaction- Determination of central field: Thomas Fermi statistical method-Hartree and Hartree-Fock approximations (self consistent fields) – Atomic structure and Hund's rule.

Born-Oppenheimer approximation – An application: the hydrogen molecule Ion (H_2^+) – Molecular orbital theory: LCAO- Hydrogen molecule.

UNIT-V: RELATIVISTIC QUANTUM MECHANICS & QUANTIZATION OF THE FIELD

Schrodinger relativistic equation- Klein-Gordan equation-charge and current densities – interaction with electromagnetic field- Hydrogen like atom – nonrelativistic limit- Dirac relativistic equation: Dirac relativistic Hamiltonian – probability density- Dirac matrices-plane wave solution – eigen spectrum – spin of Dirac particle – significance of negative eigen states – electron in a magnetic field – spin magnetic moment.

Quantization of wave fields- Classical Lagrangian equation- Classical Hamiltonian equation- Field quantization of the non-relativistics Schrodinger equation- Creation, destruction and number operators- Anticommutation relations- Quantization of Electromagnetic field energy and momentum.

TEXT BOOKS:

1. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, Tata McGraw – Hill Publications, Second Edition, 2010.
2. Satya Prakash, Quantum Mechanics, Kedar Nath Ram Nath and Co. Publications, 2018.
3. Claude Cohen-Tannoudji, Bernard Diu, Franck Laloë , Quantum Mechanics (Vol. II), John Wiley Publications, 2008.

SUPPLEMENTARY READING:

1. V. K. Thankappan, Quantum Mechanics, New Age International (P) Ltd. Publication, Second Edition, 2003.
2. Franz Schwabl, Quantum Mechanics, Narosa Publications, Fourth Edition, 2007.
3. P.W. Atkins and R.S. Friedman, Molecular Quantum mechanics, Oxford University Press publication, Fifth Edition, 2010.
4. A.K.Ghatak and Lokanathan,Quantum Mechanics – Theory and Applications, Macmillan India Ltd Publication, Fifth Edition, 2015.
5. Leonard I. Schiff, Quantum Mechanics, McGraw-Hill International Publication, Third Edition, 1968.
6. E Merzbacher, Quantum Mechanics, John Wiley Interscience Publications, Third Edition, 2011.
7. Edwin C.Kemble, Fundamental principles of Quantum mechanics with elementary applications, Dover Publications, ReIssue Edition, 2005.

COURSE OUTCOMES (COs):

By the end of the Course, the student will be able to

CO1: Apply and appreciate the approximation methods to various problems

CO2: Identify the time dependent and time independent cases

CO3: Grasp the developments in relativistic quantum mechanics

CO4: Evaluate the quantum field parameters

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓							✓	✓	✓		✓		✓	✓
CO2	✓	✓		✓							✓	✓	✓		✓		✓	
CO3	✓	✓		✓	✓		✓				✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓		✓				✓	✓	✓		✓	✓	✓	

SEMESTER - X	19IPHYC102 - SPECTROSCOPY	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To educate the students about the fundamental aspects of Rotational and Vibrational Spectroscopy.
- To import knowledge regarding the fundamental aspects of Resonance Spectroscopy.
- To expose the students to the effective applications of various molecular Spectroscopic techniques to study the chemical and structural properties of materials.

UNIT–I: MICROWAVE SPECTROSCOPY

Rotation of Molecules – Rigid Rotor (Diatomic Molecules) – Expression for the Rotational Constant - Intensity of Spectral Lines – Effect of Isotopic Substitution - Molecular Parameters (Bond Length, Bond Angle, Dipole Moment) from Rotation Spectra – Techniques and Instrumentation.

UNIT –II: INFRARED SPECTROSCOPY

Vibrational energy of a diatomic molecule- Infrared selection rules-Vibrating diatomic molecule-Diatomic vibrating rotator- Vibrations of polyatomic molecules-Fermi resonance-Rotation vibration spectra of polyatomic molecules-Normal modes of vibration in crystal-Interpretation of vibrational spectra-Group frequencies-IR spectrophotometer-Instrumentation-Sample handling techniques-Fourier Transform Infrared spectroscopy-Applications

UNIT– III: RAMAN SPECTROSCOPY

Introduction-Theory of Raman scattering-Rotational Raman spectra-Vibrational Raman spectra-Mutual Exclusion principle-Raman spectrometer-Sample handling techniques-Polarization of Raman scattered light-Structure determination using IR and Raman spectroscopy-Raman investigation of phase transitions-Resonance Raman scattering-Nonlinear Raman phenomena-Preliminaries-Hyper Raman effect-Stimulated Raman scattering-Inverse Raman effect-Coherent Anti-Stokes Raman scattering .

UNIT– IV: NUCLEAR MAGNETIC AND ELECTRON SPIN RESONANCE SPECTROSCOPY

Basic principles – Quantum theory of NMR - magnetic resonance – relaxation processes – chemical shifts – spin-spin coupling - Spectra and molecular structure – Fourier Transform NMR – Instrumentation – Applications.

Basic principles – Quantum theory - g-factor – Nuclear Interaction and Hyperfine structure – Relaxation effects - Hyperfine interaction – line widths – ESR spectrometer – Instrumentation – applications.

UNIT– V: NUCLEAR QUADRUPOLE RESONANCE AND MOSSBAUER SPECTROSCOPY

Basic theory - Nuclear Electric quadrupole interaction – Energy levels – Transition frequency – Excitation and Detection – Effect of magnetic field – Instrumentation – applications.

Mossbauer effect - recoilless emission and absorption - hyperfine interaction - chemical isomer shift - magnetic hyperfine and electric quadruple interactions – ` Instrumentation – applications.

TEXT BOOKS:

1. Colin N. Banwell and Elaine M. Mc Cash, Fundamentals of Molecular Spectroscopy, Mc Grow – Hill Education (India) Pvt. Ltd.,New Delhi, (5th edition), 2013.
2. R.P Straughen and S. Walker, Spectroscopy (vol.I, II, III), Chapman & Hall , London, 1976.
3. G.R. Chatwal and S.K.Anand, Spectroscopy (Atomic and Molecular), Himalaya Publishing House (5th edition), 2016.

SUPPLEMENTARY READING:

1. J.D.Graybeal, Molecular Spectroscopy, McGraw – Hill, New York, 1988.
2. Michael Hollas, Modern Spectroscopy,, John Wiley, New York, (4th edition), 2004.
3. Walter S. Struve, Fundamentals of Molecular Spectroscopy, John Wiley and Sons, Ames, Iowa, 1989.
4. G. Aruldhas, Molecular Structure and Spectroscopy, PHI Learning Private Limited – Hall of India, 2nd edition, 2007.

COURSE OUTCOMES (COs):

By the end of the Course, the student will be able to

CO1: Appreciate the principle of spectroscopy in different regions of the EM spectrum.

CO2: Relate the theory of spectroscopy to the study of molecular structure.

CO3: Identify the appropriate spectral technique as an analytical tool to investigate the

characteristics of materials.

CO4: Outline and correlate for providing solution to interdisciplinary problem.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - X	19IPHYE103 - PHYSICS OF NANOMATERIALS	Credit : 4 Hours: 4

LEARNING OBJECTIVES:

- To distinguish nanomaterials from bulk materials
- To apply their acquired knowledge in research level to synthesis and characterize the nanomaterials.
- To identify the various techniques to investigate the different properties such as optical, structural and morphology of nanoparticles.
- To select the nanomaterials for various applications.

UNIT – I: INTRODUCTION

Introduction – History of nanotechnology - Classification of nanomaterials: Definition of – Zero, one and two dimension nano structures – Examples - Classification of synthesis methods. Surface energy – Chemical potential as a function of surface curvature – Electrostatic stabilization - Steric stabilization – DLVO theory.

UNIT – II: SPECIAL NANOMATERIALS

Carbon Fullerenes and Nanotubes: Carbon fullerenes, Fullerene derived crystals, Carbon nanotubes. Micro and Mesoporous Materials: Ordered mesoporous structures, Random mesoporous structures, crystalline microporous materials. Core-shell structures: Metal-oxide structures, Metal-polymer structures, Oxide-polymer structures.

UNIT – III: PROPERTIES

Physical properties of nanomaterials: Melting points, Lattice constants – Mechanical properties – Optical properties:-Surface Plasmon Resonance – Quantum size effects – Electrical property: Surface scattering, charge of electronic structure - Ferroelectrics and dielectrics: Variation of magnetism with size-Super para magnetism-Diluted magnetic semi conductor.

UNIT – IV: SYNTHESIS

Synthesis of nano materials: Physical vapour deposition - Chemical vapour deposition - Sol gel - Ball milling technique - Reverse miceller technique - Electro deposition. Nanostructures fabrication by physical techniques – Nano lithography – Nanomanipulator.

UNIT – V: CHARACTERIZATION AND APPLICATIONS

Structural Characterization: X-Ray diffraction – Scanning Electron Microscopy – Transmission Electron Microscopy – Chemical Characterization: Optical spectroscopy: UV-Visible and Phototluminescence spectroscopy.

Applications: Molecular electronics and Nano electronics, Nano electromechanical systems- Colorants and pigments –DNA chips – DNA array devices – Drug delivery systems.

TEXT BOOKS:

1. Viswanathan B, Nano Materials, Narosa publishing house, 2010.
2. Pradeep T, The Essentials, Nano: Tata MC Graw-Hill publishing company limited, 2007.
3. Christof M. Niemeyer, Chad A. Mirkin,Nanobiotechnology: Concepts, Applications and Perspectives, 2004.

