Integrated M.Sc. Physics

(Five Year Programme)

Curriculum, Programme Structure and Course contents

(Prepared in conformity with TANSCHE,

LOCF & CBCS)

(2022-2023 Enrolled Students)

(II year and III year Integrated M.Sc. Physics)

DEPARTMENT OF PHYSICS

Manonmaniam Sundaranar University

Tirunelveli

Manonmaniam Sundaranar University

Learning Outcome based Curriculum

Vision of the University

To provide quality education to reach the un-reached

Mission of the University

- To conduct research, teaching and outreach programmes to improve conditions of human living
- To create an academic environment that honours women and men of all races, caste, creed, cultures and an atmosphere that values intellectual curiosity, pursuit of knowledge, academic freedom and integrity
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled

Department of PHYSICS

Vision of the Department

- In pursuit of excellence on to provide higher education in Physics.

Mission of the Department

- By the way of innovation in teaching, inculcating problem-solving skills for the application, and empowering the students' independence.
- By the way of carrying out research on thrust areas, generating facilities through grants from research projects, and competing internationally.
- By the way of extension activities for knowledge dissemination, societal obligation, and leadership role.
- By the way of promoting human values, social harmony, and justice for molding into responsible citizens.

1.	**Name of the Programme**	:	Integrated M.Sc. Physics
2	**Preamble of the Programme**	:	An integrated graduate programme in physics provides an opportunity to expand the understanding of the concepts and to imbibe theoretical frameworks with the support from mathematics and chemistry for equipping with skills to excel in the passion-driven career placement and to fulfill the lifelong researcher ambition.

3. Programme Structure (II year and III Year)

Semester	Part	Course Code	Course Nature	Course Name	Theory/ Practical/ Tutorial	Credits	Contact Hours Per week	Continuous Internal assessment	End Semester Exam
III	I		Language	Tamil / Other language	Theory	4	4	25	75
	II		Language	English	Theory	4	4	25	75
	III		Core 5	Classical Mechanics and Relativity	Theory	4	4	25	75
					Tutorial	1	2	25	25
			Common	Professional English - I	Theory	4	4	25	75
			Allied	Allied Chemistry - I	Theory	3	3	25	75
					Practical	2	4	50	50
			Mandatory	Yoga	Theory	2	2	25	75
	IV		Non-Major Elective 1	Conventional and Non-Conventional Energy sources	Theory	3	3	25	75
					Sub Total	**27**	**30**		
IV	I		Language	Tamil / Other language	Theory	4	4	25	75
	II		Language	English	Theory	4	4	25	75
	III		Core 6	Mathematical Methods and Quantum Mechanics	Theory	4	4	25	75
					Tutorial	1	2	25	25
			Common	Professional English - II	Theory	4	4	25	75
			Allied	Allied Chemistry - II	Theory	3	3	25	75
					Practical	2	4	50	50
	IV		Non-Major Elective 2	Biomedical Instrumentation	Theory	3	3	25	75
			Mandatory	Computers for Digital Era	Theory	2	2	25	75
	V		Extension Activity	NCC, NSS, YRC, YWF	Field Work	1		50	50
					Sub Total	**28**	**30**		
V	III		Core 7	Atomic and Nuclear Physics	Theory	4	4	25	75
					Practical	1	2	25	25
			Core 8	Solid State Physics	Theory	4	4	25	75
					Practical	1	2	25	25
			Core 9	Analog and Digital Electronics	Theory	4	4	25	75
					Practical	1	2	25	25
			Core 10	Numerical Methods a and programming in C	Theory	4	4	25	75
					Practical	1	2	25	25
			Skill Based Core 1	Choose any one from Group I	Theory	2	2	25	75
	IV		Skill Based Common	Personality Development / Effective Communication / Youth Leadership	Theory	2	2	25	75
					Sub Total	**24**	**28**		
VI	III		Elective I	Choose any one from Group I (online mode)	Theory	3	3	25	75
			Elective II	Choose any one from Group II (online mode)	Theory	3	3	25	75
			Skill Based Core 2	Choose any one from Group II	Theory	2	2	25	75
			Project	Internship /Project		16	20	50	50
					Sub Total	**24**	**28**		
					TOTAL (25+25+27+28+24+24)	**153**			

Skill Based Core Courses:

Skill Based Core courses I and II are offered to the students of the physics department as given below in two groups. One course shall be taken by each student during the fifth and sixth semesters respectively.

Group I

a) Computational Physics
b) Basic Instrumentation Skills
c) Applied Optics

Group II

a) Renewable Energy
b) Radiation Safety
c) Electrical Circuit and Network Skills

Elective Courses:

Elective courses I and II are offered to the students of the physics department as given below in two groups. One course shall be taken by each student during the sixth semester

Group I

a) Energy Physics
b) Computer Programming in C++
c) Optoelectronics

Group II

a) Nanophysics
b) Medical Physics
c) Laser Physics

<table>
<tr><td></td><td colspan="3">Scheme of Evaluation:</td></tr>
<tr><td>(a) CIA</td><td>Theory Course</td><td>:</td><td>For the first 6 semesters, the Continuous Internal Assessment 25 marks are divided as 20 marks for the internal written test (average of the marks from the best two tests out of three tests) and 5 marks for the assignment (At least one assignment in each unit by a student) activities. There is no passing minimum in the internal test marks for each paper. The question paper pattern for the internal assessment test of each theory paper is given below. The questions for the internal assessment test shall be distributed to assess all the cognitive levels of Bloom’s taxonomy and the same shall be tabulated at the top of the question paper.
<table>
<tr><th>Section</th><th>Type of Questions</th><th>Max. Marks</th></tr>
<tr><td>Part A</td><td>Objective Type -5 Questions</td><td>2 × 1 = 2</td></tr>
<tr><td>Part B</td><td>Answer any two out of three questions of either problems or descriptive type</td><td>2 × 5 = 10</td></tr>
<tr><td>Part C</td><td>Answer any one out of two questions of either problems or descriptive type</td><td>1 × 8 = 8</td></tr>
<tr><td colspan="2">Total Marks</td><td>20</td></tr>
</table></td></tr>
<tr><td></td><td>Practical</td><td>:</td><td>Phase I – Continuous Assessment (25 Marks)
“N” number of practicals be conducted based on the practicals prescribed in the syllabus and the marks should be distributed equally for each practical. There is no passing minimum in the Internal Continuous Assessment. Two tests should be conducted and the average of tests will be taken for 25 marks.
<u>Calculation of marks for 50:</u>
Sum of marks awarded to a number of practicals (25 marks) + the Average Marks of two tests (25 marks).</td></tr>
<tr><td></td><td></td><td>:</td><td></td></tr>
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<table>
<tr><td></td><td>Project</td><td></td><td>The project work shall be based on any research-oriented topics, both in the fields of theoretical and experimental physics under the guidance of a faculty member of the Department as a Project Supervisor. After completion of the project work at the end of semester VI, each student should submit two copies of the project report/thesis to the Department on or before a date as notified for the same. The project viva-voce examination for the students will be conducted individually.
<u>Calculation of marks for 50:</u>
Sum of marks awarded to continuous assessment of the project work (25 marks) + the Average Marks of two project reviews (25 marks).</td></tr>
<tr><td></td><td>Internship*</td><td>:</td><td>An internship is carried out by the student throughout the sixth semester in companies/institutions/hospitals/organizations. There are two mentors for an internship, one from the department and another from the company to guide them and monitor their progress.
Two review presentations should be conducted and the average of presentations will be taken for 25 marks.
<u>Calculation of marks for 50:</u>
Sum of marks awarded by the companies/institutions/hospitals/organizations (25 marks) + the Average Mark of two review presentations given by the department mentor (25 marks).</td></tr>
<tr><td>(b) ESE</td><td>Theory Course</td><td>:</td><td>The duration of the University examination for each theory course is 3 hours. There is a passing minimum of 50% in the University examinations in each theory course and there is a passing minimum of 50% in the overall component, i.e. out of the total marks in the CIA component and the University examination for each theory course. There will be a special supplementary examination for those candidates who have failed only one subject in the entire programme. The questions for the end semester examination shall be distributed to assess all the cognitive levels of Bloom’s taxonomy and the same shall be tabulated at the top of the question paper. The question paper pattern for the end-semester examination of each theory paper is given below.
<table>
<tr><th>Section</th><th>Type of Questions</th><th>Max. Marks</th></tr>
<tr><td>Part A</td><td>Objective Type -10 Questions
(2 from each units)</td><td>10 × 1 = 10</td></tr>
<tr><td>Part B</td><td>Unit-wise choice – Either (a) or (b) type – 5 Questions Problems</td><td>5 × 5 = 25</td></tr>
<tr><td>Part C</td><td>Unit-wise choice-Either (a) or (b) type – 5 Descriptive or analytical Questions</td><td>5 × 8 = 40</td></tr>
<tr><td colspan="2">Total Marks</td><td>75</td></tr>
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</td></tr>
</table>

	Practical	:	Only one practical examination should be conducted at the end of the semester for the students on a lot basis by appointing TWO examiners; one (Course Teacher) and another from the other institution (External Examiner). (In the absence of an external examiner, any other teacher from the same department shall be the external examiner. Out of the 50 marks, 10 marks shall be given for record/observation notes. **<u>Calculation of marks for 50:</u>** Course teacher and External Examiner in consensus shall award marks for 50.
	Project	:	Only one Viva-Voce examination shall be conducted at the end of the semester and the students should give ppt presentations and defend the project work. TWO examiners; one (project supervisor) and another from the other institution (External Examiner). (In the absence of an external examiner, any other teacher from the same department shall be the external examiner. Out of the 50 marks, 25 marks shall be given for the dissertation. **<u>Calculation of marks for 50:</u>** Course teacher and External Examiner in consensus shall award marks for 50.
	Internship		An interactive presentation shall be conducted at the end of the semester to assess the skill harnessed and career awareness towards the prospective job. The students should give PPT presentations and defend the internship work. TWO examiners; one (department mentor) and another from the other institution (External Examiner). (In the absence of an external examiner, any other teacher from the same department shall be the external examiner. Out of the 50 marks, 25 marks shall be given for the report. Certificate from the mentor concerned from companies/institutions/hospitals /organizations shall mandatorily be included in the report. **<u>Calculation of marks for 50:</u>** Course teacher and External Examiner in consensus shall award marks for 50.
(d)	***Passing Minimum*** CIA – No passing minimum (3 Internal Tests – Average of the best 2 will be considered) ESE – 50% Cumulative Aggregate – 50%		

5. Programme Outcomes (POs):

On the successful completion of the Bachelor of Science programme, the student will be able to

PO1	Demonstrate comprehensive knowledge and understanding of science concepts and their relevant fields during the course of study
PO2	Communicate effectively on different aspects of Physics through examples with any forum and scientific society
PO3	Critical thinking, designing experiments and research-based analytical knowledge for the interpretation of data to provide

	conclusions
PO4	Apply knowledge to analyze and solve scientific/ complex problems using theoretical and experimental techniques/tools
PO5	Find suitable software and related resources for having learning activities and meet the demands of the workplace throughout life by using information and communications technology (ICT)
PO6	Employ critical and analytical thinking in understanding the concepts and apply them to various problems appearing in different branches of Science and competitive examinations in various sectors.
PO7	Function successfully as a member/leader in any team and follow ethics, accountability, and equity in their life
PO8	Take responsibility for finding the solution to different issues related to the society

6. Programme Specific Outcomes (PSO):

On the successful completion of the B.Sc. Physics programme, the learner will be able to

PSO1	Explain the system by Newtonian, Lagrangian, and Schrodinger equation of motion and apply them to atom, nucleus, and solids
PSO2	Explain thermodynamic laws, Ray and Laser optics, and their application to simple devices
PSO3	Explain the direct & alternating circuits, discrete components, and integrated circuits and perform experiments
PSO4	Relate their understanding of physics to other subjects like Professional English, Chemistry, Environmental Science, and hence widen their knowledge and work towards multi-disciplinary/inter-disciplinary context and problems
PSO5	Learn how to design and perform experiments demonstrating their understanding of scientific concepts/phenomena/methods/techniques
PSO6	Develop written and oral communications skills to communicate physics-related topics effectively through verbal, written, computational and graphical presentations using ICT.
PSO7	Critical application of the concepts through the relations for solving Physics problems in IIT-JAM, JEST, and CUCET
PSO8	Demonstrate Physics-related technological skills that are relevant to Physics-related trades and employment opportunities

Core 5: CLASSICAL MECHANICS AND RELATIVITY – THEORY

a. Course code:

L	T	P	C
4	-	-	4

b. Course Objectives:

1. *To know the concepts of force, constraints and conservation laws.*
2. *To study the equations of motion using Lagrangian and Hamiltonian formulations and solve simple problems.*
3. *To understand the transformation equations and interpret the concepts of theory of relativity.*

c. Learning Progression:

HSC
Newton's Laws of motion, momentum, conservation of linear momentum, circular motion, work, energy and power, collisions, motion of system of particles, Central force motion, centre of mass, torque, angular momentum, moment of inertia, rotational dynamics, conservation of angular momentum.

d. Theoretical Foundations of the course:

Forces, Conservation laws, Generalized coordinates, DÁlembert's principle, Hamilton Principle, Frames of reference, Lorentz transformation equations, Special theory of Relativity, general theory of relativity.

e. Course Outcomes (COs) :

At the end of the Course, the student will be able to –

CO 1: Acquire the knowledge of forces, constraints and conservation laws.

CO 2: Describe generalized coordinates, constraints, D Álembert's and Hamilton principles, centre of mass and central force fields.

CO 3: Deduce equations of motion in Lagrangian and Hamiltonian formulations, apply conservation laws and calculate energy of various systems.

CO 4: Solve the equations of motion of simple pendulum, compound pendulum, Atwood's machine, harmonic oscillator and motion under central force.

CO 5: Analyse motion in different frames of reference and derive Lorentz transformation equations.

CO 6: Interpret the ideas of special and general theory of relativity. Evaluate the equations of motion for a new system and draw inferences

f. Course outline:

UNIT – I: MECHANICS OF SYSTEM OF PARTICLES:

Module1: **(4 Hrs)**

External and internal forces, Centre of mass, Conservation of linear momentum, Conservation of angular momentum, Conservation of energy, work-energy theorem.

