AVS

COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

Attur Main Road, Ramalingapuram, Salem - 106.

(Recognized under section 2(f) & 12(B) of UGC Act 1956 and

Accredited by NAAC with 'A' Grade)

(Co - Educational Institution | Affiliated to Periyar University, Salem

ISO 9001 : 2015 Certified Institution)

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Syllabus for

M.Sc. PHYSICS

CHOICE BASED CREDIT SYSTEM –

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK

(CBCS – LOCF)

(Applicable to the Candidates admitted from 2023-24 onwards)

VISION

- To attain excellence in the field of education by creating competent scholars with a touch of human values.

MISSION

- To accomplish eminence in the academic domain.
- To provide updated infrastructure.
- To educate value based education.
- To impart skills through efficient training programs.
- To cultivate culture and tradition with discipline and determination.

REGULATIONS

1. A candidate who has passed the B.Sc., Degree Examination with Physics as the main subject Of this University or an examination of some other universities accepted by the Syndicate as Equivalent there to is eligible for admission to the Programme.

2. Duration: 2 Years

The course of Study shall be on Semester System. The two year post graduate programme in M.Sc. Physics consists of four semesters under Choice Based Credit System (CBCS).

3. Eligibility for award of degree: 2 years Completion with no arrear

4. Course of Study: M.Sc., Physics

The course of Study for the Degree of Master of Science in Physics shall be under (Choice Based Credit System) semester system with internal assessment according to the syllabus prescribed from time to time. This Course consists of Core Subjects and Elective Subjects, Skill Enhancement Courses, Soft Skill Course, Internship and Extension Activity.

5. Scheme of Examination: Semester Based

6. Passing Rules:

i) Theory

40 % of Internal Assessment (12/25)

40% of External Assessment(38/75)

ii) Practical

40 % of Internal Assessment (10/25) /(16/40)

40% of External Assessment(30/75)/(24/60)

Programme Outcomes (POs) On successful completion of the **M.Sc. Physics**	
PO1	The main aim of the M.Sc. (Physics) programme is to have enriched syllabus prepared based on the recent scientific developments in physics and its interdisciplinary areas and to meet out the requirements of today's academic, research and industry requirements.
PO2	To impart comprehensive knowledge in theoretical, experimental and computational physics and a better understanding of the subject.
PO3	To teach core subjects of physics to students to acquire knowledge and to have in depth understanding about the laws of physics, concepts, principles and solve analytical problems
PO4	To enrich knowledge through problem-solving skills, projects, seminars, participation in scientific events and Study visits.
PO5	To prepare for careers in Teaching, Research laboratories and public/private sector units and to implant the entrepreneurship character.

Program Specific Outcomes (PSOs) On the successful completion of the **M.Sc. Physics** Programme, the students will	
PSO1	HaveadeepknowledgeofthefundamentalconceptsofPhysicsandunderstandhowthe variousphenomenainnaturefollowthelawsofPhysics.
PSO2	Identify, formulate and analyze the scientific problems using the basic principles.
PSO3	Developproblem-solvingskillsandhavetheabilitytoapplymathematicaltoolstounderstandanddescribe physical problems
PSO4	Be able to handle the laboratory equipments, gain knowledge about advanced experimentaltechniquesandcansuccessfullyinterpretresultsrequiredforresearchandindustrialapplications.
PSO5	Acquire effective computational skills to apply them to scientific and technological problems.
PSO6	GetfamiliarizedwithcontemporaryresearchwithinvariousfieldsofPhysics.

Programme Educational Objectives (PEOs) The **M.Sc Physics** programme describe accomplishments that graduates are expected to attain within five to seven years after graduation.	
PEO1	Lifelong learning: Ability to acquire knowledge and skills, including learning how to learn, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
PEO2	Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.
PEO3	Moral and ethical awareness/reasoning: Ability to embrace moral/ethical values in conducting one‟s life, formulate a position/argument about an ethical issue from multiple perspectives, and uses ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
PEO4	Multicultural competence: To possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
PEO5	To carry out experiments to understand the laws and concepts of Physics. To apply the theories learnt and the skills acquired to solve real time problems. To acquire a wide range of problem solving skills, both analytical and computational and to apply them.

CREDIT DISTRIBUTION FOR 2 YEARS M.Sc. PHYSICS PROGRAMME

Part	Course Type	Credits per Course	No. of Papers	Total Credits
Part I	Core Papers	4	11	44
	Core Practical	3	4	12
	Elective	3	4	12
	Project	4	1	4
Part II	Skill Enhancement Course	2	4	8
	Soft Skill Course	2	4	8
	Internship	2	1	2
Part III	Extension Activity	1	1	1
	Internship * /Industrial Activity	1	-	1
Part IV	Common Subject	-	1	-
			Total Credits	**92**

CONSOLIDATED SEMESTER WISE AND COMPONENT WISE CREDIT DISTRIBUTION FOR 2 YEARS M.Sc., PHYSICS PROGRAMME

Parts	Semester I	Semester II	Semester III	Semester IV	Total Credits
Part I	**18**	**17**	**18**	**19**	**72**
Part II	**4**	**4**	**6**	**4**	**18**
Part III	**-**	**1**	**-**	**1**	**2**
Total	**22**	**22**	**24**	**24**	**92**

*Part I, II components will be separately taken into account for CGPA calculation and classification for the under graduate programmes and the other components III have to completed during the duration of the programmes as per the norms, to be eligible for obtaining the PG degree.