SUPPLEMENTARY READING:

1. Kenneth F. Klablunde, Nanoscale Materials in Chemistry, John Wiley and sons, Inc., 2001.
2. Wilson M, K Kannangara, G. Smilt, M. Simmons and B. Boguse, Nanotechnology, Overseas Press, 2005
3. Freitas R A, Landes., Nanomedicine, TX publication, 1996.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Distinguish nanomaterials from bulk materials.
CO2: Apply their acquired knowledge in research level to synthesis and characterize the nanomaterials.
CO3: Identify the various techniques to investigate the different properties such as optical, structural and morphology of nanoparticles.
CO4: Select the nanomaterials for various applications.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	

SEMESTER - X	19IPHYP104- PRACTICAL – IX	Credit : 6 Hours: 9

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.

- To providing a hands-on learning experience such as in measuring the basic concepts and applications of microcontroller.

(**Any Sixteen experiments**)

1. Spectrophotometer
2. Co-effeicient of linear expansion-Interference Method.
3. R.F. Oscillator- Dipolemoment of Liquids
4. Susceptibility of Salt solutions/ Solids-Guoy method
5. Susceptibility of liquid mixture- Quincke's method-Calculation of Bohr magneton.
6. Phase diagram-Two component system.
7. Molecular constants –AlO Band
8. Molecular constants- CN Band.
9. Cu-Salt spectrum ultra violet region.
10. Optical rotation of quartz.
11. G.M. Counter -Absorption co-efficient of a foil.
12. F.P. Etalon.
13. Dielectric of Solids
14. Particle size analyzer using Laser.
15. Stark Effect.
16. Micro hardness of a Crystal.
17. 8051 Micro controller - Setting bits and Masking bits in an 8-bit number.
18. Microcontroller 8051 - Generate a delay.
19. Microcontroller 8051 - DAC interfacing.
20. Microcontroller 8051 – Display and Rolling of messages.

COURSE OUTCOMES (COS):

CO1: Basic laws and theories involving amplifiers, integrated circuits, converters and flip flops etc.,
CO2: Understand the given concepts and its physical significance
CO3: Apply the theory to design the basic electrical circuits
CO4: Provide a hands-on learning experience and understand the basic concepts and applications of microcontroller.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓

SEMESTER - X	**19IPHYPJ105- PROJECT**	**Credit : 6** **Hours: 9**

Learning Objectives:

To learn the basics of research work by carrying out selective academic and applied projects.

Course outcomes:

At the end of the course, the students will

CO1: Acquire the practical knowledge of understanding research problems.

CO2: Gain knowledge basic principles of various components of research
CO3: Apply the principles of chemistry in various fields

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓			✓			✓										
CO2	✓		✓	✓	✓				✓									
CO3	✓			✓	✓					✓				✓				
CO4	✓	✓			✓	✓	✓	✓		✓		✓	✓				✓	✓

DEPARTMENT ELECTIVES

SEMESTER – I	19IPHYE 15.1 - ELECTRICAL APPLIANCES	Credit : 3 Hour : 4

LEARNING OBJECTIVES:

- To impart knowledge about the basic electrical devices.
- To make the students understand the working of transformers.
- To give exposure in understanding the functioning of various house hold appliances
- To highlights the concept of electrical switches, inverters and motors.

UNIT- 1:

Resistance -capacitance -inductance and its units -electrical charge -current -potential -units and measuring meters -Ohm's law -Galvanometer, ammeter, voltmeter and multimeter. Electrical energy -power -watt -kWh -consumption of electrical power.

UNIT- 2:

Transformer -principle and working -classification of transformers -testing of transformers -Core, Shell and Berry types, auto transformer -construction and uses. Cooling of transformers -Losses in transformer.

UNIT - 3:

Electric bulbs –Fluorescent lamps -Street Lighting -Electric Fans -Wet Grinder -Mixer -Water Heater -Storage and Instant types-electric iron box-microwave oven -Washing Machine -Stabilizer, Fridgeand Air conditioner.

UNIT- 4:

AC and DC-Single phase and three phase connections -RMS and peak values-house wiring -Star and delta connection -overloading -earthing -short circuiting -colour code for insulation wires .

UNIT- 5:

Electrical protection -Relays -Fuses -Electrical switches -Circuit breakers-ELCB -overload devices -ground fault protection -Inverter -UPS -generator and motor.

TEXT BOOKS:

1. B L Theraja,-A text book in Electrical Technology, S Chand & Co.
2. A K Theraja, A text book of Electrical Technology.
3. B L Theraja, Basic Electronics, S Chand & Co.

SUPPLEMENTARY READING:

1. M G Say, Performance and design of AC machines - ELBS Edn.
2. P K Palanichamy, Semi conductor physics and opto electronics.
3. Arokh Singh and A K Chhabra, Principles of Communication Engineering, S Chand & Co

COURSE OUTCOMES (COs):

By the end of the course, students will be able to

CO1: Be familiar with the basic concepts of construction and working of electrical devices.

CO2: Understand the concepts and understand the working of transformers

CO3: Understanding the functioning of various house hold appliances

CO4: Apply the principles of electrical appliances in day to life.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓		✓	✓			✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER – I	19IPHYE 15.2 - PHYSICS OF HUMAN ANATOMY	Credit : 3 Hour : 4

LEARNING OBJECTIVES:

- To provide an understanding of the physics of human anatomy and body systems.
- To understand the medical applications of light to human body.
- To understand the law of physics to explain several bodily functions including the mechanics of breathing, acoustic properties of the ears and vision optics.
- To know the basic ideas in understanding the heat and work and energy of human body.

UNIT- 1:

PHYSICS OF LIGHT AND ITS MEDICAL APPLICATION TO HUMAN BODY
Properties of light – Measurement of Light – Energy of light – medical Application of Visible light, UV, IR and Laser in Human body.

UNIT- 2:

PHYSICS OF BREATHING:
Pressure –Typical pressure in Normal body –Gas transport in respiratory system –Definition of pressure-Volume in Lung-Thorax system –Resistance of air passage –Timing of breathing process –Work required for Breathing.

UNIT- 3:

ENERGY OF HUMAN BODY
Heat loss of the body due to conduction, convection, evaporation, radation-Wind chill –Mechanism to decrease body temperature –Medical implication of high temperature.

UNIT- 4:

THE ACOUSTICS OF BODY
Sound –unit –wave equation –Unit of sound intensities for auditory system –production of speech – Physics of ear –outer ear –inner ear –ear drum –middle ear.

UNIT- 5:

PHYSICS OF EYE
Optical system of the body structure of Eye –Refraction focusing of the eye system –Geometrical optics of the Eye –Structure of receptor system –Diffraction effects of Eye –Eye defects.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand the medical applications of light to human body.
CO2: Understand the law of physics to explain several bodily functions including the mechanics of breathing, acoustic properties of the ears and vision optics.
CO3: To understand the law of physics to explain several bodily functions including the mechanics of breathing, acoustic properties of the ears and vision optics.
CO4: Know the basic ideas in understanding the heat and work and energy of human body.

TEXT BOOKS:

1. M.Arumugam , Biomedical Instrumentation, , Anuradha Agencies,, Fourth reprint 2000.
2. Dominique Placko, Fundamentals of Instrumentation and Measurement, ISTE Ltd., 2007
3. Vasantha Pattabhi, N. Gautham, Biophysics, Narosa Publishing, 2009.

SUPPLEMENTARY READING:

1. web.khu.ac.kr/~bil/lecture/MedicalPhysics/Ch14.PDF
2. http://www.edb.utexas.edu/petrosino/Legacy_Cycle/mf_jm/Challenge2/physicsbreathing.pdf
3. http://web.khu.ac.kr/~bil/lecture/MedicalPhysics/Ch8.PDF

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER – III	19IPHYE 35.1 - BASIC ELECTRONIC DEVICES	Credit : 3 Hour : 4

LEARNING OBJECTIVES:

- To impart knowledge about the resistors, capacitors and inductors.
- To provide the basic ideas of semiconductors.
- To enable the students to know about the ideas of transistors and working operations for various diodes.

UNIT -1

PASSIVE DEVICES

Types of resistor –color code –Construction of various types of resistors (carbon composition.carbon film, wire-wound etc.) –power ratings-Capacitors (ceramic, mica polystrene, electrolyticetc.) –fixed and variable capacitors –Inductors, types.

UNIT- 2

ATOMIC STRUCTURE

Atomic structure Bohr atom model –energy levels -energy bands –important energy band in solids-classification of solids and energy bands –forbidden Energy gap –intrinsic and extrinsic semiconductors P type and N type semiconductors–majority and minority carriers.

UNIT- 3

PN JUNCTION

PN junction-Biasing a PN junction –forward and reverse biasing –PN junction diode: Characteristics -static and dynamic resistance -Diode Rectifiers,clippers and clampers -Zener diode –Characteristics-voltage regulation using Zener diode.

UNIT- 4

TRANSISTORS

Bipolar transistor–Common Base, Common Emitter & Common Collector configurations and their characteristics –load line –operating point –cut off and saturation regions –transistor biasing methods -Transistor as switch,Amplifier–UJT –SCR.

UNIT-5

FET

FET Constructional features-working Principle, features and characteristics –JFET and MOSFET and their characteristics –enhancement and depletion type –LED, LDR and photodiode.

TEXT BOOKS:

1. V.K.Mehta, ―Principles of Electronics S.Chand & Co, 5th Edition,2001
2. B.L.Theraja, ―Basic solid state Electronicsǁ, S.Chand & Co
3. Bapat, Electronic Circuits, Linear and Digital, Tata McGraw Hill, 1991.

SUPPLEMENTARY READING:

1. Physics of Semiconductor Devices, S.M.Sze, Wiley Interscience, 1969.
2. Basic Electronics, 6th edition by B Grob, McGraw Hill NY 1
3. Basic Electronics & Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha & SC Gupta, Tata McGrawHill, 2006.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Be familiar with the basic concepts of construction and working of electronic devices.
CO2: Acquire an in-depth knowledge about the resistors, capacitors and inductors.