Module 2: **(3 Hrs)**

Conservative forces-examples, Constraints-types of constraints-Examples, Degree of freedom

Module 3: **(3 Hrs)**

Generalized coordinates (transformation equations)- Generalized velocities, Generalized Momentum. Generalized Force

UNIT – II : LAGRANGIAN FORMULATION:

Module 1: **(4 Hrs)**

Principle of virtual work, D'Alembert's principle, Lagrange's Equations from D'Alembert's Principle. Newton's equation of motion from Lagrange's equation

Module 2: **(4 Hrs)**

Lagrange's equation of motion for conservative and non-conservative systems-Simple applications: Atwood's machine, simple pendulum, compound pendulum, L-C circuit , Motion under central force.

Module 3: **(4 Hrs)**

Hamilton's principle- Deduction of Lagrange's equation of motion from Hamilton's principle, Deduction of Hamilton's principle from D'Alembert's principle.

UNIT – III: HAMILTONIAN FORMULATION

Module : **(4 Hrs)**

Cyclic coordinates, conservation of linear and angular momentum, and energy, phase space. The Hamiltonian function H -Hamilton's Canonical equation of motion-Physical significance of H

Module 2: **(4 Hrs)**

Deduction of Canonical equation from a variational principle- Applications-Harmonic oscillator, motion of a particle in central force field (planetary motion), Compound pendulum, Projectile motion

UNIT – IV: SPECIAL THEORY OF RELATIVITY

Module 1: **(2 Hrs)**

Frames of Reference – Galilean Transformation – Ether Hypothesis – Michelson and Morley Experiment.

Module 2: **(3 Hrs)**

Postulates of special theory of relativity, Lorentz transformation, consequences- length contraction, time dilation, twin paradox.

Module 3: **(3 Hrs)**

Relativity of simultaneity, Doppler effect, variation of mass with velocity, Einstein's mass- energy relation, relativistic momentum – energy relation.

UNIT – V: GENERAL THEORY OF RELATIVITY

Module 1: **(4 Hrs)**

Lorentz transformation of force, transformation of velocity,mass, energy and momentum, four vectors and their transformations.

Module 2: **(3 Hr)**

Inertial and Gravitational mass – Principle of equivalence – Experimentalevidences for General theory of Relativity, Gravitational Red Shift.

g. Mapping of COs to POs & PSOs with correlation level and Cognitive level of COs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	L	M	M	M	L	L
CO2	M	L	H	H	L	M	L	L
CO3	M	M	H	M	L	M	M	L
CO4	H	M	M	M	M	M	L	L
CO5	H	M	M	H	L	M	L	L
CO6	H	M	H	M	M	M	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	L	H	M	M	M	L	H	L
CO2	L	H	L	L	M	M	H	L
CO3	M	H	H	M	H	M	H	L
CO4	L	H	L	L	M	L	M	L
CO5	M	H	M	M	H	M	M	L
CO6	M	H	L	L	H	M	H	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5– Evaluate, K_6 – Create)

h. Books for Study:

1. J. C. Upadhayaya, Classical Mechanics, Himalaya Publishing House Pvt. Ltd, Bangalore, Second edition, 2017.
1. Puri, S.P., Special theory of relativity, Pearson Education, Noida, 2013

i. Books for Reference:

1. Kleppner,D. & Kolenkow,R.J, An introduction to Mechanics, Tata Mc Graw Hill Pub. Co. Ltd, New Delhi, 2017.
2. Charles Kittel, Walter Knight, Helmholtz, Ruderman and Moyer, Mechanics, Tata McGraw Hill, New Delhi, Second edition, 2017.
3. H. Goldstein, C. Poole and J. Safko, Classical Mechanics, Pearson Education Asia, New Delhi, Third Edition, 2002.
4. G. Aruldhas, Classical Mechanics, PHI Learning Private Limited, New Delhi, 2015
5. Arthur Beiser, Concepts of Modern Physics, Tata McGraw Hill, New Delhi, Sixth edition, 2002.

Core 5: CLASSICAL MECHANICS AND RELATIVITY – TUTORIAL

a. Course Code:

L	T	P	C
-	2	-	1

b. Course Objectives:

1. To solve problems using D Álembert's principle, Lagrangian & Hamilton equations of motion.
2. To learn Lorentz transformations and solve relativistic problems.

c. Course Outcomes (COs):

At the end of the Course, the student will be able to –
CO1: Solve the dynamical problems using Lagrangian & Hamiltonian equations of motion
CO2: Understand Lorentz transformations and analyse relativistic problems.

d. List of Tutorials:

1. Solve IIT-JAM physics problems.
2. Solve JEST physics problems.
3. Solve CUCET(M.Sc) problems .
4. Any other.

e. Reference Books:

1. I E Irodov, Problems in General Physics, Arihant Publishers, New Delhi, 2016.
2. Lim, S. C., Lai, C. H., & Kwek, L. C. Problems and solutions on Mechanics, World Scientific Pub. Co Ltd, Singapore, Second edition, 2022.

3. Murray R.Spiegal, 1981, Theoretical Mechanics, Schaum's outline series, Mc Graw Hill

Publ. Co., New Delhi.

f. Mapping of COs to POs & PSOs with correlation level and Cognitive level of COs

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K3)	H	L	L	L	L	H	M	L
CO2 (K4)	H	L	L	M	L	H	M	L

CO\PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1 (K3)	H	L	L	L	H	H	L	L
CO2 (K4)	H	L	L	L	H	H	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

Common : PROFESSIONAL ENGLISH – I FOR PHYSICAL SCIENCES

a. Course Code

L	T	P	C
4	-	-	4

b. Course Objectives:

1. *To develop the language skills of students by offering adequate practice in professional contexts.*
2. *To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students*
3. *To focus on developing students' knowledge of domain specific registers and the required language skills.*
4. *To develop strategic competence that will help in efficient communication*
5. *To sharpen students' critical thinking skills and make students culturally aware of the target situation.*

LEARNING OUTCOMES:

- Recognise their own ability to improve their own competence in using the language
- Use language for speaking with confidence in an intelligible and acceptable manner
- Understand the importance of reading for life
- Read independently unfamiliar texts with comprehension
- Understand the importance of writing in academic life
- Write simple sentences without committing error of spelling or grammar
- (Outcomes based on guidelines in UGC LOCF – Generic Elective)

NB: All four skills are taught based on texts/passages.

UNIT 1: COMMUNICATION

Listening: Listening to audio text and answering questions Listening to Instructions
Speaking: Pair work and small group work.
Reading: Comprehension passages –Differentiate between facts and opinion
Writing: Developing a story with pictures**.**
Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 2: DESCRIPTION
Listening: Listening to process description.-Drawing a flow chart.
Speaking: Role play (formal context)
Reading: Skimming/Scanning- Reading passages on products, equipment and gadgets.
Writing: Process Description –Compare and Contrast, Paragraph-Sentence Definition and Extended definition- Free Writing.
Vocabulary: Register specific -Incorporated into the LSRW tasks.

UNIT 3: NEGOTIATION STRATEGIES

Listening: Listening to interviews of specialists / Inventors in fields (Subject specific)
Speaking: Brainstorming. (Mind mapping). Small group discussions (Subject- Specific)
Reading: Longer Reading text.
Writing: Essay Writing (250 words)
Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 4: PRESENTATION SKILLS

Listening: Listening to lectures.
Speaking: Short talks.
Reading: Reading Comprehension passages
Writing: Writing Recommendations, Interpreting Visuals inputs
Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 5: CRITICAL THINKING SKILLS

Listening: Listening comprehension- Listening for information.
Speaking: Making presentations (with PPT- practice).
Reading: Comprehension passages –Note making. Comprehension: Motivational article on Professional Competence, Professional Ethics and Life Skills)
Writing: Problem and Solution essay– Creative writing –Summary writing
Vocabulary: Register specific - Incorporated into the LSRW tasks

Non Major Elective – I: CONVENTIONAL AND NON – CONVENTIONAL ENERGY SOURCES

a. Course Code:

L	T	P	C
3	0	0	3

b. Course Objectives

1. *To increase student awareness of the energy crisis and its causes*
2. *To understand the natural Energy Sources and encourage the use of Renewable energy*
3. *To know about the various applications in Solar energy.*
4. *To gain knowledge about biomass and wind energy, as well as their economic implications.*
5. *To become familiar with geothermal energy in comparison to other energy sources.*
6. *To be able to evaluate the feasibility of wind and alternative energy initiatives*

c. Learning Progression:

HSC
Energy sources and types Fossil Fuels, Biomass, Bio-Gas Plant Solar Energy, Wind Energy, Energy from sea

d. Theoretical/Experimental Foundations of the course:

Renewable energy –Solar Energy, wind energy, Non-Renewable energy -coal, oil, agricultural waste

e. Course Outcomes (COs)

At the end of the Course, the student will be able to –

CO1: Energy saving reduces costs to households and to businesses, increasing sustainability of the local economy and Community

CO2: Being able to categorize different solar energy collectors and storage techniques.

CO3: Understanding the practical solar energy application.

CO4: To give the students the administrative abilities they'll need to determine the viability of different strategies and direct efforts towards wind and other alternative sources of energy.

CO5: Understanding of how to use different energy sources, such as wind, biogas, and geothermal.

CO6: To assist students in achieving a thorough conceptual understanding of the Technical and commercial elements of wind and alternative sources of energy.

f.Course Outline:

UNIT- I: CONVENTIONAL ENERGY SOURCES

Module 1: **(2 Hr)**

Conventional energy sources: coal-oil-agricultural and organic waste

Module 2: **(3 Hr)**

Water power – Nuclear power

Module 3: **(2 Hrs)**

New Energy technologies.

UNIT- II: NON-CONVENTIONAL ENERGY SOURCES: SOLAR ENERGY

Module 1: **(3 Hrs)**

Basis of solar energy - Solar radiation and its measurement

Module 2: **(3 Hrs)**

Solar energy collector - Solar water heater - Solar cookers-

Module 3: **(3 Hrs)**

Solar energy storage Solar Furnaces –Solar Dryer

UNIT- III: WIND ENERGY

Module 1: **(4 Hrs)**

Basic principles of wind energy conversion- the nature of the wind – the power of the wind – maximum power

Module 2: **(4 Hrs)**

Wind energy conversion – basic components of wind energy conversion systems.

UNIT- IV: BIO MASS ENERGY

Module 1: **(4 Hrs)**

Basis of bio mass energy – bio mass conversion – technologies – wet process – dry process - Photosynthesis.

Module 2: **(4 Hrs)**

Bio gas plants – classification – methods of obtaining energy from bio mass.

UNIT-V: ADDITIONAL ALTERNATE ENERGY SOURCES

Module 1: (**3 Hrs)**

Geothermal energy sources – Energy from ocean

Module 2: **(3 Hrs)**

Chemical energy sources – Hydrogen energy

Module 3: **(3 Hrs)**

Magnetohydrodynamic – Thermo electric power.

g. Books for study:

1. G. D. Rai, Non – Conventional Energy Sources, Khanna Publishers, New Delhi, 5th Edition, 2012.
2. Godfrey Boyle, Renewable Energy: Power for a sustainable Future, Alden Oess Limited, Oxford, 1996.
3. D. P. Kothari, K. C. Singal & Rakesh Ranjan, Renewable energy sources and emerging Technologies, Prentice Hall of India pvt. Ltd., New Delhi, 2008.

h.Books for references:

1. H.P. Garg and J. Prakash, Solar Energy Fundamentals and application, Tata McGraw- Hill Publishing companyltd, 1997.
2. S. P. Sukhatme, Solar energy, Tata McGraw- Hill Publishing company ltd, 1997.

i. Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	M	M	L	L
CO2 ((K2)	M	M	M	M	L	M	L	L
CO3(K3)	M	L	M	M	L	M	L	L
CO4(K4)	H	M	M	H	L	M	L	L
CO5(K5)	M	M	M	M	M	M	L	L
CO6(K6)	H	M	M	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	M	L	M	M	H	H	L	L
CO2(K2)	L	L	L	M	M	L	M	L
CO3(K3)	L	M	M	M	M	H	L	L
CO4(K4)	L	L	L	M	M	L	M	L
CO5(K5)	L	M	L	M	H	H	L	L
CO6(K6)	L	L	L	L	H	H	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create).

Core 6: MATHEMATICAL METHODS AND QUANTUM MECHANICS (Theory)

a. Course Code:

L	T	P	C
4	-	-	4

b. Course Objectives

1. *To understand the mathematical foundations of quantum mechanics which are applied to understand quantum physics.*
2. *To understand the Postulates of quantum mechanics and the consequences.*
3. *Acquire sufficient knowledge in the concept of dual nature of light, Evolution of Quantum mechanics, Schrodinger equation and its applications.*

c. Learning Progression:

Uncertainty principle, Non-relativistic Schrödinger equation, Particle in a box, Harmonic Oscillator and Hydrogen atom.

d. Theoretical Foundations of the course

Hilbert spaces, self-adjoint operators, Fourier transform, Eigenfunctions of Hermitian operator, Pauli matrices.

e. Course Outcomes (COs)

At the end of the Course, the student will be able to –

CO1: To develop the physical principles and the mathematical background important to quantum mechanical descriptions
CO2: Articulate the knowledge about linear vector space and its properties.
CO3: Inadequacy of classical mechanics and state the postulates of quantum mechanics.
CO4: Time independent Schrödinger equation and one dimensional problems
CO5: To explain the mathematical formalism of orbital, spin angular momentum
CO6: To formulate and solve the Schrodinger's equation to obtain eigenvectors and energies for particle in a three-dimensional potential.

f. Course Outline:

UNIT I: VECTOR SPACE AND LINEAR EQUATIONS

Module 1: : **(3 Hrs)**

Linear vector spaces – Linear dependence and independence – Basis sets - Norm and Inner product - Cauchy-Schwarz Inequality – Orthogonality and Completeness.