CO3: Understand the basic ideas of semiconductors.
CO4: Enable the students to know the ideas of transistors and working operations for various diodes.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓		✓	✓			✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER – III	19IPHYE 35.2 - ENVIRONMENTAL PHYSICS	Credit : 3 Hour : 4

LEARNING OBJECTIVES:

- To provide the basic ideas regarding the atmosphere.
- To impart knowledge regarding weather and climate.
- To familiarize the concept of distribution of temperature and temperature inversion.
- To enable the students to understand atmospheric and wind pressure.
- To highlight the concept of energy in Biology.

Unit -1

Atmospheric Science-I

Atmosphere as part of the biosphere ecosystems- Evolution of atmosphere- Composition and structure of the atmosphere- Need of atmospheric studies in environmental sciences.

Transport of matter; energy and momentum in nature; Stratification and stability of the atmosphere; Laws of motion; Hydrostatic equilibrium; General circulation of the tropics.

Unit -2

Atmospheric Science-II

Elements of weather and climate- Weather parameters (temperature, wind, pressure, relative humidity, rainfall)- Climatology of weather parameters, long-term and short term climatic effects.

Unit -3

Temperature measurements and Controls

Temperature measurements- Horizontal and vertical distribution of temperature- Tempearture inversion- Types of inversion- Tempearture gradients- Urban heat island effect.

Unit -4

Atmospheric Pressure and Winds

Pressure measurement and distribution- Wind observations-Factors affecting wind pressure- Wind belts- Local winds- Geostrophic and gradient winds.

Unit -5

Chemical Energy- Energy in Biology-Photosynthesis-Respiration-Energy use in the human body-Energy content of food.

Deforestation- Degradation of soils- Agriculture and land use changes- Changing composition of local and global environment- Introduction to Remote sensing techniques.

TEXT BOOKS:

1. R.N. Kesavamoorthy and N Sankar Rao, The Physics of Monsoon, Allied Publication.
2. J.T.Houghton, The Physics of Atmosphere,Cambridge Uty
3. J.Twidell and J Weir, Renewal Energy Resources,ELBS 1988.

SUPPLEMENTARY READING:

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Describe various aspects of atmosphere.
CO2: Acquire knowledge regarding weather and climate
CO3: Appraise the concept of distribution of temperature and temperature inversion.
CO4: Analyze the factors affecting atmospheric and wind pressure.
CO5: Interpret the concept of Energy in Biology

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER – V	19IPHYE 56.1 - COMMUNICATION SYSTEM	Credit : 3 Hour : 4

LEARNING OBJECTIVES:

- To provide the basic ideas regarding the various aspects of communication system.
- To impart knowledge about analog and Pulse communication.
- To enable to students understand digital and data fiber optical communication.
- To highlight the concept of fiber optical future developments communication system.

To make the students understand the basic knowledge about various communication systems.

Unit - 1 : Basics Of Communication

Communication systems- modulation- need for modulation- bandwidth requirements- noise- thermal agitation noise- noise calculations- signal to noise Ratio- noise figure- calculation of noise figure- measurement of noise figure.

Unit - 2 : Analog Communication

Amplitude modulation- frequency spectrum of AM wave- power relations in the AM wave- frequency modulation- mathematical representation of FM- frequency spectrum- phase modulation- comparisons: frequency and phase modulation, frequency and amplitude modulations.

Unit - 3 : Pulse Communication

Pulse communication- pulse modulation types- pulse amplitude modulation- pulse width modulation- pulse position modulation- pulse code modulation- telegraphy- telemetry.

Unit - 4 : Data Communication

Data communication systems- data transmission circuits- error detection and correction- interconnection requirements- modern classification- network and control considerations.

Unit - 5 : Fiber Optical Communication

Optical fiber cables- losses in fibers- measurements of fiber characteristics- analog and digital modulation schemes- fiber optical communication systems- operating wavelength- emitter design- detector design- fiber choice- future developments.

TEXT BOOKS:

1.George Kennedy, Electronic communication system, McGraw-Hill international editions,1987.
2.J.Wilson, J.F.B. Hawkes, Optoelectronics- An Introduction, Prentice hall of India,1992.
3.G.Jose Robin & A.Ubald Raj, communication electronics, Indira publications, Martandam, 2002.
4.John Gowar, Optical Communication Systems,Prentice Hall India Private Ltd, New Delhi, 1993.

SUPPLEMENTARY READING:

1. 5.Gerd Keiser, Optical fiber communications, McGrw Hill, Singapore,2000
2. 6.Joseph C.Palais,Fiber Optic Communications, Prentice Hall International, USA,2001.
3. 7.B.P.Lathi, Communication systems, Wiley Eastern Ltd, New Delhi, 1968.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓		✓	✓			✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER – V	19IPHYE 56.2 - AUDIO AND VIDEO SYSTEMS	Credit : 3 Hour : 4

LEARNING OBJECTIVES:

- To know the characteristics of sound.
- To understand the working principles and main features of audio and video devices

Unit - I Characteristics of Sound

Nature of sound – Pressure and intensities of sound waves – Sensitivity of human ear for sound –Loudness and Phon – Frequency of sound waves – Pitch – Production of audio waveforms.

Unit - II Audio System

MICROPHONES : Characteristics of microphones – Requisites of a good microphones – Types of microphones – Moving coil microphone – Crystal microphone – Carbon microphone – Special microphone.Loudspeakers : Characteristics of loudspeakers – Types of loudspeakers – Moving coil cone loudspeaker – Electrodynamicloudspeaker – Horn type loudspeaker – Multi – Way speaker system (Woofers and Tweeters).

Unit - III Television Monochrome Television

Introduction to television – Basic monochrome television system – Transmitter – Receiver – Television systems and standards – Television camera tubes – Videocon camera tube. Colour Television :Colour Transmission and Reception – Colour combination – Three colour theory – Colour TV transmitter and receiver – Colour picture tube – CCTV.

Unit - IV Digital Television

Digital Television-Transmission and Reception: Digital system hardware, Signal quantizing and encoding, digital satellite television, Direct –To – Home (DTH) satellite television, Digital TV receiver, Merits of digital TV receivers, Digital Terrestrial Television (DTT), CCTV.

Unit - V Liquid Crystal Screen Television

LCD technology - LCD matrix types and operation - LCD screens for television - LED TV - Edge LEDs, Differences between LED and LCD displays.

TEXT BOOKS:

1.R G Gupta, Audio and Video Systems (Principles , maintenance and troubleshooting), Tata McGraw – Hill Publishing Company Limited, New Delhi, 2002. (Unit I, II)
2.George Kennedy, Bernard Davis, S R M Prasanna, Electronic Communication Systems, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2012, (Unit III).
3.R.R.Gulati, Modern Television Practice (Fourth revised edition), New Age International Publishers ,2007.(Unit IV & V).

SUPPLEMENTARY READING:

1. A.M.Dhake, Television & Video Engineering (Second edition) , McGraw Hill education Limited,May1999.
2. Bali & Bali, Audio Video Systems Principles, Practices and Troubleshooting, Khanna Publishing Company,2010.

3. S.P.Bali, Consumer Electronics, Pearson Education, India,2005.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Describe the various aspects of sound.
CO2: Acquire knowledge regarding Audios and Video system.
CO3: Appraise the concept of Digital and LCD Television.
CO4: Highlight the concept of LED and LCD

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓		✓	✓			✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - VIII	**19IPHYE85.1 - MICROPROCESSORS AND MICROCONTROLLER**	**Credit : 3** **Hours: 4**

LEARNING OBJECTIVES:

- To learn the architecture of 8085 microprocessor and its programming.
- To study the architecture of 8086 microprocessor.
- To familiarize the architecture of 8051 microcontroller and its programming
- To study the interfacing devices of microprocessor 8085.

UNIT-I: MICROPROCESSORS 8085 ARCHITECTURE

Intel 8085 microprocessor: Introduction – Pin configuration- Architecture and its operations - Machine cycles of 8085. Interfacing of memory and I/O devices. Instruction classification: number of bytes, nature of operations- Instruction format. Vectored and non-vectored interrupts.

UNIT-II: 8085 ASSEMBLY LANGUAGE PROGRAMMING

Instruction set: Data transfer operations - Arithmetic operations Logical operations – Branching and machine control operations. Addressing modes. Writing assembly language programs: Looping, counting and indexing. Counters and time delays - Stack - subroutine. Translation from assembly language to machine language

UNIT-III: MICROPROCESSOR 8086

Intel 8086 microprocessor: Introduction – Architecture - Pin configuration- Operating modes: Minimum mode, Maximum mode. Memory addressing: 8-bit data from even and odd address bank, 16-bit data from even and odd address bank. Addressing modes. Interrupts: Hardware interrupts – Software interrupts –Interrupt priorities. Simple programs

.**UNIT - IV: MICROCONTROLLER 8051 ARCHITECTURE AND PROGRAMMING**

Introduction to microcontroller and embedded system. Difference between microprocessor and microcontroller. 8051 microcontroller : Pin configuration, Architecture and Key features. 8051. Data types and directives Instruction set: Data transfer instructions - Arithmetic instructions –

Logical instructions- Branching instructions- Single bit instructions. Addressing modes. Simple programs using 8051 instruction set.

UNIT – V: INTERFACING OF MICROPROCESSOR 8085

Basic concepts of programmable device - 8255 Programmable Peripheral Interface (PPI) – interface of ADC and DAC. 8257 Direct Memory Access (DMA) controller. Basic concepts of serial I/O and data communication – interface of 8251 Universal Synchronous Asynchronous Receiver Transmitter (USART)

TEXT BOOKS:

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085/8080, New Age International 6th edition, 2013.
2. Douglas V., Microprocessors and Interfacing-Programming and Hardware, Hall, Tata McGraw Hill, 1993.
3. Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming and Applications. Penram International publishing Pvt. Ltd., second edit, 1996.