Module 2: : **(3 Hrs)**

Eigenvalues and Eigenvectors of Hermitian operator - Matrix representation - Change of orthonormal basis

Module 3: : **(3 Hrs)**

Hilbert space – Linear Functions –Orthogonal polynomials as basis sets - Gram- Schmidt orthogonolization

Module 4: : **(3 Hrs)**

Operators – Linear operators – Hermitian, Unitary and Projection operators – Inverse and Rank of an operator - Rotation matrices in 2 and 3 dimensions

Module 5: : **(3 Hrs)**

Fourier Transforms of linear operators – Dirac delta function - Dirac's Bra and Ket vectors

UNIT II: FOUNDATIONS OF QUANTUM MECHANICS

Module 1: **(5 Hrs)**

Inadequacy of classical mechanics – The origins of quantum theory - Black body radiation – Photo electric effect – Compton effect

Module 2: **(4 Hrs)**

Stern-Gerlach experiment – Angular momentum and spin – De Broglie's hypothesis

Module 3: : **(5 Hrs)**

Wave particle duality – Probability interpretation of wavefunction - Superposition principle – Phase and group velocities - Heisenberg uncertainty principle

UNIT III: ONE DIMENSIONAL POTENTIALS

Module 1: **(4 Hrs)**

Time independent Schrödinger equation – Stationary states - Expectation values and operators– Ehrenfest theorem – Schrödinger equation in momentum space

Module 2: **(4 Hrs)**

Free particle – Infintite square well – Infintite square well - Quantum tunneling - The delta functional potential

Module 3: : **(4 Hrs)**

Linear harmonic oscillator – Analytic method – Ladder operator method - rigid rotator

UNIT IV: ANGULAR MOMENTUM

Module 1: **(5 Hrs)**

Angular Momentum - Orbital angular momentum – Spatial rotations – Eigen values - Matrix representation of angular momentum

Module 2: **(3 Hrs)**

Spin of an electron - Elementary ideas of spin angular momentum - Pauli matrices

Module 3: **(3 Hrs)**

Total angular momentum – Addition of angular momenta

UNIT V: THREE DIMENSIONAL POTENTIALS

Module 1: **(3 Hrs)**

Atomic spectra – Bohr atom model – Quantization of energy

Module 2: **(5 Hrs)**

Central Potentials - Schrödinger equation in spherical polar coordinates – Separation of variables

Module 3 : **(4 Hrs)**

Three dimensional square well potential - Hydrogen atom solution

g. Books for Study

1. Gilbert Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press, 2016.
2. B. H. Bransden, C. J. Joachain, Quantum Mechanics, Pearson Education, 2000.
3. Arthur Beiser, Concepts of Modern Physics, Tata McGraw Hill, 2002.

h. Books for Reference

1. M. L. Boas Mathematical Methods in the Physical Sciences, Wiley, 2005.
2. K. F. Riley, M. P. Hobson and S. J. Bence: Mathematical Methods for physics and engineering Cambridge University Press, 2006.
3. R. Shankar, Basic Training in Mathematics: A Fitness Program for Science Students, Springer1995.
4. D J Griffiths, Introduction to Quantum Mechanics, Pearson Education, 2016.
5. V Devanathan, Quantum Mechanics, 2nd edition, Narosa Publishing House, 2011.
6. N Zettili, Quantum Mechanics: Concepts and applications. John Wiley, 2009.
7. Ashok Das. Lectures on Quantum Mechanics. 2nd edition. World Scientific, 2012.

8. Richard L Liboff, Introductory Quantum Mechanics, 4th edition, Pearson Education, 2002.
9. David Halliday, Robert Resnick and Jearl Walker, Fundamentals of Physics, John Wiley and Sons, 2004.

i. Mapping of COs to POs & PSOs with correlation level and Cognitive level of Cos

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	L	L	M	M	H	L	L
CO2 (K2)	H	L	M	M	H	L	L	H
CO3 (K3)	H	M	L	M	H	H	L	H
CO4 (K4)	H	M	L	H	H	H	M	H
CO5 (K5)	H	M	M	H	M	H	L	L

CO\PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1 (K1)	H	L	L	M	M	H	L	L
CO2 (K2)	H	L	M	L	H	H	M	L
CO3 (K3)	M	H	L	L	H	L	M	M
CO4 (K4)	H	L	L	M	H	H	L	L
CO5 (K5)	H	M	M	L	M	L	L	L
CO6 (K6)	M	L	L	L	H	H	L	L

(L – Low, M – Medium, H – High; K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5–Evaluate, K6-Create)

Core 6: MATHEMATICAL METHODS AND QUANTUM MECHANICS (Tutorial)

a. Course Code:

L	T	P	C
-	2	-	1

b. Course Objectives

1. *To solve Particle in a box, Harmonic Oscillator and Hydrogen atom using mathematical foundations of quantum mechanics and Schrodinger equation*

c. Course Outcomes (COs)

At the end of the Course, the student will be able to –

CO1: Evaluate the energies and other physical properties of one dimensional potentials using mathematical methods.
CO2: Calculate the orbital, spin angular momentum for the central potentials.
CO3: Using Schrödinger equation in spherical polar coordinates solve the energy eigen values of Hygrogen atom.

d. List of Tutorials:

Mathematical Background:

1. Show that the sum and product of two linear operators are linear operators.
2. Show that the eigenvalues of the Hermitian operators are real.
3. Prove the following commutator identity $[f(x), p] = i\hbar\frac{df}{dx}$

One Dimensional Potentials:

4. Consider a one-dimensional delta function potential, Show that the energy of the uniquely existing bound state.
5. A particle is represented by the wavefunction, at time *t=0* is

$$\psi_n(x,0) = A\ sin\left(\frac{n\pi x}{a}\right) \qquad if\ 0 \le x \le a$$

Check whether the uncertainty principle is satisfied for the wavefunction.

6. Find the momentum space wave function for a particle in the ground state of the Harmonic Oscillator.

Angular Momentum:

7. Prove the following canonical commutation relations,

$$[L_x, x] = i\hbar y \qquad [L_x, y] = i\hbar x \qquad [L_x, z] = 0$$
$$[L_x, p_x] = i\hbar p_y \qquad [L_x, p_y] = -i\hbar p_x \qquad [L_x, p_z] = 0$$

8. Prove that for a particle in a potential $V(x)$ the rate of change of the expectation value of the orbital momentum L is equal to the expectation value of the torque. $\frac{d}{dt}\langle L\rangle = \langle N\rangle$ where $N = r \times (-\nabla V)$. Show that $\frac{d}{dt}\langle L\rangle = 0$ for spherically symmetric potential.
9. Show that the Pauli spin matrices satisfy the product rule

$$\sigma_j\sigma_k = \delta_{jk} + i\sum \epsilon_{jkl}\sigma_l$$

Hydrogen atom:

10. Show that the uncertainty relation $\Delta x \Delta p \geq \frac{\hbar}{2}$ forces us to reject the semiclassical Bohr model for Hydrogen atom.
11. What is the probability that an electron in the ground state of hydrogen atom will be found inside the nucleus?
12. Find the Schrödinger equation for a two-dimensional Hydrogen atom and solve the radial and the angular equations using separation of variables.

e. Books for Reference

1. Yung- Kuo Lim, Problems and solutions on quantum mechanics, World Scientific, 2001.
2. Y. Peleg, R. Pnini, E. Zaarur, E. Hecht, Schaum's Outline Series of Quantum Mechanics, McGraw Hill Education 2017.
3. Aruldhas G, Quantum Mechanics: 500 Problems With Solutions, Prentice Hall India Learning Private Limited, 2010.
4. Kyriakos Tamvakis, Problems and Solutions in Quantum Mechanics, Cambridge University Press 2005.
5. S. B. Cahn, G. D. Mahan, B. E. Nadgorny and M. Dresden, A Guide to Physics Problems: Part 2: Thermodynamics, Statistical Physics, and Quantum Mechanics, Springer; 1997th edition, 2007.

f. Mapping of COs to POs & PSOs with correlation level and Cognitive level of Cos

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	M	L	M	H	H	L	H
CO2 (K2)	H	M	L	H	H	H	M	H
CO3 (K3)	H	M	M	H	M	H	L	L

CO\PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1 (K1)	M	H	L	L	H	L	M	M
CO2 (K2)	H	L	L	M	H	H	L	L
CO3 (K3)	H	M	M	L	M	L	L	L

(L – Low, M – Medium, H – High; K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5–Evaluate,K6 Create)

Common: PROFESSIONAL ENGLISH – II For Physical Sciences

a. Course Code

L	T	P	C
4	-	-	4

b. Course Objectives:

The Professional Communication Skills Course is intended to help Learners in Arts and Science colleges

1. *Develop their competence in the use of English with particular reference to the workplace situation.*
2. *Enhance the creativity of the students, which will enable them to think of innovative ways to solve issues in the workplace.*
3. *Develop their competence and competitiveness and thereby improve their employability skills.*
4. *Help students with a research bent of mind develop their skills in writing reports and research proposals.*

Unit 1- Communicative Competence (18 hrs)

Listening – Listening to two talks/lectures by specialists on selected subject specific topics -(TED Talks) and answering comprehension exercises (inferential questions)

Speaking: Small group discussions (the discussions could be based on the listening and reading passages- open ended questions

Reading: Two subject-based reading texts followed by comprehension activities/exercises

Writing: Summary writing based on the reading passages.

Grammar and vocabulary exercises/tasks to be designed based on the discourse patterns of the listening and reading texts in the book. This is applicable for all the units.

Unit 2 - Persuasive Communication (18 hrs)

Listening: listening to a product launch- sensitizing learners to the nuances of persuasive communication

Speaking: debates – Just-A Minute Activities

Reading: reading texts on advertisements (on products relevant to the subject areas) and answering inferential questions

Writing: dialogue writing- writing an argumentative /persuasive essay.

Unit 3- Digital Competence (18 hrs)

Listening to interviews (subject related)

Speaking: Interviews with subject specialists (usingvideo conferencing skills)

Creating Vlogs (How to become a vlogger and use vlogging tonurture interests – subject related)

Reading: Selected sample of Web Page (subject area)

Writing: Creating Web Pages

Reading Comprehension: Essay on Digital Competence for Academic and Professional Life.

The essay will address all aspects of digital competence in relation to MS Office and how they can be utilized in relation to work in the subject area

Unit 4 - Creativity and Imagination (18 hrs)

Listening to short (2 to 5 minutes) academic videos (prepared by EMRC/other MOOC videos on Indian academic sites – E.g. https://www.youtube.com/watch?v=tpvicScuDy0)

Speaking: Making oral presentations through short films – subject based Reading: Essay on Creativity and Imagination (subject based)

Writing – Basic Script Writing for short films (subject based) - Creating blogs, flyers and brochures (subject based) - Poster making – writing slogans/captions(subject based)

Unit 5- Workplace Communication& Basics of Academic Writing (18 hrs)

Speaking: Short academic presentation using PowerPoint

Reading & Writing: Product Profiles, Circulars, Minutes of Meeting. Writing an introduction, paraphrasing

Punctuation(period, question mark, exclamation point, comma, semicolon, colon, dash, hyphen, parentheses, brackets, braces, apostrophe, quotation marks, and ellipsis)

Capitalization (use of upper case)

Outcomes of the Course.

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

1. Attend interviews with boldness and confidence.
2. Adapt easily into the workplace context, having become communicatively competent.
3. Apply to the Research &Development organisations/ sections incompanies and offices with winning proposals.

Instruction to Course Writers:

1. Acquisition of subject-related vocabulary should not be overlooked. Textboxes with relevant vocabulary may be strategically placed as a Pre Task or in Summing Up

2. Grammar may be included if the text lends itself to the teaching of a Grammatical item. However, testing and evaluation does not include Grammar.

Non Major Elective - II : BIOMEDICAL INSTRUMENTATION

a. Course Code:

L	T	P	C
3	0	0	3

b. Course Objectives

1. *To educate students with fundamental biomedical engineering techniques and to address various biological signals, their acquisition, measurements, and associated Limitations.*
2. *To make students understand a basic in biological devices.*
3. *It provides an overview of the human physiological system, which is crucial for design consideration.*
4. *The principle, design and working of various biomedical instruments are dealt in a simple manner.*
5. *It will stimulate the students to understand the design and functioning of various medical equipment.*

c. Learning Progression:

HSC
X-ray, G.M counter, batteries, basics in Electrocardiography, Microwaves, Ultrasonics, resonance, Computers in medicine, Lasers in medicine

d. Theoretical/Experimental Foundations of the course:

Awareness of Operation theatre equipment, Knowledge about Pacemaker batteries and Artificial heart valves

e. Course Outcomes (COs)

CO1: Gain a deep understanding of the fundamentals of Biopotential Recorders
CO2: Become well-versed in the fundamentals of Operation theatre equipment
CO3: Acquire an in-depth knowledge of the fundamentals behind medical instrumentation.
CO4: Become thoroughly knowledgeable about the clinical uses of medical instrumentation systems.
CO5: Understanding of how to use different devices, such as Pacemakers – Pacemaker batteries – Artificial heartvalves.
CO6: To assist students in achieving a thorough conceptual understanding of the Technical and commercial elements of biomedical measurements.

f. Course Outline:

UNIT – I: BIOPOTENTIAL RECORDERS

Module 1: **(4 Hrs)**

Characteristics of the recording system – Writer and Pen Damping system

Module 2: **(3 Hrs)**

Electrocardiography (ECG) –Electroencephalography (EEG) – Electromyography (EMG)

Module 3: **(2 Hrs)**

Electroretinography (ERG) – Electroculography (EOG).

UNIT – II: PHYSIOLOGICAL ASSIST DEVICES

Module 1: **(3 Hrs)**

Pacemakers – Pacemaker batteries Artificial heartvalves - (Principle block diagram and operation)

Module 2: **(3 Hrs)**

Defibrillators – Nerve and muscle stimulators

Module 3: **(2 Hrs)**

Heart –lung machine – Kidney machine .

UNIT-III: OPERATION THEATRE EQUIPMENT

Module 1: **(3 Hrs)**

Introduction – Surgical diathermy – Short-wave diathermy – Microwave diathermy – Ultrasonic diathermy

Module 2: **(3 Hrs)**

Ventilators - Anesthesia machine – Flow meters – Blood flow meter and its applications

Module 3: **(3 Hrs)**

Ultrasonic Blood flow meter – Laser based Doppler blood flow meter.

UNIT – IV: SPECIALISED MEDICAL EQUIPMENT

Module 1 : **(3 Hrs)**

Blood cell counter – Electron Microscope – Radiation detectors – Geiger Muller Counter

Module 2 : **(3 Hrs)**

Cloud chamber – X-ray tube & Machine -Radiography and Fluoroscopy

Module 3 : **(3 Hrs)**

Image intensifiers – Angiography -Applications of X-ray examination.

UNIT – V: ADVANCES IN BIOMEDICAL INSTRUMENTATION

Module 1 : **(3 Hrs)**

Computers in medicine – Lasers in medicine – Endoscopes

Module 2 : **(5 Hrs)**

Nuclear imaging techniques – Computertomography – Ultrasonic imaging systems – Magnetic resonance imaging.

g.Book for Study:

1. M. Arumugam, Bio-medical Instrumentation, Anuradha Agencies, Chennai, 10th edition, reprint, 2013.

h.Books for references:

1. R.S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill Publishing Company Limited,Newdelhi, Reprint, 2002.
2. Nandini K. Jog, Electronics in Medicine and Biomedical Instrumentation, PHI Learning Pvt. Ltd., 2nd Edition,2013.

i. Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	M	M	L	L
CO2 ((K2)	M	M	M	H	L	M	L	L
CO3(K3)	M	M	M	H	L	H	L	L
CO4(K4)	H	M	M	H	L	M	L	L
CO5(K5)	H	L	M	M	L	H	L	L
CO6(K6)	H	L	M	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	H	L	M	M	H	H	L	L
CO2(K2)	M	L	M	M	M	L	M	L
CO3(K3)	L	M	M	H	H	H	L	L
CO4(K4)	M	L	L	M	M	L	M	L
CO5(K5)	H	L	L	H	H	M	M	L
CO6(K6)	L	L	L	L	H	M	L	L

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Core 7: ATOMIC AND NUCLEAR PHYSICS - THEORY

a. Course code:

L	T	P	C
4	0	0	4

b. Course Objectives:

1. *To study the structure of atom, different atomic models and atomic spectra*
2. *To learn the properties of nucleus, nuclear reactions and nuclear detectors*
3. *To understand radioactivity, elementary particles and cosmic rays*

c. Learning Progression:

HSC
Atom, Thomson model, Alpha particle scattering, Rutherford nuclear atom model, Atomic spectra, Bohr atom model, Spectra of hydrogen atom. Nuclei, composition of nucleus, discovery of neutron, nuclear size, mass, binding energy, Nuclear force, Radioactivity, Nuclear energy, Nuclear fission, Nuclear reactor and Nuclear fusion.

d. Theoretical Foundations:

Structure of atom, Nucleus, Radioactivity, Nuclear fission, Nuclear fusion, Detectors, Elementary particles.

e. Course Outcomes (COs):

At the end of the Course, the student will be able to -

CO1: Describe the structure of atom and nucleus using different models
CO2: Interpret the atomic spectra and periodic table based on the atomic models
CO3: Understand the basic nuclear properties and uses of radioactivity
CO4: Acquire knowledge of nuclear fission and fusion and their applications
CO5: Enumerate the principles and applications of nuclear detectors and accelerators
CO6: Explain the effect of cosmic rays and classify elementary particles.

f. Course Outline:

Unit I: ATOMIC STRUCTURE

Module 1: **(7 hrs)**

Atom, Thomson atom model, Alpha particle scattering, Rutherford 's nuclear model, Bohr atom model, Bohr's interpretation of the Hydrogen spectrum-correction for nuclear motion-evidences in favour of Bohr's theory-Ritz combination principle-correspondence principle.

Module 2: **(5 hrs)**

Sommerfield's relativistic atom model-fine structure of $H\alpha$ line. the vector atom model – Quantum numbers associated with the vector atom model – the Pauli's exclusion principle – electronic configuration.

Unit II: FINE STRUCTURE OF SPECTRAL LINES

Module 1: **(7 hrs)**

Coupling schemes-L-S Coupling-j-j Coupling- Hund rules- magnetic dipole moment due to orbital motion of the electron- due to spin of the electron - Stern and Gerlach experiment spin-orbit coupling-optical spectra-spectral terms-spectral notation- selection rules- intensity rules- interval rule- fine structure of sodium D line.

Module 2: **(5 hrs)**

Hyperfine structure- Normal Zeeman effect- theory and experiment- quantum mechanical explanation - Larmor's theorem, Anomalous Zeeman effect- Paschen –Bach effect-Stark effect.

Unit III: PROPERTIES OF NUCLEI AND RADIOACTIVITY

Module 1: **(7 hrs)**

Nuclei - Constituents of nuclei – isotopes, isobars, isotones – nuclear size, mass, density, charge, spin,

angular momentum, magnetic dipole moment, electric quadrupole moment (qualitative) – binding energy – mass defect – packing fraction – nuclear stability – binding energy per nucleon graph – properties of nuclear force – meson theory of nuclear forces – Yukawa potential.

Module 2: **(5 hrs)**

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

Unit IV: NUCLEAR REACTION AND DETECTION

Module 1: **(7 hrs)**

Nuclear fission - Liquid drop model – semiempirical mass formula – shell model – magic numbers. and energy released. Chain Reaction – critical mass – reproduction factor. Nuclear reactor – types of reactors – breeder reactor, atom bomb. Nuclear fusion – thermonuclear reaction – source of stellar energy – uncontrolled fusion – Hydrogen bomb.

Module 2: **(5 hrs)**

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

Module 1: **(7 hrs)**

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

Module 2: **(5 hrs)**

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

g. Book for Study:

1. A B Gupta, Modern Atomic and Nuclear Physics, Books and Allied, 2nd revised edition,2009.
2. Atomic and Nuclear Physics by N. Subrahmanyam and Brijlal, S Chand & Co.,New Delhi,1996.

h. Books for reference:

1. R. Murugeshan and Kiruthiga Sivaprasath, Modern Physics, S. Chand and Co., 18th edition, 2016.
2. J.B. Rajam, Atomic Physics , S. Chand & Co., 20thEdition, New Delhi, 2004.
3. H. Semat and J. R. Albright, Introduction to Atomic and Nuclear Physics, 5th Edition, Chapman and Hall, 1985.
4. Irving Kaplan, Nuclear Physics, 2nd Edition, Addison-Wesley, 1977.
5. Tayal D.C., Nuclear Physics , Himalaya Publishing House, Mumbai, 2006.
6. Sharma, R.C., Nuclear Physics, K.Nath& Co., Meerut, 2000.

i. Mapping of Cos to POs and PSOs

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CO2 ((K2)	M	M	M	H	L	M	L	L
CO3(K3)	M	M	M	H	L	H	L	L
CO4(K4)	H	M	M	H	L	M	L	L
CO5(K5)	H	L	M	M	L	H	L	L
CO6(K6)	H	L	M	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	H	L	M	M	H	H	L	L
CO2(K2)	M	L	M	M	M	L	M	L
CO3(K3)	L	M	M	H	H	H	L	L
CO4(K4)	M	L	L	M	M	L	M	L
CO5(K5)	H	L	L	H	H	M	M	L
CO6(K6)	L	L	L	L	H	M	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6-Create).

Core 7: ATOMIC AND NUCLEAR PHYSICS (Practical)

a. Course Code:

L	T	P	C
0	0	2	1

b. Course Outcomes (COs)

At the end of the Course, the student will be able to –

CO1: Measure attenuation coefficient and efficiency of a GM detector

CO2: Calibrate energy and intensity of gamma rays

CO3: Analyse the spectrum of Cs137 and Co60 with Scintillation Counter

c. Course Outline:

List of Experiments/Demonstrations (Any Eight from the list)

1. G.M. Counter Characteristics
2. G.M. Counter: Dead time & Inverse square law
3. GM Counter: Linear & Mass attenuation coefficient
4. Estimation of efficiency of the GM detector
5. Feather's analysis – Range of beta rays
6. Fermi – Curie plot
7. Scintillation counter characteristics
8. Mass attenuation coefficient of solid materials for gamma rays
9. Study of Cs137 and Co60 spectrum and calculation of full width at half maximum and resolution for the scintillation detector
10. Energy calibration of gamma ray spectrometer (Study of Linearity)
11. Variation of gamma intensity as a function of distance (verification of inverse square law)
12. Any other experiment

d. Mapping of COs to POs & PSOs with correlation level and Cognitive level of COs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K4)	H	M	M	M	M	M	M	L
CO2 (K5)	H	M	M	M	M	M	M	L
CO3 (K6)	H	M	L	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K4)	M	L	L	M	H	L	M	L
CO2(K5)	M	L	L	M	H	L	M	L
CO3(K6)	H	M	M	M	H	L	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

Core 8: SOLID STATE PHYSICS - Theory

a. Course Code:

L	T	P	C
4	-	-	4

b. Course Objectives:

1. *To gain ideas on crystal structure, magnetic materials and various types of magnetization*
2. *To know the concept of crystal diffraction, dielectrics and to know the properties of superconducting materials*

c. Learning Progression

HSC -II
Energy band diagram of solids, Classification of materials, types of semiconductors,

d. Theoretical Foundations:

Bragg's law, Crystal Structure, Meissner effect, Magnetism and its types

e. Course Outcomes (COs):

At the end of the Course, the student will be able to -

CO1: State Bragg's law , cohesive energy, Meissner effect
CO2: Understand the fundamentals of Lattice dynamics
CO3: Apply the laws and classify the magnetic materials.
CO4: Analyze the different types of crystal structure, the different magnetic properties
CO5: Calculate the dielectric constant energy gap of the materials,
CO6: Appreciate the ferroelectric and super conducting properties of materials

f. Course Outline:

UNIT I: (12 hrs)

Module 1

Bonding in Solids Types of bonds in crystals - Ionic, covalent, Metallic, Vander waal's and Hydrogen Bonding

Module 2

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: (14 hrs)

Module 1

Crystal Structure and Crystal Diffraction Crystal Lattice -Primitive and unit cell- seven classes of crystal- Bravais Lattice- Miller Indices-

Module 2

Structure of crystals-- Simple cubic, Face centered cubic, Body centered cubic and Hexagonal close packed structure -Sodium Chrloride, Zinc Blende and Diamond Structures.

Module 3

Crystal Diffraction – Bragg's law- Experimental methods-Laue method, powder method and rotating crystal method - Reciprocal lattice- Intensity and structure factor.

UNIT III: **(10 hrs)**

Module - 1
Magnetic Properties- permeability, susceptibility, relation between them – classification of magnetic materials – properties of dia, para,ferro, ferri and antiferromagnetism
Module -2
Weiss Theory – Temperature dependence of Magnetization - classical Theory of Diamagnetism – Weiss theory of Para magnetism
Module 3
Ferromagnetic domains – Bloch wall – Basic ideas of anti- ferromagnetism – Ferrimagnetisms – discussion of B-H curve – hysteresis and energy loss – soft and hard magnets – magnetic alloys

UNIT IV: **(12 hrs)**
Module 1
Dielectric Properties Band theory of solids –classification of insulators, Semiconductors, conductors – intrinsic and extrinsic semiconductor – Carrier concentration for electron - Barrier Potential Calculation – Rectifier Equation
Module 2
Dielectrics - Polarization – frequency and temperature effects on polarization- dielectric loss- Clausius Mosotti relation-determination of dielectric constants.

UNIT V: **(12 hrs)**
Module 1
Ferroelectric effect- ferroelectric domains- P-E Hysteresis loop – Hall effect-measurement of conductivity - four probe method. – Hall coefficient
Module 2
Super Conductivity Introduction - General Properties of Superconductors - effect of magnetic field - Meissner effect - effect of current –
Module 3
Thermal properties - entropy - specific heat -energy gap - isotope effect - London equations .
Module 4
Type–I and Type–II Superconductors - Explanation for the Occurrence of Super Conductivity - BCS theory - Application of Superconductors

g. Book for Study:

1. Introduction to Solid State Physics, Kittel, Willey Eastern Ltd (2003).
2. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw
3. Solid State Physics, M.A. Wahab, 2011, Narosa Publishing House,ND
4. Materials Science by M.Arumugam, Anuradha Agencies Publishers.,(2002).

h. Books for Reference:

1. Puri&Babber – Solid State Physics – S.Chand&Co. New Delhi.
3. Raghavan - Materials science and Engineering, PHI
4. Azaroff - Introduction to solids, TMH
5. S. O. Pillai - Solid State Physics, Narosa publication
6. A.J. Dekker - Solid State Physics, McMillan India Ltd.
7. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India

i. Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	H	H	M	L
CO2 (K2)	H	M	M	M	L	M	L	L
CO3(K3)	H	H	M	M	M	H	H	M
CO4(K4)	H	M	M	H	M	M	L	L
CO5(K5)	H	H	M	M	H	H	M	M
CO6(K6)	H	M	L	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	H	L	M	M	H	H	L	L
CO2(K2)	H	M	L	M	M	L	M	H
CO3(K3)	H	M	M	M	H	H	L	M
CO4(K4)	H	M	L	M	M	L	M	M
CO5(K5)	H	L	L	M	H	H	L	L
CO6(K6)	L	M	L	L	H	H	L	M

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

Core 8: SOLID STATE PHYSICS - (Practical)

a. Course Code:

L	T	P	C
-	-	2	1

b. Course Outcome:

CO1: To perform basic experiments on hysteresis curve, conductivity of a material.
CO2: To study the magnetic susceptibility, dielectric constant, of materials.