SUPPLEMENTARY READING:

1. A.P.Godse and D.A.Godse, Microprocessors and Microcontrollers, Technical Publications, Pune.
2. Badri Ram, Advanced Microprocessors and Interfacing, Tata McGraw Hill, 2001.
3. Muhammad Ali Mazidi and Janice Mazidi, The 8051 Microcontroller and Embedded systems,Pearson Education, 2000.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Describe basic concept and architecture of 8085 microprocessor and implement programs in 8085.

CO2: Learn the architecture of 8086 microprocessor.

CO3: Understand the architecture of 8051 microcontroller and develop assembly language programs.

CO4: Discuss concept of interfacing in microprocessor 8085.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓		✓	✓	✓

SEMESTER - VIII	19IPHYE85.2 - PHYSICS OF THE EARTH	Credit : 3 Hours: 4

LEARNING OBJECTIVES:

- To understand the physical structure and behaviour of the earth as well as geomagnetic properties of rocks in the Earth's crust.

- To study the elastic behaviour in earth by applying various theories and hypothesis.
- To highlight the concept of solar system and behaviour of planets in this system.

UNIT – I: SOLAR SYSTEM

The earth and the solar system – Important physical parameters and properties of the planet earth; Stress and Strain, Wave and motion, Seismic waves. Travel time Tables and Velocity – Depth curves – Variation of Density within the Earth.

UNIT – II: GRAVITATION

Rotation of the Earth - Gravitational attraction, Gravitational Theory, Measurements of Gravity, Gravity meters - Principles and method of measuring gravity - Gravity anomalies-Local and regional variations.

UNIT – III: THERMAL HISTORY OF EARTH

Thermal history of the Earth. Temperature in the Primitive Earth and the Earth's surface and interior. Thermal conductivity. Generation of heat in the Earth. Heat flow measurements, methods and results.

UNIT – IV: ELASTIC PROPERTIES

Elastic constants and Elastic process in the earth. Earth's free rotation. Latitude variation. Tides of the Solid earth. Numerical values of Love's numbers. Rigidity of the Earth. Bulk modules in the earth. Poisson's ratio in the Earth, Young's modulus and Lame's constant.

UNIT – V: GEOMAGNETISM AND PALAEOMAGNETISM

Geomagnetism and palaeomagnetism-Earth's magnetic field. Origin-Theory of earth's magnetic field. Magneto hydrodymics of the Earth. Magnetic reversals. Polar wandering. Tectonic movements and its relation to palaeomagnetism - Measurement of magnetic properties of rocks.

TEXT BOOKS:

1. A.H. Cook, Physics of the Earth and planets, Macmillan, 1973.
2. J. A. Jacobs, R. D. Russel and J. T. Wilson, Physics and Geology, 1974.
3. A.S. Eve and Keys, D. A, Applied Geophysics, Cambridge University, 1954.

SUPPLEMENTARY READING:

1. Gutenberg, Physics of the Earth's Interior, International Geophysics Series, Vol.1 Academic Press, 1959.
2. P.J. Wyllie, International Student Edition., The dynamic Earth, John Wiley and sons, 1971.
3. C.M.R. Fowler, The Solid Earth, An Introduction to Global Geophysics, Cambridge University press, 1990.
4. Alan Cox, Geomagnetic Reversals and Plate Ttectonics, Freeman and company, 1973.

COURSE OUTCOMES (COs):

By the end of the semester, the students will be able to

CO1 : Think and analyse the concept of the Earth and its properties.
CO2 : Accumulate the various concept proposed by theories and laws.
CO3 : Enlighten the concept solar system.
CO4: Acquire basic knowledge about geomagnetism and paleomagnetism.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER -VIII	19IPHYE85.3 - ENERGY PHYSICS	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To create an awareness among the students regarding the forms of energy and the availability of their resources
- To educate regarding the utilization and conservation of energy
- To impart a knowledge about the Sustainable forms of energy

UNIT– I: CONVENTIONAL ENERGY SOURCES

Energy sources and their availability – Various forms of energy – Renewable and conventional energy systems – Comparison – Coal, oil and natural gas.

UNIT – II: SOLAR ENERGY

Solar Energy - Thermal application and solar radiation – Energy alternatives – Devices for thermal collection and storage – Thermal applications – Water heating – Space heating – Power generation – Instruments for measuring solar radiation and sun shine.

UNIT – III: THERMAL ENERGY STORAGE

General characteristics - Definitions - Methods of classifications - Thermal energy storage - Sensible heat storage - Liquids - Solids – Latent heat storage - Thermal chemical storage.

UNIT – IV: PHOTO CONVERSION

Photovoltaic conversion - Principle and working of solar cells - Conversion efficiency - Single crystal and Polycrystalline silicon - Cadmium sulphide - Cadmium telluride.

UNIT – V: SUSTAINABLE FORMS OF ENERGY

Reserves of Energy Resources – Environmental aspects of energy extraction, conversion and utilization – challenges associated with the non-sustainable energy sources with regard to future Supply and the environment

Hydrogen: principle of operation and system components-comparisons among energy uses, resources, and technologies-technical and economic challenges in the integration of sustainable energy form-potential solutions and application.

TEXT BOOKS:

1. P. Sukhatme, Solar energy, Tata McGraw-Hill, (Second edition), 2008.

2. D.P. Kothari, K.C. Singal and Rakesh Ranjan,Renewable energy sources and emerging Technologies, Prentice Hall of India, 2008.
3. S.A. Abbasi and Nasema Abbasi, Renewable Energy sources and their Environmental Impact, PHI Learning Pvt. Ltd., 2008.
4. M.P.Agarwal, Solar Energy, S.Chand & Co, 1983.
5. S.P.Sukhatme, Solar Energy, TMH, 1996.
6. G.D.Rai, Non-conventional Energy sources, Khauna Publication, 2004.

SUPPLEMENTARY READING:

1. John Twidell & Tony Weir, Renewable Energy Resources Taylor & Francis Group, 2006.
2. Kreith and Kreider, Principles of Solar Engineering, McGraw Hill Pub, 1978.
3. A.B.Meinel and A.P.Meinal, Applied Solar Energy, 1976.

COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1: Be aware of various forms of energy and the effective utilization of their resources.
CO2: Be exposed to the practical usage of solar energy.
CO3: Be exposed to the practical usage of thermal energy.
CO4: Acquire an in depth knowledge about the sustainable forms of energy.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - IX	19IPHYE95.1 – INSTRUMENTATION	Credit : 3 Hours: 3

ELECTIVE-IV (DE 2)

LEARNING OBJECTIVES:

- To understand the types of transducer for a particular measurement.
- To develop knowledge in digital, analytical and biomedical instruments for different applications.
- To know the functioning of medical imaging instruments.

UNIT – I: TRANSDUCERS

Basic functional elements of measuring system-Transducers: Definition-Parts-Classification-Types of primary sensing element.

LVDT: Principle –Working –Measurement of displacement.

Electrical Strain Gauge: Principle-Theory-Types-Working -Measurement of Force (or) Pressure.

Capacitive Transducers: Principle-Types-Working-Measurement of linear and angular displacement.

Thermistor: Principle-Working-Measurement of temperature.

Piezo electric transducers: Principle, theory and working of piezo electric crystals.

UNIT – II: DIGITAL INSTRUMENTATION

Principle, block diagram and working of: Digital Multimeter, Digital Frequency counter, Digital pH meter, Digital conductivity meter, Digital storage Oscilloscope and Q-meter.

UNIT – III: ANALYTICAL INSTRUMENTATION

Principle, working, Instrumentation and applications of UV-Vis Spectrophotometer, ICP-AES, (Inductively coupled plasma-Atomic emission spectroscopy), SEM (Scanning Electron Microscope) and AFM (Atomic Force Microscopy).

UNIT – IV: BIO-MEDICAL INSTRUMENTATION

Orgin of Bio–potentials: Measurements- Resting and action potentials-Characteristics of resting potential-Bio electric potentials-Types of bioelectric signal and their characteristics.

Components of the Bio-medical instrument system-Electrodes: Equivalent circuit-Theory - Types. Principle, block diagram and functioning of ECG, EEG and EMG.

UNIT – V: MEDICAL IMAGING INSTRUMENTATION

Magnetic Resonance Imaging: Principle-Magnetic resonance phenomena-Magnetic resonance imaging-Imaging process-Instrumentation.

Ultrasonic Imaging System: Principle-Construction of an ultrasonic transducer-Ultrasonic propagation through tissues-Display-A mode- B mode- M mode-TM mode-Doppler mode-Recording devices.

Computed Tomography: Principle-CAT scanning-Instrumentation-Contrast scale-Scanning components.

TEXT BOOKS FOR STUDY:

1. Electrical and Electronics Measurement and Instrumentation, A.K.Sawhney, Dhanpath Rai and Co., Pvt., Ltd., 2000.
2. Electronic measurements and Instrumentation, Dr.Rajendra Prasad, Khanna Publishers, 2002
3. Biomedical Instrumentation, M.Arumugam, Anuradha Publishers, 2001.
4. Instrumentation, V.Ramasamy, Swami Publications, 2005.

TEXT BOOKS FOR REFERENCE:

1. Instrumental methods of analysis, Willard.D. Merrit et.al.,CBS Publishers, 2004.
2. Instrumental methods of analysis, Gurdeep Chatwal and Sham Anand, Himalaya Publishers, 2003.
3. Hand Book of Biomedical Instrumentation, R.S.Khandpur, TMH, 2004.
4. Instrumentation, B.C.Nakra and K.K.Chawdry, Measurement and Analysis, TMH, 2004.
5. Modern Electronic Instrumentation and Measurement Techniques, Albert D.Helfrock and William D Cooper, Printice Hall of India, 2000.
6. Bio Medical Electronics and Instrumentation, S.K.Venkata Ram, Galgotia Publications

Pvt. Ltd., 2001.

COURSE OUTCOMES (COs):

By the end of the Course, the students will be able to

CO1: Select the types of transducer for a particular measurement.
CO2: Test and use the digital instruments for different applications.
CO3: Understand the various analytical and biomedical instrumentation and their uses.
CO4: Know the functioning of medical imaging instruments.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓				✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓				✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓

SEMESTER - IX	19IPHYE95.2- BIO-MEDICAL INSTRUMENTATION	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To gain the knowledge about the bio medical instruments used for measuring bio-electric potentials and the electrodes used for sensing the bio potentials.
- To understand the working principles of imaging equipments and bio medical instruments used for determining the physiological parameters.
- To update the knowledge of various lasers used for medical applications for the students.

UNIT – I: BIO-ELECTRIC POTENTIALS

Resting and action potentials – Propagation of action potentials – Bioelectric potentials-Electrocardiogram (ECG) – Electroencephalogram (EEG) –Electromyogram (EMG) – Electroretinography(ERG) - Electrooculography (EOG).

UNIT – II: BIO-POTENTIAL ELECTRODES

Biopotential Electrodes – Types of Electrodes -Microelectrodes – Body surface electrodes – Depth and Needle electrodes- Chemical electrodes –Distortion in measured bioelectric signals using electrodes-Electrode paste

UNIT – III: IMAGING EQUIPMENTS

Ultrasonic Imaging-Reflection-Scattering-A mode display-B mode display-T-M mode display-Ultrasonic imaging instrumentation-Biomedical applications- Magnetic Resonance Imaging (MRI)-Principle-Instrumentation-Advantages of MRI over other medical imaging techniques-Thermography-Endoscopy

UNIT – IV: MEASUREMENT OF PHYSIOLOGICAL PARAMETERS

Blood Pressure Measurement-Introduction-Direct Measurement using Catheters-Advance of Direct Method-Indirect Method-Oscillometric measurement method-

Electromagnetic Blood Flow Meters-Ultrasonic Blood Flow Meter-transit time method-Doppler effect based ultrasonic blood flow meter-laser Doppler Blood Flow Meter-NMR Blood Flow Meter

UNIT – V: LASER IN MEDICINE

Introduction- Characteristics of laser light- Generation of laser- Components of laser- Types of laser-Nd-YAG laser-Helium-Neon laser - CO_2 laser- Semiconductor laser- Applications of laser in Medical field.

TEXT BOOKS FOR STUDY:

1. Bio Medical Instrumentation, T.Rajalakshmi, First Edition, Sams Publishers, 2008.
2. Biomedical Instrumentation, M.Arumugam, Fourth reprint, Anuradha Agencies, 2000.
3. Hand book of Biomedical Instrumentation, R.S. Khandpur, Tata McGraw Hill, 2007.

TEXT BOOKS FOR REFERENCE:

1. Introduction to Biomedical Instrumentation and Measurements 2 nd Ed, Robert B Northrop, (2005) LLCCRC Press is an imprint of Taylor & Francis Group.
2. Hand Book of Bio medical Instrumentation,3 rd Edn., R.S. Khandpur, Access Eng. (2016).
3. Fundamentals of Instrumentation and Measurement, Dominique Placko, (2007) by ISTE Ltd.

COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1: Understand the importance of bio medical instruments and accuracy of the measured physical parameters and their practical implementation in the medical field.
CO2: Understand experimentally recording data, its inference to diagnose the diseases.
CO3: Understand various techniques and its relevance in various defects in the body parts.
CO4: Solve the health issues from the bio medical instruments and applicability in physics concepts may give the clear idea about the health issues.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓				✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓				✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓

SEMESTER - IX	19IPHYE95.3 - PETRO PHYSICS	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To understand the various magnetites and behaviour of the remenance properties.

- To study the geomagnetic elements of the earth and various magnetometer instruments.
- To understand the classification and properties of of rock forming minerals
- To highlight the concept of seismic waves and various dating methods.

UNIT – I

Magneto crystalline anisotropy – Dipolar anisotropy – Single ion anisotropy – Anisotropic exchange – Constants. Magnetic properties of mineral systems – Solid- Solid – Solution of oxides of iron – magnetite, haematite magnemites, titano magnetites, titono magneites, haematite – illmenite solid solution and pyrhotites – Intrinsic properties, magnetization process, weak field remanance.

Remanance properties- NRM, TRM, CRM, DRM, VRM, PRM – their mechanisms – Thermal demagnetization technique – partial TRM – additive law – Neel's theory of TRM. Primary and Secondary magnetization – Testing for stability of remanance.

UNIT – II

Geomagnetic elements of the earth – Field variation and detection - The Magnetic observatory – mapping of secular variations. Diurnal variation of magnetic disturbances – initial susceptibility of rocks – single and multidomain cases – Curie point determination and its importance.

Laboratory and field instruments for magnetic measurements – Astatic magnetometer – spinner magnetometer – Fluxgate magnetometer, Proton procession magnetometer – Theory, practice and applications.

UNIT -III

Classification of rock forming minerals – physical properties of minerals with special reference to optical properties – elementary details of a polarizing microscope and petrographic analysis.

Geophysical prospecting – different methods – Geophysical properties of rocks and minerals – Resistivity methods – Two current electrode method - different electrode layouts – measuring equipment – application to ground water survey.

UNIT – IV

Seismic waves – S waves & P waves – elastic, plastic behavior of rocks – modulus of elasticity in rocks – Time distance curves and the location of epicenters – Derivation properties from the velocities – the recent developments.

UNIT – V

Geochronology – the geological time scale – archaeo-magnetic dating – Radio active methods of dating – Rubidium, Strontium method – Potassium Argon method – Thermo-luminescence dating and interpretation of data.

Text Books for study:

1. Solid State Physics – RL. Singhal, Kedarnath Ramnath & Co. Meerut.
2. Solid State Physics – A.J. Dekker, Prentice Hill.
3. Solid State Physics – Semana and Gupta and Sexana Pragati Prakash, Meerut.

4. Applied Geophysics – Eve and Keys, Cambridge University Press.
5. Rock and Mineral magnetism – W.O. Reilly, Blackmoore.

Text Books for Reference:

1. Introduction to Geophysics – Howell, McGraw Hill Book Co.
2. Introduction to Geophysics – G.D. Garland, 2nd Edn. Saunder's Book Co.
3. Principles and Applications of Palaemaguetism – T.H. Tarling, Chapmann and Hall.
4. Palaemaguetism and plate tectonics – Mc Elhinny, Cambridge University Press.
5. Introduction to Geophysical propecting – Dobrin, McGraw Hill Book Co.

COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1: Uunderstand the various magnetites and behaviour of the remenance properties.

CO2: Sudy the geomagnetic elements of the earth and various magnetometer instruments.
CO3: To understand the classification and properties of of rock forming minerals
CO4: To highlight the concept of seismic waves and various dating methods.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - IX	19IPHYE95.4 - MEDICAL PHYSICS	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To gain the knowledge about the bio medical instruments used for measuring bio-electric potentials and the electrodes used for sensing the bio potentials.
- To understand the working principles of imaging equipments and bio medical instruments used for determining the physiological parameters.
- To update the knowledge of various nuclear medicine and biological effects of radiation.

Unit – I: Bio-Electric Potentials

Resting and action potentials - Propagation of action potentials – Bioelectric potentials – Electrocardiogram (ECG) – electroencephalogram (EEG) – Electromyogram (EMG) – Electroetinography – Electrooculography (EOG).

Bio- potential Electrodes – Types of electrodes – Microelectrodes – Body surface electrodes – Depth and Needle electrodes – Chemical electrodes – Distortion in measured bioelectric signals using electrodes – Electrode paste.

Unit – II: Digital X-ray imaging and Computed Tomography

Production of X-rays – Types of X-ray tubes – Generators – Interaction of X and Gamma rays with matter – Image formation and image quality – CR and DR – the image intensifier – fluoroscopy – Equipment for computed tomography scanning – Image reconstruction – Helical and multi-slice scanning – Image quality and artifacts – CT dose index.

Unit – III: Imaging with Ultrasound and MRI

Piezoelectric effect – Interference – Different types of transducers – Modes of scanning – Image quality and artifacts – Doppler methods – Hemodynamic data – The spinning proton – the MR signal – Spin echo sequence – Spatial encoding – Other pulse sequences – functional MRI – Image quality and artifacts – Magnets and coils – Hazards and safe practice –Thermograpy – endoscopy.

Unit – IV: Physics of Nuclear Medicine and Biological effects of Radiation

Radioactivity - Radioactive transformation – Radiopharmaceuticals – Hot lab – Gamma camera – Planner imaging – tomography with radionuclide – PET scanner – Characteristics and quality assurance of images – Precautions necessary in handling open radioactive sources – Ionizing radiation interactions with tissues – Radiation dose and units – Effects of radiation – Principles of radiation protection – ICRP, BARC and AERB – eLORA – Practical aspects of radiation protection.

Unit – V: Medical Imaging Instrumentation

Radiation therapy – Surgery – Chemotherapy – Hormone therapy – Immunotherpy and Radionuclide therapy – Begin and malignant disease – Methods of spread of malignant disease – Staging and grading systems, Treatment intent – Curative and Palliative – Teletherapy and Brachy therapy – Co-60 and other radioactive sources used in the treatment of cancer – Linear accelerator – Modern treatment techniques – Treatment planning – Non-Photon ionizing radiation treatments and challenges.