List of Practical's

1. To study magnetic susceptibility of a liquid
2. To study the dielectric constant of a material
3. To plot the magnetic hysteresis curve of a ferromagnetic material
4. To determine the lattice constant of a crystalline material.
5. To find the specific heat capacity of a solid.
6. To estimate the band gap energy of a material.
7. Measurement of conductivity - four probe method
8. Determine the hall coefficient.
9. Any other experiments related

d. Mapping of COs to POs & PSOs with correlation level and Cognitive level of COs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K4)	H	M	M	M	M	M	M	L
CO2 (K5)	H	M	M	M	M	M	M	L
CO3 (K6)	H	M	L	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K4)	M	L	L	M	H	L	M	L
CO2(K5)	M	L	L	M	H	L	M	L
CO3(K6)	H	M	M	M	H	L	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

Core 9: ANALOGAND DIGITAL ELECTRONICS (Theory)

a. Course Code:

L	T	P	C
4	-	-	4

b. Course Objectives:

1. *To gain ideas on basic circuits using diodes, transistors. IC's*
2. *To know the concept of feedback, logic gates and their usage in digital circuits*

c. Learning Progression

HSC-II
Capacitors, resistors in series and parallel, Kirchhoff's laws Wheatstones bridge, Semiconductors and its types, De Morgan's Theorem

d. Theoretical Foundations:

Kirchhoff's current and voltage law, De Morgan's Theorem, Types of Semiconductors

e. Course Outcomes (COs):

At the end of the Course, the student will be able to -

CO1: State Thevenin's theorem, Maximum power transfer theorem, Demorgan's theorems

CO2: Explain fundamental laws of of Boolean algebra, feedback principle, understand the working diode and transistor.

CO3: Apply the laws of Boolean Algebra, Thevenin's theorem in circuits.

CO4: Analyze the sequential circuit Calculate the input impedance of a transistor, compare and classify oscillators, Demonstrate the operating principle and output characteristics of pn junction diodes, zener diode

CO5: Estimate the cut off frequency of a low pass, high pass filters, Compute different parameters of circuits using diodes FET – MOSFET – UJT.

CO6: Design and construct sequential circuits, counter, registers.

f. Course Outline:

Unit I: Linear circuit, semiconductor diodes and devices (12 hrs)

Module – I

Thevenin's theorem - Maximum power transfer theorem- PN junction theory - Half wave rectifier - Bridge rectifier- Zener diode - voltage Regulator - LED

Module -2

Filters – low pass, high pass and band pass filters, clipping and clamping circuits

Unit II: Transistor Amplifier and Operational Amplifier (14 hrs)

Module -1

Transistor - Different modes of operations - CB mode & CE mode - Two port representation of a transistor- h parameter – FET – MOSFET - UJT–characteristics

Module -2

RC coupled amplifier - transformer coupled amplifier - power amplifier -classification of amplifiers - Push pull amplifier

Module -3

Operational Amplifier- characteristics- Voltage follower - Adder - Subtractor Integrator – Differentiator – comparator - square wave generator

Unit III: Oscillators and Multivibrator (12 hrs)

Module – 1

Feedback principle - effect negative feedback-and Barkhaussen criterion - Phase shift and Wien Bridge oscillators using transistors

Module – 2

Multivibrators - Astable, Monostable and Bistable multivibrators using transistors - Schmitt trigger.

Unit IV: Digital Fundamentals (10hrs)

Module - I

Number Systems and Conversions - BCD Code – Gray and excess -3 code - 1's and 2's complements, binary addition and subtraction

Module - 2

Boolean laws – Demerger's Theorem, Basic logic gates - NAND, NOR and EX-OR gates - NAND and NOR as Universal Building blocks .

Module -3

Half adder, full adder, Karnaugh'smap - SOP and POS - applications

Unit V: Sequential Logic (12hrs)

Module - 1

Flip –flops - RS, Clocked RS, D, J-K and J-K Master-Slave Flip-flop

Module -2

Registers - Shift registers - serial in serial out and parallel in and parallel out

Module -3

Counters - asynchronous – mod 8, mod 10 counters, synchronous – ring counter.

Module - 4

Multiplexers and Demultiplexers – Decoders and Encoders - Memory Circuits - D/A and A/Dconverters

g. Book for Study:

1. Integrated Electronics by J.Millman and C.Halkias, Tata McGraw Hill, New Delhi(2001)
2. Digital Principles and Application by Malvino Leach, Tata McGraw Hill, 4thEdition(1992).
3. M.Morris Mano, "Digital Design "3rd Edition, PHI, NewDelhi
4. Basic Electronics by B.L.Theraja,S.Chand&Co.,(2008).

h. Books for Reference:

1. Electronic Devices by Mittal.G.K., G.K. Publishers Pvt. Ltd.,(1993).
2. Solid State Electronics by Ambrose and Vincent Devaraj, Meera Publication.
3. Applied Electronics by R.S.Sedha,S.Chand&Co.(1990).
4. Digital Electronics by Practice Using Integrated Circuits - R.P.Jain - Tata McGrawHill(1996).
5. Linear Integrated Circuits by D. Roy Choudhury and Shail Jain - New Age International (P)Ltd.(2003).
6. Electronics - Analog and Digital by I.J. Nagrath - Prentice - Hall of India, NewDelhi (1999).

i. Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	H	H	M	L
CO2 (K2)	H	M	M	M	L	M	L	L
CO3(K3)	H	H	M	M	M	H	H	M
CO4(K4)	H	M	M	H	M	M	L	L
CO5(K5)	H	H	M	M	H	H	M	M
CO6(K6)	H	M	L	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	H	L	M	M	H	H	L	L
CO2(K2)	H	M	L	M	M	L	M	H
CO3(K3)	H	M	M	M	H	H	L	M
CO4(K4)	H	M	L	M	M	L	M	M
CO5(K5)	H	L	L	M	H	H	L	L
CO6(K6)	L	M	L	L	H	H	L	M

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Core 6: ANALOG AND DIGITAL ELECTRONICS (Practical)

c. Course Code:

L	T	P	C
-	-	2	1

d. Course Outcome:

CO1: To perform basic experiments on electronic devices
CO2: To study the characteristics of diodes transistors, filters, amplifiers.

c. List of Practical's

1. Principles of Soldering, Usage of Multimeter, CRO and Function generator
2. Zener diode characteristics
3. Bridge Rectifier using diodes
4. Dual Regulated power supply using ICs
5. CE configuration characteristics
6. Low pass and High pass filters
7. Differentiator and Integrator
8. Clipping and Clamping
9. Voltage follower – Frequency response
10. Monostable Multivibator
11. Shift registers - serial in serial out and parallel in and parallel out
12. Mod 8, Mod 5 counters
13. Ring counters
14. Flip –flops - RS, Clocked RS
15. J-K Master-Slave flip-flop
16. Study of gate ICs – NOT,OR,AND, NOR,NAND, XOR, XNOR
17. Verification of De Morgan's theorem using ICs –NOT, OR,AND
18. Any other experiments.

f.Mapping of COs to POs & PSOs with correlation level and Cognitive level of COs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K4)	H	M	M	M	M	M	M	L
CO2 (K5)	H	M	M	M	M	M	M	L
CO3 (K6)	H	M	L	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K4)	M	L	L	M	H	L	M	L
CO2(K5)	M	L	L	M	H	L	M	L
CO3(K6)	H	M	M	M	H	L	L	L

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Core 10: NUMERICAL METHODS AND PROGRAMMING IN C (Theory)

a.Course Code:

L	T	P	C
4	-	-	4

b. Course Objectives:

1. *To introduce numerical methods for finding roots, integration and differentiation*
2. *To introduce Programming in C*

c. Course Outcomes (COs):

At the end of the Course, the student will be able to -

CO1: Know the basic structure of C program,

CO2: Understand the different functions, arrays.

CO3: Apply the different iteration methods and to determine the roots of the equations

CO4: Analyze and fitting the linear and transcendential equation

CO5: Evaluation of the polynomials , differentiating continuous functions.

CO6: Write and execute computer programming in C

d. Course Outline:

UNIT- I : Iterative Methods and Curve Fitting (12 hrs)

Module I

Roots of nonlinear equations – methods of solution – Iterative methods, starting and stopping - Evaluation of polynomials – Bisection method – False position method –

Module 2

Newton-Raphson method – determining all possible roots – roots of polynomials - curve fitting, regression – Fitting linear equation – fitting transcendental equation.

UNIT – II: Numerical Differentiation and Integration (12 hrs)

Module 1

Differentiating continuous functions , tabulated functions – difference tables – Richardson extrapolation – Newton - Cotes method

Module 2

Trapezoidal rule – Simpson's 1/3 rule – Simpson's 3/8 rule – Romberg integration – Gaussian integration.

Unit III: Introduction to Programming in C (12 hrs)

Module 1

Basic structure of C Program – character set – identifiers and keywords- constants and variables - data types

Module 2

Operators and expressions – Relational, Logical and Assignment operators – increment and decrement operators – Arithmetic expressions – Mathematical functions.

Unit IV: Programming in C (12 hrs)

Module 1

Data input and output – getchar, putchar, scan f, print f, gets, puts functions, Decision making – branching and looping – if, if-else, else if ladder, switch, break, continue, go to – while, do while – for, nested loops –

Module 2

Arrays (one dimensional and two dimensional) declaration – initialization - simple programs.

UNIT – V: User-Defined Functions **(12 hrs)**

Module 1

Introduction – Need and Elements of User-Defined Functions- Definition-Return Values and their types

Module 2

Function Calls – Declarations – Category of Functions- Nesting of Functions - Recursion – Passing Arrays and Strings to Functions - The Scope, Visibility and Lifetime of Variables. Structures and Unions.

e. Book for Study:

1. Balagurusamy.E, (2008), "Programming in ANSI C" , Second Edition, Tata McGraw Hill.
2. Numerical methods – A. Singaravelu, Meenakshi Agency, Chennai (2001).

f. Books for Reference:

1. Kamthane Ashok.N, (2013), "Programming in C", 2nd Edition, Pearson Education.
2. Yashvant P. Kanetkar, (2008), "Let us C", 8th Edition, Infinity science press.
3. Introductory methods of numerical analysis – S.S. Sastry, Prentice Hall of India, New Delhi (2000)
4. E. Balagurusamy, Computing Fundamentals & C Programming, Tata McGraw-Hill, Second Reprint, 2008.

g.Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	H	H	M	L
CO2 ((K2)	H	M	H	M	L	M	L	L
CO3(K3)	H	H	H	M	M	H	H	L
CO4(K4)	H	M	M	H	M	M	L	L
CO5(K5)	H	H	M	M	H	H	M	M
CO6(K6)	H	M	L	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	H	L	M	M	H	H	L	L
CO2(K2)	H	M	L	M	M	L	L	H
CO3(K3)	H	M	L	H	H	H	L	L
CO4(K4)	M	M	L	M	M	L	L	L
CO5(K5)	H	L	L	M	H	H	L	L
CO6(K6)	L	M	L	L	H	H	L	L

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Core 10: NUMERICAL METHODS AND PROGRAMMING IN C (Practical)

a. Course Code:

L	T	P	C
-	-	2	1

b. Course Outcome:

CO1: To write C program to generate prime numbers, Fibonacci series

CO2: To study the different iteration methods and execute the program.

c. List of Practical's

1. Write a C program to find the sum, average, standard deviation for a given set of numbers.
2. Write a C program to generate prime numbers.
3. Write a C program to generate Fibonacci series.
4. Write a C program to print magic square of order n where n > 3 and n is odd.
5. Write a C program to sort the given set of numbers in ascending order.
6. Write a C program to check whether the given string is a palindrome or not using pointers
7. Addition of numbers. Finding the largest and smallest of the given numbers
8. Sum of the series, Ascending and Descending order
9. Bisection method
10. Newton Raphson Method
11. Regular Falsi Method
12. Least Squares Method
13. Trapezoidal rule
14. Simpson's rule
15. Gaussian integration
16. Matrix addition and subtraction
17. Any other numerical method
18. Any other experiments

d. Mapping of COs to POs & PSOs with correlation level and Cognitive level of COs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K4)	H	M	M	M	M	M	M	L
CO2 (K5)	H	M	M	M	M	M	M	L
CO3 (K6)	H	M	L	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K4)	M	L	L	M	H	L	M	L
CO2(K5)	M	L	L	M	H	L	M	L
CO3(K6)	H	M	M	M	H	L	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

Skill Based Core I: Group I: (a) COMPUTATIONAL PHYSICS

a. Course Code:

L	T	P	C
2	0	0	2

b. Course Objectives

1. *To provide the core tools and methodology of computational physics*
2. *The emphasis is on gaining practical skills and a key objective is that the students gain the techniques and the confidence to tackle a broad range of problems in physics.*
3. *To provide a broad basis of skills and each is illustrated by application to physical system Using matlab.*
4. *To provide knowledge about various mathematical methods.*

c. Learning Progression:

Scalars, Vectors and Arrays, Linear Equation, Differential Equation, Simpson's rule, algebraic Equation, Algebra of Matrices and definition of square matrices

d. Theoretical/Experimental Foundations of the course:

Numerical differential equation, Integration, Linear equation, Gaussian quadrature method, simple matrix operations and programs

e. Course Outcomes (COs)

On completion of this course, students should be able to:

CO1: identify modern programming methods and describe the extent and limitations of computational methods in physics,
CO2: identify and describe the characteristics of various numerical methods.
CO3: independently program computers using leading-edge tools,
CO4: formulate and computationally solve a selection of problems in physics,
CO5: use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.

f. Course Outline:

UNIT I: NUMERICAL DIFFERENTIATION

Module 1: **(3 Hrs)**

Finding Roots of a Polynomial-Bisection Method-Newton Raphson Method

Module 2: **(3 Hrs)**

Solution of Simultaneous Linear Equation by Gauss Elimination Method

UNIT II: NUMERICAL INTEGRATION

Module 1: **(3 Hrs)**

Newton's cotes formula- -Simpson's 1/3 rule- Simpson's 3/8 rule-Boole's rule

Module 2: **(3 Hrs)**

Gaussian quadrature method-(2 point and 3 point formulae)- Giraffe's root square method for solving algebraic equation.

UNIT III: MATLAB FUNDAMENTALS

Module 1: **(5 Hrs)**

Introduction - Matlab Features-Desktop Windows: Command, Workspace, - Matlab Help and Demos-Matlab Functions, Operators and Commands.