Text Books for study:

1. Bio Medical Instrumentation, T.Rajalakshmi, First Edition, 2008.
2. Bio Medical Instrumentation, M.Arumugam, Fourth reprint, 2000.
3. Handbook of Biomedical Instrumentation, R.S.Khandpur, 2007.

Text Books for References:

1. Farr's Physics for Medical Imaging, Penelope Allsiy, Rpberts, Jerry R.Villiams, Saunders, Elsevier, Second Edition, 2008.
2. The Physics of Radiation Therapy, Fiaz M.Khan, 2006.
3. Nuclear Medicine Physics, Ramesh Chandra, 5th Edition, Lea and Febiger.

COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1 :To gain the knowledge about the bio medical instruments used for measuring bio-electric potentials and the electrodes used for sensing the bio potentials.

CO2: To understand the working principles of imaging equipments used for determining the physiological parameters.

CO3 :To understand the working principles of bio medical instruments used for determining the physiological parameters.

CO4 : To update the knowledge of various nuclear medicine and biological effects of radiation.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8

CO1	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓				✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓				✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓

SEMESTER - IX	19IPHYE95.5 – BIOPHYSICS	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To understand the applications of various microscopic tools in cell biology.
- To understand the fundamentals of macromolecular structure.
- To understand the analytical techniques in characterizing biomolecular interactions and its structure.

UNIT I: CELL ORGANIZATION

Cell as the basic structural unit- Origin & organization of Prokaryotic and Eukaryotic cell- Cell size & shape- Fine structure of Prokaryotic & Eukaryotic cell organization (Bacteria, Cyanobacteria, plant & Animal cell)- Internal architecture of cells- cell organelles- compartment & assemblies membrane system- Ribosome- Polysomes- Lysosomes- Peroxisomes- Connection between cell & its environment- Extracellular Matrix.

UNIT II: TOOLS IN CELL BIOLOGY

Light microscope- Resolving Power- Phase contrast microscope- Detection of small differences in refractive indices- Interference microscope-, Dark field microscope- Polarization microscope- Fluorescence microscope- Cytophotometry methods- Flowcytometry & cell sorting- Electron microscopy- specimen preparation- Scanning Electron Microscopy (SEM)- Transmission Electron Microscopy (TEM)-Applications.

UNIT- III: MACROMOLECULAR STRUCTURE

Nucleic acid structure: Chemical structure of the nucleic acid - Conformational possibilities of monomers and polymers- Double helix structure of DNA- Polymorphism of DNA- DNA nanostructures and the structure of transfer RNA.

Proteins structure: Amino acids and the primary structures of proteins – Secondary – Tertiary - Quaternary structure and virus structure.

UNIT-IV: SEPERATION TECHNIQUES

Centrifugation**:** Principle of centrifugation –Analytical ultracentrifugation – Differential centrifugation – Density gradient centrifugation.

Chromatography**:** Principles of chromatography– Paper chromatography – Thin layer chromatography (TLC) – Gas liquid chromatography (GLC) – High performance liquid chromatography (HPLC).

Electrophoresis: Principles – Factors affecting the migration of substances – Supporting media in electrophoresis – Gel electrophoresis – Polyacrylamide gel electrophoresis (PAGE) – Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE).

UNIT V: OPTICAL & DIFFRACTION TECHNIQUES

Circular Dichroism and optical rotator dispersion-: Plane, circular and elliptical polarization of light- Absorption by oriented molecules- Dichroic ratio of proteins and nucleic acids- Circular dichroism (CD) - optical rotatory disperson (ORD) - Relation between CD and ORD- Application of ORD in conformation and interactions of biomolecules.

Crystallization of proteins- preparation of heavy metal derivatives- Patterson synthesis- isomorphous replacement methods- structure factors of centro-symmetric and non-centrosymmetric crystals- General remarks on Protein-Structure determination from X-ray diffraction data-Neutron diffraction-, Electron diffraction-, Synchrotron diffraction, Application in Biomolecular structural studies.

TEXT BOOKS FOR STUDY:

1. Biophysics, M.A. Subramanian, MJP Publishers, 2005.
2. Bioinstrumentation, L.Veerakumari, MJP Publishers, 2006.
3. Fundamentals of Biochemistry, A.C. Deb, New central book agency, 2011.

TEXT BOOKS FOR REFERENCE:

1. The Cell: A Molecular Approach, Geoffrey M.Cooper, ASM Press, 2013.
2. Biophysics, Vasantha Pattabhi, N. Gautham, Narosa Publishing, 2009.
3. Biophysics, P.S. Mishra, VK Enterprises, 2010.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Have in-depth knowledge of the structure of cells and the macromolecular structure.

CO2: Understand the basic principles of the various microscopic techniques presented in the course, their advantages and limitations.

CO3: Provide an introduction to various separation techniques that are used in biological samples.

CO4: Understand the different processes of optical and diffraction techniques.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓						✓	✓		✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

19IPHYA-1- ANCILLARY PHYSICS-I	**Credit : 3** **Hours: 3**

[Common for Integrated Chemistry, Mathematics, Geology, Marine (OST) and IT]

LEARNING OBJECTIVES:

- To make the interdisciplinary students to understand the elementary concepts of various topics of physics.
- To understand the centre of gravity, behaviour of fluids and laser physics.
- To understand the fundamental principles and ideas of nuclear physics and basic electronics.

UNIT - I: MECHANICS

Centre of gravity – Definition - Determination of centre of gravity of a hollow hemisphere, solid hemisphere and solid cone.

Streamline and Turbulent flow - Equation of continuity of flow – Energy of a liquid in flow- Bernouli's theorem – Velocity of efflux of a liquid - Torricelli's theorem – Venturimeter.

UNIT - II: RELATIVITY

Introduction - Definition of Relativity - Special theory and general theory of relativity - Postulates- Newtonian relativity - Frame of reference - Galilean transformation equations - The Michelson - Morley experiment - Lorentz transformation equations - Derivation - Length contraction -Time dilation - Addition of velocity - Variation of mass with velocity - Mass - Energy equivalence.

UNIT-III: LASER PHYSICS

Introduction - absorption – spontaneous emission – Stimulated emission – Einstein's A and B coefficients – Population inversion – Meta stable state – Pumping– Methods of pumping – Components of laser – Ruby laser – Helium – Neon laser – Applications.

UNIT- IV: NUCLEAR PHYSICS

Properties of nucleus (size, mass, binding energy, spin and parity) – Particle detectors - G.M.Counter – Wilson cloud chamber - Bubble chamber- Nuclear models – Liquid drop model - Shell model– Nuclear Energy – Nuclear fission - Fusion - Self sustained chain reaction - Nuclear fusion in stars – Carbon - Nitrogen cycle - Proton - Proton cycle - Thermonuclear reaction - Nuclear reactor.

UNIT- V: BASIC ELECTRONICS

Junction diode- Zener diode- Photodiode- Transistor -CE and CB characteristics- LED and LCD – Applications.

TEXT BOOKS FOR STUDY:

1. Allied Physics by R. Murugesan, S.Chand & Co, Ltd., 2005.
2. Modern Physics, Murugasen & Kiruthiga Sivaprasath S.Chand & Co Ltd., 2016
3. Elements of Nuclear Physics, M.L.Pandya and P.R.S.Yadav Kedarnath Ramnath, 1993.
4. Principles of Electronics – V.K. Metha, Rohit Mehta, S.Chand & Co Ltd., 1980.

TEXT BOOKS FOR REFERENCES:

1. Mechanics, DS.Mathur & P.S. Hemne, S.Chand & Co Ltd., 2006.
2. Concepts of Modern Physics by A. Beiser, Tata McGraw Hill Publication, 1997.
3. An introduction to Lasers theory and applications, M.N. Avadhanulu and P.S. Hemne, S. Chand & Co. Ltd., 2011.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand the behaviour of fluids and practical applications of the same in real life.

CO2: Understand relativity and its consequences.

CO3: Acquire in depth knowledge of various lasers and diodes used for different applications.

CO4: Knowledge about the different types of nuclear models and detectors.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓	✓	✓
CO2	✓	✓					✓				✓			✓		✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

19IPHYA-2- ANCILLARY PHYSICS – II	**Credit : 3** **Hours: 3**

[Common for Five year M.Sc: Chemistry, Mathematics, Geology and Marine (OST)]

LEARNING OBJECTIVES:

- To educate the interdisciplinary students to understand the fundamental concepts of various topics of physics.
- To understand about atom model, X-rays, photoelectric effect and wave mechanics.
- To know about the ideas of nuclear physics,polarization and digital electronics.

UNIT - I: ATOMIC PHYSICS

Atom model: Bohr, Sommerfeld's and vector atom models -The Pauli's exclusion principle - Various quantum numbers.

X-Rays: Production and properties of X-rays - Bragg's law - Bragg's X-ray spectrometer - Moseley's law - Compton Scattering.

UNIT – II: MODERN PHYSICS

Photo electric effect – Einstein's photo electric equation – verification of Einstein's photo electric equation by Millikan's experiment – photo electric cells – applications

Wave mechanics: De Broglie matter waves – characteristics and calculation of De Broglie wave length – Experimental study of De Broglie matter wave by G.P.Thomson experiment.

UNIT – III: NUCLEAR PHYSICS

Nuclear detectors – Ionization Chamber – Proportional counter –Scintillation counters.

Particle accelerators – Linear accelerator – Cyclotron – synchro cyclotron – Betatron.

UNIT – IV: POLARIZATION

Polarization - Brewster's Law -Huygen's explanation of double refraction in uniaxial crystals - polarizing prisms - Quarter and half wave plates - Production and detection of a plane, circularly and elliptically polarized light.