Module 2: **(3 Hrs)**

Basic Arithmetic in Matlab- Matrices and Matrix Operations-

Module 3: **(4 Hrs)**

Complex Numbers- Matlab Built-In Functions-Illustrative Examples

UNIT IV: MATLAB PROGRAMMING

Module 1: **(4 Hrs)**

Control Flow Statements: if, else, else if, switch Statements - for, while Loop Structures-break Statement-

Module 2: **(4 Hrs)**

Input/Output Commands-Script "m" Files -Function "m" Files-Controlling Output

UNIT V: MATLAB GRAPHICS

Module 1: **(2 Hrs)**

2D Plots-Planar Plots, Log Plots, Scatter Plots, Contour Plots-Multiple Figures,

Module 2: : **(3 Hrs)**

Graph of a Function- Titles, Labels, Text in a Graph- Line Types, Marker types

Module 3: : **(3 Hrs)**

Colors-3D Graphics-Curve Plots-Mesh and Surface Plots-Illustrative Examples

g. Books for study

1. Numerical methods in Science and Engineering- M.K. Venkataraman- National Publishing Co. Madras,1996.
2. Getting Started With Matlab-RudraPratap-Oxford University Press-New Delhi.

h. Books for reference:

1. Engineering and Scientific Computations Using Matlab- Sergey E. Lyshevski- JohnWiley & Sons.
2. A Guide to Matlab for Beginners & Experienced Users-Brian Hunt, Ronald Lipsman, Jonathan Rosenberg-Cambridge UniversityPress.
3. Matlab Primer-Timothy A. Davis & Kermit Sigmon-Chapman & Hall CRC Press- London.
4. Matlab Programming-David Kuncicky-PrenticeHall.
5. An Introduction to Programming and Numerical Methods in MATLAB- S.R. Otto and J.P.Denier-Springer-Verlag-London.
6. Numerical Methods Using Matlab-John Mathews &Kurtis Fink- Prentice Hall-New Jersey,2006.
7. Introductory Methods of Numerical Analysis- S.S. Sastry-Pr

i. Mapping of COs to POs & PSOs with correlation level and Cognitive level of COs

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1(K1)	H	L	H	L	L	L	H	M
CO2(K2)	H	L	H	L	M	L	H	M
CO3(K3)	H	L	H	L	L	L	H	M
CO4(K4)	H	H	L	L	H	H	L	L
CO5(K5)	H	H	L	L	H	H	L	L

CO\PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	H	L	H	L	L	L	H	L
CO2(K2)	H	L	H	L	M	L	H	L
CO3(K3)	H	L	H	L	L	L	H	L
CO4(K4)	H	L	L	L	H	H	L	L
CO5(K5)	H	L	L	L	H	H	L	L

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Skill Based Core I: Group I: (b) **BASIC INSTRUMENTATION SKILL**

a.Course code

L	T	P	C
2	0	0	2

b. Course Objectives:

1. *To get exposure with various aspects of instruments and their usage throughhands-on mode.*
2. *To handle experiments through theoretical knowledge and analyze their results*

c. **Course Outcomes (COs)**

On completion of this course, students should be able to:

CO1: identify different instruments with different specifications.
CO2: Understand the Working principle of various instruments
CO3: Analyze the analog &digital instruments.
CO4: Measure and Calculate the current, voltage and impedance.
CO5: Construct the circuits using block diagrams and test the results.

d. Course outline

Unit I: Basic of Measurement: **(12 hrs)**

Module 1:

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects.

Module 2:

Multimeter: Principles of measurement of dc voltage and dc current,ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Module 3:

Electronic Voltmeter: Advantage- Principles of voltage,measurement (block diagram only). Specifications of an electronic Voltmeter/Multimeter and their significance.

Module 4:

AC millivoltmeter: Type of AC millivoltmeters:

Unit II: Cathode Ray Oscilloscope: (9 hrs)

Module 1:

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment).

Module 2: Time base operation, synchronization. Front panel controls.Use of CRO for the measurement of voltage (dc andac frequency, time period).

Unit III: Signal Generators and Analysis Instruments: (12 hrs)

Modu Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator.

Module 2: Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Unit IV: Impedance Bridges & Q-Meters: (9 hrs)

Module 1: Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge.

Module 2: Block diagram & working principles of a Q- Meter. Digital LCR bridges.

Unit V: Digital Instruments: (9 hrs)

Module 1: Block diagram of bridge. working principles of basic (balancing type) RLC bridge.Specifications of RLC bridge.

Module 2: Principle and working of digital meters. Comparison of analog &digital instruments. Characteristics of a digital meter. Working principles of digitalvoltmeter
Module 3: Digital Multimeter: Block diagram and working of a digital multimeter-Working

g. Books for study

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

f. Reference Book:

1. Logic circuit design, Shimon P. Vingron, 2012, Springer.
2. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
3. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, TataMc-Graw Hill

i.Mapping of COs to POs & PSOs with correlation level and Cognitive level of COs

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1(K1)	H	L	H	L	L	L	H	H
CO2(K2)	H	M	H	M	M	M	H	H
CO3(K3)	H	M	H	M	M	L	H	H
CO4(K4)	H	H	L	L	H	H	L	H
CO5(K5)	H	H	L	L	H	H	L	H

CO\PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	H	M	H	L	L	L	H	H
CO2(K2)	H	L	H	M	M	L	H	H
CO3(K3)	H	M	M	L	L	L	H	H
CO4(K4)	H	M	M	M	H	H	L	H
CO5(K5)	H	M	M	L	H	H	L	H

(L – Low, M – Medium, H – High; K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5–Evaluate, K6 – Create)

Skill Based Core I: Group I: (c) APPLIED OPTICS

a.Course Code:

L	T	P	C
2	0	0	2

b. Course Objectives

1. *To utilize optical principles in lasers, optical fibre communications, and optoelectronics.*
2. *To increase student awareness in communication systems.*
3. *To know about the various applications in Laser.*
4. *To gain knowledge about optoelectronics, as well as their economic implications.*

c. Learning Progression:

HSC
Polarization, Diffraction, Light, Interference, Reflection, Refraction, LED, Spherical Mirror, Mirror equation, Lens makers formula Optical instruments, Telescope, Microscope, Grating

d. Theoretical/Experimental Foundations of the course:

Laser elements, Energy levels and Stimulated emission of Lasers, Transmitters, Receivers, Fiber cable types, Amplification

e. Course Outcomes (COs)

CO1: To be able to evaluate the various laser systems and the applications they have in various industries.
CO2: Being able to List a few diverse uses for optics, such as laser, fibre optics, optoelectronics, and nonlinear optics.
CO3: Understanding the practical solar energy application.
CO4: To recognize the ideas of opto-couplers and opto-isolators.
CO5: Understanding of how to use the optical fibre concept, its design, and its significance n communication physics.
CO6: To Interpret nonlinear optics (NLO) ideas, and be able to distinguish between various harmonic generating NLO materials.

f.Course Outline: **(9 hrs)**

UNIT- I: LASER

Module 1: Review of laser theory, Properties of laser radiation, Principles of Laser,
Module 2: Designing of laser, Glass lasers, Gas lasers (Carbon dioxide laser and Carbon monoxide laser), Pulsed lasers, Excimer laser, Dye laser, Chemical laser, X-ray lasers and Free-electron lasers, Laser Safety.

UNIT- II: APPLICATIONS OF LASER **(9 hrs)**

Module 1: Application of lasers in data storage, communication and information technology
Module 2: Laser applications in Civil; Bio-medical applications of lasers; Laser tweezers and applications; Laser applications in defense

UNIT- III: OPTICAL FIBRE **(10 hrs)**

Module 1: Motivations for using for using Optical Fiber System, Evolution of Optical Communications, Elements of Optical Link, WDM Concept, Application of Optical Fiber Link, WDM Concept
Module 2: Light Propagation in Optical Fiber, Optical Fiber Modes, Variations of Fiber Types, Single Mode Fibers, Optical Fiber Attenuation, Fiber Information apacity, Optical Fiber Standards, Specialty Fibers – Erbiam doped Fibers.

UNIT- IV: OPTOELECTRONICS **(7 hrs)**

Module 1: Introduction to Optoelectronics device, Photo-transistors
Module 2: Opto-isolators, Opto-Couplers.

UNIT-V: NON LINEAR OPTICS **(8 hrs)**

Module 1: Introduction to Non Linear Optics, Non Linear Optical Materials
Module 2: Second and third harmonic generation NLO materials, Z-Scan technique.

g.Books for study:

1. G. Keiser, Optical Communications Essentials, Tata McGraw-Hill.
2. W. T. Silfvast, Laser Fundamentals, Cambridge Univ. Press, Cambridge.
3. J. F. Ready, Industrial Applications of Lasers, 2nd Edn. Academic Press, San Diego.

h.Books for references:

1. Roy Henderson, A Guide to Laser Safety, Chapman & Hall, London.
2. J. B. Gupta, Electronic Devices and Circuits, Katson Books.
3. R. L. Boylestad, Electronic Devices and Circuit Theory, 10th Edition, Pearson Publication.
4. G. C. Baldwin, An Introduction to Nonlinear Optics, Springer. ISBN 978-1-4613-4615-9

i. Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	M	M	H	L
CO2 ((K2)	M	M	M	M	L	M	M	M
CO3(K3)	M	L	M	M	L	M	H	M
CO4(K4)	H	M	M	H	L	M	M	L
CO5(K5)	M	M	M	M	M	M	M	L
CO6(K6)	H	M	M	L	L	L	M	M

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	M	M	M	M	H	H	L	L
CO2(K2)	M	L	L	M	M	L	M	L
CO3(K3)	M	M	M	M	M	H	L	M
CO4(K4)	M	M	M	M	M	L	M	M
CO5(K5)	L	M	L	M	H	H	M	M
CO6(K6)	M	L	M	L	H	H	M	M

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create).

Skill Based Core I: Group II: (a) RENEWABLE ENERGY

a. Course Code:

L	T	P	C
2	0	0	2

b. Course Objectives

1. *To increase student awareness of the energy crisis and its causes*
2. *To understand the natural Energy Sources and encourage the use of Renewable energy*
3. *To know about the various applications in Solar energy.*
4. *To gain knowledge about biomass and wind energy, as well as their economic implications.*
5. *To become familiar with geothermal energy in comparison to other energy sources.*
6. *To be able to evaluate the feasibility of wind and alternative energy initiatives*

c. Learning Progression:

HSC
Energy sources and types Fossil Fuels, Biomass, Bio-Gas Plant Solar Energy, Wind Energy, Energy from sea

d. Theoretical/Experimental Foundations of the course:

Renewable energy –Solar Energy, wind energy, Non-Renewable energy -coal, oil , agricultural waste

e. Course Outcomes (COs)

CO1: Energy saving reduces costs to households and to businesses, increasing sustainability of the local economy and Community

CO2: Being able to categorize different solar energy collectors and storage techniques.

CO3: Understanding the practical solar energy application.

CO4: To give the students the administrative abilities they'll need to determine the viability of different strategies and direct efforts towards wind and other alternative sources of energy.
CO5: Understanding of how to use different energy sources, such as wind, biogas, and geothermal.
CO6: To assist students in achieving a thorough conceptual understanding of the Technical and commercial elements of wind and alternative sources of energy.

f. Course Outline:

UNIT- I: Conventional Energy Sources (9 hrs)
Module 1: World reserve- Commercial energy sources and their availability – Various forms of energy- Water power – Nuclear power
Module 2: Conventional energy sources: coal-oil-agricultural and organic waste
Module 3: New Energy technologies.

UNIT- II: Solar energy (9 hrs)
Module 1: Renewable energy sources – Solar energy – nature and Solar radiation –components –
Module 2: Solar heaters – Solar energy collector - Crop dryers – Solar cookers – Solar Furnaces –Solar Dryer
Module 3: Photovoltaic generation – merits and demerits.

UNIT- III: Biomass energy fundamentals (9 hrs)
Module 1: Basis of bio mass energy – bio mass conversion – technologies – wet process – dry process - Photosynthesis.
Module 2: Bio gas plants – classification – methods of obtaining energy from bio mass.

UNIT- IV: Wind energy (9 hrs)
Module 1: Basic principles of wind energy conversion- the nature of the wind – the power of the wind – maximum power
Module 2: Wind energy conversion – basic components of wind energy conversion systems.

UNIT-V: Additional alternate energy sources (9 hrs)
Module 1: Geothermal energy sources – Energy from ocean- Ocean thermal energy conversion –Energy from waves and tides (basic ideas).
Module 2: Chemical energy sources – Hydrogen energy

g.Books for study:

1. G. D. Rai, Non – Conventional Energy Sources, Khanna Publishers, New Delhi, 5th Edition, 2012.
2. Godfrey Boyle, Renewable Energy: Power for a sustainable Future, Alden Oess Limited, Oxford, 1996.
3. D. P. Kothari, K. C. Singal & Rakesh Ranjan, Renewable energy sources and emerging Technologies, Prentice Hall of India pvt. Ltd., New Delhi, 2008.

h.Books for references:

1. H.P. Garg and J. Prakash, Solar Energy Fundamentals and application, Tata McGraw-Hill Publishing companyltd, 1997.
2. S. P. Sukhatme, Solar energy, Tata McGraw- Hill Publishing company ltd, 1997.

i.Mapping of Cos to POs and PSOs

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CO2 ((K2)	M	M	M	M	L	M	L	L
CO3(K3)	M	L	M	M	L	M	L	L
CO4(K4)	H	M	M	H	L	M	L	L

CO5(K5)	M	M	M	M	M	M	L	L
CO6(K6)	H	M	M	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	M	L	M	M	H	H	L	L
CO2(K2)	L	L	L	M	M	L	M	L
CO3(K3)	L	M	M	M	M	H	L	L
CO4(K4)	L	L	L	M	M	L	M	L
CO5(K5)	L	M	L	M	H	H	L	L
CO6(K6)	L	L	L	L	H	H	L	L

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Skill Based Core I: Group II: (b) RADIATION SAFETY

a. Course Code:

L	T	P	C
2	0	0	2

b. Couse Objectives

1. *To study the effects of radiation and overcome radiation hazards*
2. *To understand the interaction of ionizing radiation with matter and its effects.*

c. Course Outcomes (Cos):

At the end of the Course, the student will be able to -

CO1: Explain different types of radiation and its properties and applications.
CO2: Monitor background radiation levels using detectors
CO3: Adapt better solutions for dosimetry standards in a human society.
CO4: Acquire knowledge on radiation safety and personal monitoring devices
CO5: Know about the radioisotopes produced from particle accelerators
CO6: Understand the safety procedures followed in Nuclear medicine departments

d. Course Outline

Unit I: Basics of Atomic and Nuclear Physics:

Module 1 **(2 hrs)**

Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron.

Module 2 **(1 hr)**

The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes,

Module 3 **(3 hrs)**

Laws of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission.

Unit II: Interaction of Radiation with matter:

Module 1 **(2 hrs)**

Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources,

Module 2 **(2 hrs)**

Interaction of Photons -Photo-electric effect, Compton Scattering, Pair Production, Linear and Mass - Attenuation Coefficients

Module 3 **(3 hrs)**

Interaction of Charged Particles: Heavy charged particles- Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss(Bremsstrahlung), Interaction of Neutrons- Collision, slowing down and

Moderation

Unit III: Radiation detection and monitoring devices:

Module 1 **(3hrs)**

Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC).

Module 2 **(4 hrs)**

Radiation detection: Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter,Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), Scintillation Detectors (Inorganic and Organic Scintillators), Solid States Detectors and Neutron Detectors, Thermo luminescent Dosimetry.

Unit IV: Radiation safety management:

Module 1 **(3 hrs)**

Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation.

Module 2 **(2 hrs)**

Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management

Unit V: Application of nuclear techniques:

Module 1 **(3 hrs)**

Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil.

Module 2 **(2 hrs)**

Industrial Uses: Tracing, Gauging, Material Modification, Sterization, Food preservation.

e. Books for Study:

1. W.E. Burcham and M. Jobes, Nuclear and Particle Physics, Longman, 1995.
2. G.F.Knoll, Radiation detection and measurements, John wiley and sons, 2010.
3. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". John Wright and Sons, UK, 1989.

g. Books for Refernce:

1. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981.
2. Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowental and P.L. Airey, Cambridge University Press, U.K., 2001
3. A. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc. New York, 1981.
4. W.R. Hendee, "Medical Radiation Physics", Year Book – Medical Publishers Inc. London, 1981

i.Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	M	M	L	L
CO2 ((K2)	M	M	M	M	L	M	L	L
CO3(K3)	M	L	M	M	L	M	L	L
CO4(K4)	H	M	M	H	L	M	L	L
CO5(K5)	M	M	M	M	M	M	L	L
CO6(K6)	H	M	M	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	M	L	M	M	H	H	L	L
CO2(K2)	L	L	L	M	M	L	M	L
CO3(K3)	L	M	M	M	M	H	L	L
CO4(K4)	L	L	L	M	M	L	M	L
CO5(K5)	L	M	L	M	H	H	L	L
CO6(K6)	L	L	L	L	H	H	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create).

Skill Based Core I: Group II: (c) ELECTRICAL CIRCUITS AND NETWORK SKILLS

a. Course Code:

L	T	P	C
2	0	0	2

b. Course Objectives

1. To enable students to design and trouble shoot electrical circuits, networks and appliances through hands-on mode

c. Course Outcomes (Cos)

At the end of the Course, the student will be able to -

CO1: Trouble shoot electrical circuits, networks and appliances
CO2: Familiarize in electrical wiring and preparation of extension board
CO3: Understand the operation of generators, transformers and motors
CO4: Design new electric circuits with solid-state devices

d. Course Outline

Unit I: Basic Electricity Principles and Electrical Circuits:

Module 1 **(3hrs)**

Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

Module 2 **(4 hrs)**

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

Unit II: Electrical Drawing and Symbols:

Module 1 **(2hrs)**

Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits.

Module 2 **(2hrs)**

Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

Unit III: Generators, Transformers and Motors:

Module 1 **(3 hrs)**

DC Power sources, AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

Module 2 **(4 hrs)**

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

Unit IV: Solid-State Devices and Electrical Protection:

Module 1 **(3 hrs)**

Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources

Module 2 **(4hrs)**

Electrical Protection- Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

Unit V: Electrical Wiring:

Module 1 **(3 hrs)**

Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits.

Module 2 **(2 hrs)**

Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board.

e. Books for Study:

1. B L Theraja and A K Theraja, A text book in Electrical Technology, VOL -I, II,III & IV S Chand & Co, New Delhi, 2007.

f. Books for Reference:

1. M G Say, The performance and design of AC machines – CBS Publishers, Bangaluru, 2005.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	M	M	L	L
CO2 ((K2)	M	M	M	M	L	M	L	L
CO3(K3)	M	L	M	M	L	M	L	L
CO4(K4)	H	M	M	H	L	M	L	L
CO5(K5)	M	M	M	M	M	M	L	L
CO6(K6)	H	M	M	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	M	L	M	M	H	H	L	L
CO2(K2)	L	L	L	M	M	L	L	L
CO3(K3)	L	M	M	M	M	H	L	L
CO4(K4)	L	L	L	M	M	L	L	L
CO5(K5)	L	M	L	M	H	H	L	L
CO6(K6)	L	L	L	L	H	H	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create).

Elective 1- Group I: (a) ENERGY PHYSICS

a. Course Code:

L	T	P	C
3	0	0	3

b. Course Objectives

1. *To educate students with fundamental principles of energy sources and their availability.*
2. *To make students understand the working principle in Solar energy devices, wind energy and biomass energy.*
3. *The principle, design and working of various Photovoltaic Systems are dealt in a simple manner.*
4. *It will stimulate the students to understand the present energy crisis and various available energy sources.*

c. Learning Progression:

HSC
Solar energy, Wind energy. Water energy (hydro-energy). Geothermal energy, Ocean energy, Biomass energy (firewood, animal dung and biodegradable waste from cities and crop residues constitute biomass).

d. Theoretical/Experimental Foundations of the course:

Awareness of energy sources and their availability, Knowledge about various Photovoltaic Systems, Solar energy devices, wind energy and biomass energy.

e. Course Outcomes (COs)

CO1: Gain a deep understanding of the fundamentals of energy extraction from water and biomass
CO2: Become well-versed in the fundamentals of Photovoltaic Systems
CO3: Summarise the principles of Direct Energy Conversion systems and their uses.
CO4: Understand the practical uses of solar energy.
CO5: Outline the production of biogas and its effects on the environment.
CO6: Awareness in Energy saving reduces costs to households and to businesses, increasing sustainability of the local economy and Community

f. Course Outline:

UNIT I: Introduction to Energy Sources (8 hrs)

Module 1 : World's production and reserves of Commercial energy sources -India's production and reserves

Module 2: Conventional and non-conventional sources of energy, comparison – Coal- Oil and Natural gas –applications - merits and demerits.

UNIT II: Solar Thermal Energy (9 hrs)

Module 1: Solar constant -Solar spectrum-Solar radiations outside earth's atmosphere –at the earth Surface- on tilted surfaces -Solar Radiation geometry

Module 2: Basic Principles of Liquid flat plate collector –Materials for flat plate collector

Module 3: Construction and working- Solar distillation–Solar disinfection - Solar drying-Solar Cooker (box type)-Solar water heating systems -Swimming pool heating.

UNIT III: Photovoltaic Systems (10 hrs)

Module 1: Introduction-Photovoltaic principle-Basic Silicon Solar cell- Power output and conversion efficiency-Limitation to photovoltaic efficiency

Module 2: Basic photovoltaic system for power generation- Application of solar photovoltaic Systems-Advantages and disadvantages

Module 3: Types of solar cells- - PV Powered fan – PV powered area - lighting system – A Hybrid System.

UNIT IV: Biomass Energy (10 hrs)

Module 1: Introduction-Biomass classification- Biomass conversion technologies- Methods for obtaining energy from biomass- Thermal gasification of biomass

Module 2: Bio-gas generation- Factors affecting bio-digestion -Working of biogas plant- floating and fixed dome type plant-advantages and disadvantage of -Bio-gas from plant wastes

Module 3: Working of downdraft gasifier- Advantages and disadvantages of biological conversion of solar energy.

UNIT V: Wind Energy and Other Energy Sources (8 hrs)

Module 1: Wind Energy Conversion-Classification and description of wind machines, wind Energy collectors-Energy storage-

Module 2: Energy from Oceans and Chemical energy resources-Ocean thermal energy Conversion - tidal power, advantages and limitations of tidal power generation

Module 3: Energy and power from waves- wave energy conversion devices-

Module 4: Fuel cells- and application of fuel cells- batteries- advantages of battery for bulk energy storage- Hydrogenas alternative fuel for motor vehicles.

g.Books for study:

1. Kothari D.P., K.C. Singal and Rakesh Ranjan, Renewable energy sources and emerging Technologies, Prentice Hall of India, 2008.
2. Solar Energy-principles of thermal collection and storage- S.P.SUKHAME-tata-McGraw-Hill publishing company ltd.
3. Non-conventional energy sources B.H.Khan

h. Books for References:

1. Chetan Singh Solanki, Solar Photvoltaics Fundamentals, Technologies and Applications, 2ndEdition, PHI Learning Private Limited, 2011.
2. Rai G. D, Non conventional Energy sources, 4th Edition, KhannaPublishers,2010.
3. Jeffrey M. Gordon, Solar Energy: The State of the Art, Earthscan, 2013.
4. Kalogirou S.A., Solar Energy Engineering: Processes and Systems , 2nd Edition, Academic Press, 2013.
5. ZobaaA.F.and Ramesh Bansal,Handbook of Renewable Energy Technology, World Scientific, 2011.

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CO6(K6)	H	M	M	M	M	L	M	M

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
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CO2(K2)	M	L	M	M	M	L	M	M
CO3(K3)	L	L	M	H	H	H	L	M
CO4(K4)	M	L	M	M	M	L	M	M
CO5(K5)	M	L	M	H	H	M	M	M
CO6(K6)	M	L	M	H	H	M	L	M

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Elective 1- Group I: (b) NUMERICAL METHODS AND PROGRAMMING IN C

a.Course Code:

L	T	P	C
3	-	-	3

b.Course objectives:

1. *To introduce numerical methods for finding roots, integration and differentiation*
2. *To introduce Programming in C*

c. Course Outcomes (COs):

At the end of the Course, the student will be able to -

CO1: Know the basic structure of C program,

CO2: Understand the different functions, arrays.

CO3: Apply the different iteration methods and to determine the roots of the equations

CO4: Analyze and fitting the linear and transcendential equation

CO5: Evaluation of the polynomials , differentiating continuous functions.

CO6: Write and execute computer programming in C

f. Course Outline:

UNIT- I : Iterative Methods and Curve Fitting (12 hrs)

Module I

Roots of nonlinear equations – methods of solution – Iterative methods, starting and stopping - Evaluation of polynomials – Bisection method – False position method –

Module 2

Newton-Raphson method – determining all possible roots – roots of polynomials - curve fitting, regression – Fitting linear equation – fitting transcendental equation.

UNIT – II: Numerical Differentiation and Integration (12 hrs)

Module 1

Differentiating continuous functions , tabulated functions – difference tables – Richardson extrapolation – Newton - Cotes method

Module 2

Trapezoidal rule – Simpson's 1/3 rule – Simpson's 3/8 rule – Romberg integration – Gaussian integration.

Unit III: Introduction to Programming in C (12 hrs)

Module 1

Basic structure of C Program – character set – identifiers and keywords- constants and variables – data types

Module 2

Operators and expressions – Relational, Logical and Assignment operators – increment and decrement operators – Arithmetic expressions – Mathematical functions.

Unit IV: Programming in C (12 hrs)

Module 1
Data input and output – getchar, putchar, scan f, print f, gets, puts functions, Decision making – branching and looping – if, if-else, else if ladder, switch, break, continue, goto – while, do while – for, nested loops –
Module 2
Arrays (one dimensional and two dimensional) – declaration – initialization - simple programs.

UNIT – V: User-Defined Functions (12 hrs)
Module 1
Introduction – Need and Elements of User-Defined Functions- Definition-Return Values and their types
Module 2
Function Calls – Declarations – Category of Functions- Nesting of Functions - Recursion – Passing Arrays and Strings to Functions - The Scope, Visibility and Lifetime of Variables. Structures and Unions.

g.Books for Study:
1. Balagurusamy.E, (2008), "Programming in ANSI C" , Second Edition, Tata McGraw Hill.
2. Numerical methods – A. Singaravelu, Meenakshi Agency, Chennai (2001).

h.Books for Reference:
1. Kamthane Ashok.N, (2013), "Programming in C", 2nd Edition, Pearson Education.
2. Yashvant P. Kanetkar, (2008), "Let us C", 8th Edition, Infinity science press.
3. Introductory methods of numerical analysis – S.S. Sastry, Prentice Hall of India, New Delhi (2000)
4. E. Balagurusamy, Computing Fundamentals & C Programming, Tata McGraw-Hill, Second Reprint, 2008.

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CO3(K3)	H	M	L	H	L	H	M	L
CO4(K4)	H	M	M	H	M	M	M	M
CO5(K5)	H	M	L	M	M	H	M	L
CO6(K6)	H	M	M	M	M	L	M	M

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	M	L	M	M	H	H	L	L
CO2(K2)	M	L	M	M	M	L	M	M
CO3(K3)	L	L	M	H	H	H	L	L
CO4(K4)	M	L	M	M	M	L	M	M
CO5(K5)	M	L	M	H	H	M	M	L
CO6(K6)	M	L	M	H	H	M	L	M

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create).

Elective 1- Group I: (c) OPTOELECTRONICS

a.Course Code:

L	T	P	C
3	-	-	3

b.Course Objectives

1. *To study the basic principles of Optoelectronic devices*
2. *To understand the principle and working of LASER and fibre optic communication*

c.Course Outcomes (Cos):

At the end of the Course, the student will be able to -

CO1: Explain the principle and operations of LEDs and Semiconductor LASER
CO2: Understand the working of optical detectors and optical modulators
CO3: Acquire knowledge of optical fibre communication system

f.Course Outline

Unit I: OPTICAL PROPERTIES OF SEMICONDUCTORS

Module 1 **(3 hrs)**

Introduction – Maxwell equations and vector potential- Electrons in an electromagnetic field. Interband and Intraband transitions in bulk semiconductors and Quantum wells.