Optical Activity – Fresnel's explanation of rotation - Fresnel's experiment - Specific rotation - Determination of Specific rotatory by Laurent's half shade polarimeter.

UNIT- V: DIGITAL ELECTRONICS:

Decimal, Binary, Octal and hexadecimal number systems - Basic logic gates - OR, AND, NOT - Universal gates - Boolean algebra - Demorgan's theorem - Verification.

TEXT BOOKS FOR STUDY:

1. Modern Physics, R. Murugasen, & Kiruthiga Sivaprasath S.Chand & Co Ltd., 2016
2. Allied Physics by R. Murugesan, S.Chand & Co, Ltd., 2005.
3. A Text Book of Optics, N. Subramanyam Brij lal, M.N. Avadhanulu, S. Chand & Co Ltd., 2018.

TEXT BOOKS FOR REFERENCES:

1. Principles of Modern Physics, A.K. Saxena, Narosa Publishing House, 2010.
2. Atomic Physics, J.B. Rajam, S. 20th Edition, Chand & Co Ltd., 2004.
3. Modern Digital Electronics, RP.Jain, Tata McGraw Hill, 2006.
4. Elements of Nuclear Physics, M.L.Pandya and P.R.S.Yadav Kedarnath Ramnath, 1993.

COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1 : Understand the atomic models, production of X-rays and photoelectric effect with its applications.

CO2: Understand the various nuclear detectors and particle accelerators.

CO3: Understand the phenomenon of polarization.

CO4: Acquire basic knowledge about number systems and logic gates.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓	✓	✓
CO2	✓	✓					✓				✓			✓		✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

19IPHYAP-1- ANCILLARY PHYSICS PRACTICAL –I	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To providing a hands-on learning experience such as in measuring the basic concepts in properties of matter, sound, heat, optics and electricity.

Any Eight Experiments

1. Sonometer – Verification of laws.
2. Spectrometer – Refractive index of a solid prism.
3. Spectrometer – Hollow prism.
4. Potentiometer – Low range voltmeter.
5. Potentiometer – Internal resistance of a cell.
6. Coefficient of viscosities- Ostwald's apparatus.
7. Rigidity modulus by torsional pendulum.
8. Potentiometer – Comparison of e.m.f of the cells.
9. Young's modulus – Non uniform bending (pin and microscope).
10. Coefficient of viscosities- Hare's apparatus.
11. Drop weight method - Surface tension of a liquid.

COURSE OUTCOMES (COs):

CO1: Apply knowledge of physics fundamentals and an instrumentation to arrive solution for various problems.

CO2: Understand the usage of basic laws and theories to determine various properties of the materials given.

CO3: Understand the application side of the experiments

CO4: Use of basic laws to study the spectral properties and optical properties of the given prism.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓

19IPHYAP-2- ANCILLARY PHYSICS PRACTICAL – II	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To gain depth of knowledge regarding the physics fundamentals and an instrumentation to arrive solution for various problems.
- To study the aspects related to the application side of the experiments
- To understand the usage of basic laws and theories to determine various properties of the materials given.
- To providing a hands-on learning experience such as in measuring the basic concepts in properties of matter, sound, heat, optics and electricity.

(Any **Ten** experiments)

1. Young's modulus –uniform bending (pin and microscope).
2. Newton's Rings.
3. Spectrometer – Refractive index of a Prism (Minimum deviation).
4. Spectrometer – Grating – Normal incidence – λ determination.
5. Field along the axis of a circular coil - Determination of H (Using Vibration Magnetometer).
6. Potentiometer – Low range Ammeter.
7. Potentiometer – High range voltmeter.
8. Field along the axis of a circular coil – deflection magnetometer.
9. V-I characteristics of junction diode.
10. Logic gates – Discrete components.
11. Half wave and full wave rectifier.
12. V-I Characteristics of Zener diode.

COURSE OUTCOMES (COS):

CO1: Apply knowledge of physics fundamentals and an instrumentation to arrive solution for various problems.
CO2: Understand the usage of basic laws and theories to determine various properties of the materials given.
CO3: Understand the application side of the experiments
CO4: Acquire in depth knowledge regarding the basic concepts in electricity and magnetism.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓

19IPHYIE85.1: CLASSICAL MECHANICS AND SPECIAL THEORY OF RELATIVITY	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To develop familiarity with the physical concepts and facility with the mathematical methods of classical mechanics
- The main goal of this course is to acquire fundamental knowledge of classical mechanics.
- To understand relativity and its consequences

Unit – I

Principle of Newtonian Mechanics – particle mechanics – conservation laws of linear momentum, Angular momentum and energy of a particle and body – Constraints and classification with examples – particle motion under a constant force – Motion of a system with variable mass.

Unit – II

Principle of virtual work – D'Alembert's principle – generalized coordinates – Lagrange equations – Cyclic or ignorable coordinates – remarks about the Lagrangian – Generalized moments and energy – Hamilton's principle – Hamilton's equations of motion.

Unit – III

Motion of a rigid body – the inertia tensor – Euler's equation of motion – Euler's angles – motion of a symmetric top – Poisson brackets and their properties – conservation theorems in Poisson brackets – small oscillations – normal modes – free vibrations of linear triatomic molecules – Harmonic oscillator – as an example of Hamilton-Jacobi method.

Unit – IV

Newtonian relativity- Michelson Morley experiment- Lorentz transformation and Consequences- relativity of simultaneity- the Lorenz-Fitz Gerald length contraction, Time dilation- Addition velocities.

Unit – V

Variation of mass with velocity, Mass energy relation, Minkowski four dimensional contiumum- Four vectors Compton scattering.

TEXT BOOKS FOR STUDY:

1. Introduction to classical mechanics, R.G.Takwale and P.S.Purani Tata Macgraw Hill Publishing co Ltd., New Delhi.
2. Classical Mechanics, B.D.Gupta and Sathyaprakash Kedaernath Ramnath and Co. Ltd.
3. Classical Mechanics, V.B.Bhatia Narosa Publishing House, Chennai.

TEXT BOOKS FOR REFERENCE:

1. Classical Mechanics, H.Goldstein,Addision Wesley publishing company, Masssachusetts, 1961.
2. Classical Mechanics of Rigid Bodies, Kiran C.Guta, New Age Publications, 1997.

COURSE OUTCOMES (COs):

By the end of the course, students will be able to

CO1: Know the physical concepts and facility with the mathematical methods of classical mechanics
CO2: Use D'Alembert's principle to derive the Lagrange equations of motion.
CO3: Acquire fundamental knowledge of classical mechanics.
CO4: Understand relativity and its consequences

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓							✓	✓	✓	✓	✓		✓	
CO2	✓	✓		✓							✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓		✓				✓	✓	✓	✓	✓		✓	
CO4	✓	✓		✓	✓		✓				✓	✓	✓	✓	✓		✓	

19IPHYIE85.2: PHYSICS OF THE EARTH	**Credit : 3** **Hours: 3**

LEARNING OBJECTIVES:

- To understand the physical structure and behaviour of the earth as well as geomagnetic properties of rocks in the Earth's crust.
- To study the elastic behaviour in earth by applying various theories and hypothesis.
- To highlight the concept of solar system and behaviour of planets in this system.

UNIT – I: SOLAR SYSTEM

The earth and the solar system – Important physical parameters and properties of the planet earth; Stress and Strain, Wave and motion, Seismic waves. Travel time Tables and Velocity – Depth curves – Variation of Density within the Earth.

UNIT – II: GRAVITATION

Rotation of the Earth - Gravitational attraction, Gravitational Theory, Measurements of Gravity, Gravity meters - Principles and method of measuring gravity - Gravity anomalies-Local and regional variations.

UNIT – III: THERMAL HISTORY OF EARTH

Thermal history of the Earth. Temperature in the Primitive Earth and the Earth's surface and interior. Thermal conductivity. Generation of heat in the Earth. Heat flow measurements, methods and results.

UNIT – IV: ELASTIC PROPERTIES

Elastic constants and Elastic process in the earth. Earth's free rotation. Latitude variation. Tides of the Solid earth. Numerical values of Love's numbers. Rigidity of the Earth. Bulk modules in the earth. Poisson's ratio in the Earth, Young's modulus and Lame's constant.

UNIT – V: GEOMAGNETISM AND PALAEOMAGNETISM

Geomagnetism and palaeomagnetism-Earth's magnetic field. Origin-Theory of earth's magnetic field. Magneto hydrodymics of the Earth. Magnetic reversals. Polar wandering. Tectonic movements and its relation to palaeomagnetism - Measurement of magnetic properties of rocks.

TEXT BOOKS FOR STUDY:

1. Physics of the Earth and planets, A.H. Cook, Macmillan, 1973.
2. Physics and Geology, J. A. Jacobs, R. D. Russel and J. T. Wilson, 1974.
3. Applied Geophysics, A.S. Eve and Keys, D. A, Cambridge University, 2954.

TEXT BOOKS FOR REFERENCE:

1. Physics of the earth's Interior, Gutenberg, international Geophysics series, Vol.1 Academic press, 1959.
2. International student edition. P.J. Wyllie, The dynamic Earth, John Wiley and sons, 1971.
3. The solid earth, An Introduction to Global Geophysics, C.M.R. Fowler, Cambridge University press, 1990.
4. Geomagnetic reversals and plate tectonics, Alan Cox, Freeman and company, 1973.