Module 2 **(3hrs)**

Carrier injection and radiative recombination, Nonradiative recombination: Auger process, Continuity equation: diffusion length, Charge injection and bandgap renormalization

Unit II: LED AND LASERS

Module 1 **(3 hrs)**

Introduction- Materials system for LED- Operation of the LED- carrier injection and quantum efficiency. Output power and modulation bandwidth. Advanced LED structures – Hetro-junction LED, Edge emitting LED and surface emitting LED

Module 2 **(3 hrs)**

Laser- Introduction– characteristics of Laser– Spontaneous and stimulated emission– Einstein coefficients- condition for population inversion– three level scheme– semi conductor Laser- Advanced Laser structures- Double heterojunction lasers and quantum well lasers

Unit III: OPTICAL DETECTORS

Module 1 **(3 hrs)**

Optical detectors-optical detector principle, absorption coefficient, detector, characteristics, Quantum efficiency, responsivity, response time-bias voltage, Noise in detectors

Module 2 **(3 hrs)**

PN junction-photo diode, characteristics, P-I-N-photo diode, response, Avalanche photo diode (APD) multiplication process-B,W-Noise photo transistor

Unit IV: OPTICAL FIBRE COMMUNICATION

Module 1 **(3 hrs)**

Introduction – principle of optical fibre – light transmission in a optical fibre – Acceptance angle – Numerical aperture. V-parameter.

Module 2 **(3 hrs)**

Fibre index profiles – Step index, graded fibre (transmission of signals) – Advantages of fibre optic communications, optical switching.

Unit V: OPTOELECTRONIC MODULATION AND AMPLIFICATION DEVICES

Module 1 **(3 hrs)**

Introduction, Analog and Digital Modulation, Electro-optic modulators, Electro-absorptions modulators, Magneto Optic Devices.

Module 2 **(3 hrs)**

Liquid crystal displays, Acousto-Optic devices, Optical Switching, Optical Amplification- CW signals and pulse shaping.

g.Books for Study

1. Semiconductor Optoelectronics: Physics and Technology, Jasprit Singh, McGraw Hill publishers,2019.
2. Semiconductor Optoelectronic Devices 2nd Edition", P. Bhattacharya, Prentice Hall publihers.2017.

f. Books for Reference:

1. Optoelectronics – Wilson & Hawker, Prentice Hall of India 2004.
2. Optoelectronic Devices and Systems, S C Gupta, Prentice Hal of India, 2005.
3. Opticalelectronics, A. Ghatak and K. Thyagarajan, Cambridge india, 2017.

i.Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	M	M	L	L
CO2 ((K2)	H	M	M	H	L	M	L	L
CO3(K3)	H	M	L	H	L	H	L	L
CO4(K4)	H	M	M	H	M	M	L	L
CO5(K5)	H	M	L	M	M	H	M	L
CO6(K6)	H	M	M	M	M	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	M	L	M	M	H	H	L	L
CO2(K2)	M	L	M	M	M	L	L	M
CO3(K3)	L	L	M	H	H	H	L	L
CO4(K4)	M	L	M	M	M	L	L	L
CO5(K5)	M	L	M	H	H	M	L	L
CO6(K6)	M	L	M	H	H	M	L	M

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create).

Elective 1- Group II: (a) NANO PHYSICS

a.Course Code:

L	T	P	C
3	-	-	3

b.Course Objectives:

1. To have an overall ideas of nanophysics

2. To know the different types of nanomaterials and their applications

c. Course Outcomes (COs):

At the end of the Course, the student will be able to -

CO1: Know the history of nanotechnology, electronic structure of nanotubes.

CO2: Understand the fundamentals of nanomaterials

CO3: Classify the types of nanomaterial by applying the theoretical background

CO4: Analyze the different types of nanostructure and their properties.

CO5: Differentiate the different nanotubes.

CO6: Develop new nonmaterial's for different new application.

d. Course Outline:

UNIT I: Nanomaterials **(9 hrs)**

Module 1

History of Nanotechnology - nanoscale – nature and nanostructures - synthesis of oxide nano particles

Module 2

Synthesis of semiconductor nano particles- Synthesis of metallic nano particles

UNIT II: Quantum Hetero structure **(9 hrs)**

Module 1

Super lattice- preparation of Quantum nanostructure- Quantum well laser- Quantum cascade laser-

Module 2

Quantum wire - Quantum dot - Application of Quantum dots.

UNIT III: Carbon Nanotubes **(9 hrs)**

Module 1

Discovery of Nanotubes- Carbon Allotropes- Types of carbon Nanotubes Graphene sheet to a single walled nanotube

Module 2

Electronic structure of Carbon Nanotubes- Synthesis of Carbon Nanotube.

UNIT IV **(9 hrs)**

Module 1

Nanocrystalline soft material- Permanent magnet material- Theoretical background

Module 2

Super paramagnetism- Coulomb blockade - Quantum cellular Automata.

UNIT V: Application of Nanotechnology **(9 hrs)**

Module 1

Chemistry and Environment – Energy applications of nanotechnology- Information and Communication - Heavy industry -Consumer goods

Module 2

Nanomedicine - Medical application of Nanotechnology

g. Books for Study:

1. Text book of Nanoscience and Nanotechnology – B. S. Moorthy, P. Sankar, Baldev Raj, B. B. Rath and James Murdy University Press – IIM
2. Nanophysics, Sr. Geradin Jayam, Holy Cross College, Nagercoil (2010)

h.Books for Reference:

1. Nanoscience and Nanotechnology: Fundamentals to Frontiers'
   M.S. Ramachandra Rao, Shubra Singh, Wiley India pvt. Ltd., New Delhi. (2013).

2. 'Nano the Essentials' - T. Pradeep, Tata Mc.Graw Hill company Ltd (2007)
3. '*The Chemistry of Nano materials : Synthesis, Properties and Applications*', Volume 1 C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, , Germany (2004).

i.Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	M	M	L	L
CO2 ((K2)	H	M	M	H	L	M	L	L
CO3(K3)	H	M	L	H	L	H	L	L
CO4(K4)	H	M	M	H	M	M	L	L
CO5(K5)	H	M	L	M	M	H	M	L
CO6(K6)	H	M	M	M	M	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	M	L	M	M	H	H	L	L
CO2(K2)	M	L	M	M	M	L	L	M
CO3(K3)	L	L	M	H	H	H	L	L
CO4(K4)	M	L	M	M	M	L	L	L
CO5(K5)	M	L	M	H	H	M	L	L
CO6(K6)	M	L	M	H	H	M	L	M

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Elective 1- Group II: (b) MEDICAL PHYSICS

a. Course Code:

L	T	P	C
3	0	0	3

b. Course Objectives

1. *To understand the basics about the biological systems in our body, their behavior,and the diagnostic devices.*
2. *To educate students the Applications of Electricity and Magnetism in Medicine techniques and to address various biological signals, their acquisition, measurements, and associated Limitations.*
3. *It provides an overview of the human physiological system, which is crucial for design consideration.*
4. *The principle, design and working of various ECG, EEG, EMG and CT dealt in a simple manner.*
5. *It will stimulate the students to understand the design and functioning of various medical equipment.*

c. Learning Progression:

HSC
Pressure, Batteries, Electricity and Magnetism, basics in Electrocardiography, Transducers, X-rays- Production of X-rays Computers in medicine, Light in medicine

d. Theoretical/Experimental Foundations of the course:

1. Awareness of X-rays and basic principles in Electricity and Magnetism
2. Knowledge about Electro Cardio Graph (ECG), Electro Encephalo Graph (EEG) Electro Myogragh (EMG) Computer Tomography (CT)
3. A detailed knowledge in Sound in medicine and Light in medicine

e. Course Outcomes (COs)

CO1: Gain a deep understanding of the fundamentals of Electricity and Magnetism
CO2: Become well-versed in the fundamentals of – Heat and Cold in Medicine
CO3: Acquire an in-depth knowledge of the fundamentals behind - Physics of eyes and vision.
CO4: Become thoroughly knowledgeable about the clinical uses of medical systems.
CO5: Understanding of how to use different devices, such as ECG, EEG, EMG and CT.
CO6: To assist students in achieving a thorough conceptual understanding of the Basics medical devices.

f. Course Outline:

Unit I: (9hrs)

Module 1: Basic Anatomical Terminology- Standard anatomical position, Planes, Familiarity with terms like – Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal, Distal.
Module 2: Forces on and in the Body – Physics of the Skeleton- Heat and Cold in Medicine- Energy work and Power of the Body.

Unit II: (9hrs)

Module 1: Pressure system of the body- Physics of Cardiovascular system-Electricity within the Body- Applications of Electricity and Magnetism in Medicine.
Module 2: Sound in medicine- Physics of theEar and Hearing- Light in medicine-Physics of eyes and vision.

Unit III: (9hrs)

Module 1: Transducers- performance of characteristics of transducer- static and dynamic active transducers- magnetic induction type-piezoelectric type -photovoltaic type - thermoelectric type.
Module 2: Passive transducer- resistive type – effect and sensitivity of the bridge capacitive transducer- linear variable differential transducer (LVDT).

Unit IV: (9hrs)

Module 1: X-rays- Production of X-rays- X-ray spectra- continues spectra and characteristic spectra- Coolidge tube
Module 2: Electro Cardio Graph (ECG) - Block diagram- ECG Leads- Unipolar and bipolar-ECG recording set up.

Unit V: (9hrs)

Module 1: Electro Encephalo Graph (EEG) - origin- Block diagram- ElectroMyogragh (EMG) – Block diagram-
Module 2: EMG recorder- Computer Tomography (CT) principle- Block diagram of CT scanner.

g. Book for study:

1. Medical Physics –John R. Cameron and James G.Skofronick, 1978, John Willy &Sons.
2. M. Arumugam, Bio-medical Instrumentation, Anuradha Agencies, Chennai,10th edition, reprint, 2013.

h.Books for references:

1. R.S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill Publishing Company Limited,Newdelhi, Reprint, 2002.

2. Nandini K. Jog, Electronics in Medicine and Biomedical Instrumentation, PHI Learning Pvt. Ltd., 2nd Edition,2013.

i. Mapping of Cos to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1 (K1)	H	H	H	M	M	M	L	L
CO2 ((K2)	M	M	M	H	L	M	L	L
CO3(K3)	M	M	M	H	L	H	L	L
CO4(K4)	H	M	M	H	L	M	L	L
CO5(K5)	H	L	M	M	L	H	L	L
CO6(K6)	H	L	M	L	L	L	L	L

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1(K1)	H	L	M	M	H	H	L	L
CO2(K2)	M	L	M	M	M	L	M	L
CO3(K3)	L	M	M	H	H	H	L	L
CO4(K4)	M	L	L	M	M	L	M	L
CO5(K5)	H	L	L	H	H	M	M	L
CO6(K6)	L	L	L	L	H	M	L	L

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create).

Elective 1- Group II: (c) LASER PHYSICS

a. Course Code:

L	T	P	C
3	0	0	3

b. Course Objectives

1. *To learn the basics of laser dynamics*
2. *To Know the principle of lasers, types and applications*
3. *To familiarise with the mechanism of Laser pumping and resonators*

c. Learning Progression:

Quantum theory of Light, Emission broadening, Spontaneous and stimulated emissions, Types of Lasers, Laser pumping and resonators

d. Course Outcomes (COs)

At the end of the Course, the student will be able to –

CO1: Identify the properties of interactions of light and matter
CO2: Explain the concept of population inversion and spontaneous and stimulated emission
CO3: Articulate the knowledge about Laser and its properties.
CO4: To study the working principle of different types of Lasers
CO5: Acquire knowledge about the laser pumping and resonators

e. Course Outline:

UNIT I: FUNDEMENTALS OF ELECTROMAGNETIC RADIATION (12 Hrs)

Module 1: Maxwell's equations - Wave equations - Origin of refractive index - Coherence
Module 2: Quantum theory of Atomic energy levels - selection rules for multi-electron atoms

UNIT II : RADIATIVE TRANSITION (12 Hrs)

Module 1: Excited states and Decay - Emission broadening

Module 2: Radiation laws- cavity radiation - Spontaneous and stimulated emission- Einstein's A and B oefficient

UNIT III: INTRODUCTION TO LASERS (12 Hrs)

Module 1: Condition for producing a laser – Population inversion - Gain and gain saturation – threshold for a laser production

Module 2: Components of the laser – Resonator and lasing action - Requirements for obtaining population inversion- 2 and 3 level systems - Steady state and transient population

UNIT IV: DIFFERENT TYPES OF LASERS (12 Hrs)

Module 1: Types of Lasers and its Applications - Solid State Lasers – Ruby laser -Nd:YAG laser

Module 2: Gas lasers - He-Ne laser - CO2 laser; Chemical lasers - HCl laser - DF-CO2 laser – Semiconductor lasers

UNIT V: LASER PUMPING AND RESONATORS (12 Hrs)

Module 1: Excitation threshold - Pumping pathway - Specific excitation parameters for pumping

Module 2: Laser cavity modes - longitudinal and transverse cavity modes - Properties of laser modes

g. Books for study:

1. T. Silfvast, Laser Fundamentals, William Cambridge University Press, New York, 1996.
2. Peter W. Milonni, Joseph H. Eberly, Laser Physics, Wiley, 2010

h.Books for Reference:

1. Dieter Meschede, Optics, Light and Lasers, Wiley-VCH, Verley GmbH, 2004.
2. Ajoy Ghatak, Optics, McGraw-Hill Education (India) Pvt Ltd, 6th Edition, 2017.
3. B.B. Laud, Lasers and Non-Linear Optics, New Age International (P) Ltd., 2011.
4. Francis A. Jenkins and Harvey E. White, Fundamentals of Optics, McGraw-Hill Edition (India) Pvt. Ltd., 4th Edition, 2011.
5. Ariel Lipson, Stephen G. Lipson, Henry Lipson, Optical Physics, Cambridge University Press, New Delhi, 4th Edition, 2011.

i. Mapping of COs to POs & PSOs with correlation level and Cognitive level of Cos

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	L	L	H	L	H	L	L
CO2	M	L	L	M	L	H	M	M
CO3	M	L	L	H	L	H	M	L
CO4	M	L	L	H	L	H	L	L
CO5	M	L	L	H	L	H	M	L

CO\PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1 (K1)	L	L	M	M	L	H	L	H
CO2 (K2)	M	L	H	L	M	H	L	H
CO3 (K3)	L	H	H	L	M	L	M	M
CO4 (K4)	L	L	H	M	L	H	L	H
CO5 (K5)	M	M	M	L	L	L	L	H

(L – Low, M – Medium, H – High; K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5–Evaluate, K6-Create)