COURSE OUTCOMES (COs):

By the end of the semester, the students will be able to

CO1 : Think and analyse the concept of the Earth and its properties.
CO2 : Accumulate the various concept proposed by theories and laws.
CO3 : Enlighten the concept solar system.
CO4: Acquire basic knowledge about geomagnetism and paleomagnetism.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

SEMESTER - IX	19IPHYIE95.1: BIO-MEDICAL INSTRUMENTATION	Credit : 3 Hours: 3

LEARNING OBJECTIVES:

- To gain the knowledge about the bio medical instruments used for measuring bio-electric potentials and the electrodes used for sensing the bio potentials.
- To understand the working principles of imaging equipments and bio medical instruments used for determine the physiological parameters.
- To update the knowledge of various lasers used for medical applications for the students.

UNIT – I: BIO-ELECTRIC POTENTIALS

Resting and action potentials – Propagation of action potentials – Bioelectric potentials- Electrocardiogram (ECG) – Electroencephalogram (EEG) –Electromyogram (EMG) – Electroretinography(ERG) - Electrooculography (EOG).

UNIT – II: BIO-POTENTIAL ELECTRODES

Biopotential Electrodes – Types of Electrodes -Microelectrodes – Body surface electrodes – Depth and Needle electrodes- Chemical electrodes –Distortion in measured bioelectric signals using electrodes-Electrode paste.

UNIT – III: IMAGING EQUIPMENTS

Ultrasonic Imaging-Reflection-Scattering-A mode display-B mode display-T-M mode display-Ultrasonic imaging instrumentation-Biomedical applications- Magnetic Resonance Imaging (MRI)-Principle-Instrumentation-Advantages of MRI over other medical imaging techniques-Thermography-Endoscopy.

UNIT – IV: MEASUREMENT OF PHYSIOLOGICAL PARAMETERS

Blood Pressure Measurement-Introduction-Direct Measurement using Catheters-Advance of Direct Method-Indirect Method-Oscillometric measurement method.

Electromagnetic Blood Flow Meters-Ultrasonic Blood Flow Meter-transit time method-Doppler effect based ultrasonic blood flow meter-laser Doppler Blood Flow Meter-NMR Blood Flow Meter.

UNIT – V: LASER IN MEDICINE

Introduction- Characteristics of laser light- Generation of laser- Components of laser- Types of laser-Nd-YAG laser-Helium-Neon laser - CO_2 laser- Semiconductor laser- Applications of laser in Medical field.

TEXT BOOKS FOR STUDY:

1. Bio Medical Instrumentation, T.Rajalakshmi, First Edition, Sams Publishers, 2008.
2. Biomedical Instrumentation, M.Arumugam, Fourth reprint, Anuradha Agencies, 2000.
3. Hand book of Biomedical Instrumentation, R.S. Khandpur, Tata McGraw Hill, 2007.

TEXT BOOKS FOR REFERENCE:

1. Introduction to Biomedical Instrumentation and Measurements 2 nd Ed, Robert B Northrop, (2005) LLCCRC Press is an imprint of Taylor & Francis Group.
2. Hand Book of Bio medical Instrumentation,3 rd Edn., R.S. Khandpur, Access Eng. (2016).
3. Fundamentals of Instrumentation and Measurement, Dominique Placko, (2007) by ISTE Ltd.

COURSE OUTCOMES:

By the end of the course, the student will be able to

CO1: Understand the importance of bio medical instruments and accuracy of the measured physical parameters and their practical implementation in the medical field.

CO2: Understand experimentally recording data, its inference to diagnose the diseases.

CO3: Understand various techniques and its relevance in various defects in the body parts.

CO4: Solve the health issues from the bio medical instruments and applicability in physics concepts may give the clear idea about the health issues.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓				✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓				✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓

19IPHYIE95.2: ENERGY PHYSICS	**Credit : 3** **Hours: 3**

LEARNING OBJECTIVES:

- To create an awareness among the students regarding the forms of energy and the availability of their resources
- To educate regarding the utilization and conservation of energy
- To impart a knowledge about the Sustainable forms of energy

UNIT– I: CONVENTIONAL ENERGY SOURCES

Energy sources and their availability – Various forms of energy – Renewable and conventional energy systems – Comparison – Coal, oil and natural gas.

UNIT – II: SOLAR ENERGY

Solar Energy - Thermal application and solar radiation – Energy alternatives – Devices for thermal collection and storage – Thermal applications – Water heating – Space heating – Power generation – Instruments for measuring solar radiation and sun shine.

UNIT – III: THERMAL ENERGY STORAGE

General characteristics - Definitions - Methods of classifications - Thermal energy storage - Sensible heat storage - Liquids - Solids – Latent heat storage - Thermal chemical storage.

UNIT – IV: PHOTO CONVERSION

Photovoltaic conversion - Principle and working of solar cells - Conversion efficiency - Single crystal and Polycrystalline silicon - Cadmium sulphide - Cadmium telluride.

UNIT – V: SUSTAINABLE FORMS OF ENERGY

Reserves of Energy Resources – Environmental aspects of energy extraction, conversion and utilization – challenges associated with the non-sustainable energy sources with regard to future Supply and the environment

Hydrogen: principle of operation and system components-comparisons among energy uses, resources, and technologies-technical and economic challenges in the integration of sustainable energy form-potential solutions and application.

TEXT BOOKS FOR STUDY:

1. Solar energy (Second edition), P. Sukhatme, Tata McGraw-Hill, 2008.
2. Renewable energy sources and emerging Technologies, D.P. Kothari, K.C. Singal and Rakesh Ranjan, Prentice Hall of India, 2008.
3. Renewable Energy sources and their Environmental Impact, S.A. Abbasi and Nasema Abbasi PHI Learning Pvt. Ltd., 2008.
4. Solar Energy - M.P.Agarwal, S.Chand & Co, 1983.
5. Solar Energy - S.P.Sukhatme, TMH, 1996.
6. Non-conventional Energy sources - G.D.Rai, Khauna Publication, 2004.

TEXT BOOKS FOR REFERENCES:

1. Renewable Energy Resources - John Twidell & Tony Weir, Taylor & Francis Group, 2006.
2. Principles of Solar Engineering - Kreith and Kreider, McGraw Hill Pub, 1978.
3. Applied Solar Energy - A.B.Meinel and A.P.Meinal, 1976.

COURSE OUTCOMES (COs):

By the end of the course, the student will be able to

CO1: Be aware of various forms of energy and the effective utilization of their resources.
CO2: Be exposed to the practical usage of solar energy.
CO3: Be exposed to the practical usage of thermal energy.
CO4: Acquire an in depth knowledge about the sustainable forms of energy.

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓

VALUE ADDED COURSE

(COMBINEDLY OFFERED BY DEPARTMENT OF PHYSICS AND ZOOLOGY)

BIO- MEDICAL INSTRUMENTATION

LEARNING OBJECTIVES:

- To understand the basic structural and functional elements of human body
- To understand the working principles of various instruments in bio-medical field
- To update the knowledge of various bio-instrumentation techniques.

Unit –I : Basic Elements of human Body

Cell: Structure and organelles – Functions of each component in the cell. Cell membrane-transport across membrane – origin of cell membrane potential –Action potential.

Human physiological systems of the body –Structure of heart – properties of Cardiac muscle-Conducting system of heart –Cardiac cycle- Structure of a Neuron – Types of Neuron – Synapses and types- conduction of action potential in neuron – Respiratory system –Components of respiratory system –Respiratory Mechanism- Types of respiration – Oxygen and carbon dioxide transport and acid base regulation – problems encountered in biomedical measurements.

Unit II: Separation techniques for Bio-molecules

Electrophoresis: Principles, methods and application of paper, Cellulose and immune electorophoresis, Poly Acrylamide. Gel Electphoresis.

Chromatography: Principles, methods and application of paper chromatography, thin layer chromatography (TLC), Gas chromatography (GC) Gas liquid chromatography (GLC), High performance liquid chromatography(HPLC), Ion-Exchange chromatography.

Unit III: Bio-Electric Potentials

Resting and action potentials – Propagation of action potentials – Bioelectric potentials – Electrocardiogram (ECG) – Electroencephalogram (EEG) – Electromyogram (EMG) Electroretinography (ERG) – Electrooculography (EOG).

Unit IV: Bio- Potential Electrodes

Biopotential Electrodes – Types of Electrodes- Microelectrodes – Body surface electrodes – Depth and Needle electrodes –Chemical electrodes –Distortion in measured bioelectric signals using electrodes – Electrode paste.

Unit V: Imaging Equipments

Ultrasonic imaging – Reflection –Scattering-A mode display-B mode display –T-M mode display-Ultrasonic imaging instrumentation – Biomedical applications. Magnetic Resonance imaging (MRI)- Principles – Instrumentation – Advantages of MRI over other medical imaging techniques – Thermography- Endoscopy.

TEXT BOOKS FOR STUDY:

1. Biomedical Instrumentation, T.Rajalakshmi, First Edition, 2008.
2. Bio medical Instrumentation, M.Arumugam , Fourth Reprint,2000.
3. Animal Physiology, .P.S. Verma, B.S. Tyagi and V.K.Agarwal, 2005. S.Chand & Company Ltd, New Delhi.

TEXT BOOKS FOR REFERENCE:

1. Farr's Physics for Medical imaging, Penelope Allsiy, Rpberts, Jerry R.Villiams, Saunders, Elsevier,Second Edition, 2008.
2. Handbook of Biomedical instrumnetion, R.S. Khandpur,2007.
3. The Physics of Radiation Therapy,Fiaz M.Khan, 2006.
4. Nuclear Medicine physics, Ramesh Chandra, 5th Edition, Lea and Febiger.

COURSE OUTCOMES (COs):

By the end of the course, the students will be able to

CO1: Understand the structure and physiological functioning of various organ systems of human body

CO2: Master the common bio-separation techniques used for clinical applications

CO3: Operate various medical equipments working on the principles of bio-electric potentials

CO4: Understand the basic principles and operations of various imaging equipments used in the clinical field

MAPPING WITH PROGRAMME OUTCOMES (POs) and PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