METHOD OF EVALUATION

Evaluation	Components		Marks
Internal Evaluation	Continuous Internal Assessment Test	15	25 Marks
	Assignments	3	
	Class Participation	2	
	Distribution of marks for Attendance (in percentage) 96 – 100: 5 Marks 91 – 95: 4 Marks 86 – 90: 3 Marks 81 – 85: 2 Marks	5	
External Evaluation	End Semester Examination		75 Marks
Total			**100 Marks**

Note: 1.UG Programmes- A candidate must score minimum 10 marks in Internal and 30 marks in External Evaluation.

2. PG Programmes- A candidate must score minimum 13 marks in Internal and 38 marks in External Evaluation.

CONTINUOUS INTERNAL ASSESSMENT

Categorizing Outcome Assessment Levels Using Bloom's Taxonomy

level	Cognitive Domain	Description
K1	Remember	It is the ability to remember the previously learned concepts or ideas.
K2	Understand	The learner explains concepts or ideas.
K3	Apply	The learner uses existing knowledge in new contexts.
K4	Analyze	The learner is expected to draw relations among ideas and to compare and contrast.
K5	Evaluate	The learner makes judgments based on sound analysis.
K6	Create	The learner creates something unique or original.

Question Paper Blue Print for Continuous Internal Assessment – I & II

Duration: 2 Hours							Maximum: 50 marks
Section	K level						Marks
	K1	K2	K3	K4	K5	K6	
A (no choice)	10						10 X 1 =10
B (no choice)		1	1				2 X 5 =10
C (either or choice)				3			3 x 10 = 30
Total							50 marks

Note: K4 and K5 levels will be assessed in the Model Examination whereas K5 and K6 Levels will be assessed in the End Semester Examinations.

Question Paper Blue Print for Continuous Internal Assessment - I

Time: 2 Hours Total Marks: 50 Marks Minimum Pass: 20 Marks

Unit	Section - A	Section - B	Section - C
I	Q.N. 1, 2, 3, 4, 5	Q.N. 11	Q.N. 13 A, 13 B
I or II	-	-	Q.N. 14 A, 14 B
II	Q.N. 6, 7, 8, 9, 10	Q.N. 12	Q.N. 15 A, 15 B

SECTION – A (10 X 1 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – C (3 X 10 = 30 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)

Question Paper Blue Print for Continuous Internal Assessment - II

Time: 2 Hours Total Marks: 50 Marks Minimum Pass: 20 Marks

Unit	Section - A	Section - B	Section - C
III	Q.N. 1, 2, 3, 4, 5	Q.N. 11	Q.N. 13 A, 13 B
III or IV	-	-	Q.N. 14 A, 14 B
IV	Q.N. 6, 7, 8, 9, 10	Q.N. 12	Q.N. 15 A, 15 B

SECTION – A (10 X 1 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – C (3 X 10 = 30 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)

Question Paper Blue Print for Model Examination & End Semester Examination

Duration: 3 Hours		Maximum: 75 marks						
Section		K level						Marks
		K1	K2	K3	K4	K5	K6	
A (no choice, three questions from each unit)		15						15 X 1 =15
B (choice, one question from each unit)			1	1				2 X 5 =10
C (either or choice & two questions from each unit)	*Courses with K4 as the highest cognitive level*				4	1		5 x 10 = 50
	Course with K5 as the highest cognitive level wherein three K4 questions and two K5 questions are compulsory.				3	2		
	Course with K6 as the highest cognitive level wherein two questions each on K4, K5 and one question on K6 are compulsory.				2	2	1	
Total								75 marks

Question Paper Blue Print for Model Examination & End Semester Examination

Time: 2 Hours Total Marks: 75 Marks Minimum Pass: 30 Marks

Unit	Section - A	Section - B	Section - C
I	Q.N. 1, 2, 3	Q.N. 16	Q.N. 21 A, 21 B
II	Q.N. 4, 5, 6	Q.N. 17	Q.N. 22 A, 22 B
III	Q.N. 7, 8, 9	Q.N. 18	Q.N. 23 A, 23 B
IV	Q.N. 10, 11, 12	Q.N. 19	Q.N. 24 A, 24 B
V	Q.N. 13, 14, 15	Q.N. 20	Q.N. 25 A, 25 B

SECTION – A (15 X 1 = 15 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ANY TWO QUESTIONS

SECTION – C (5 X 10 = 50 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)

Question Paper Blue Print for Model Practical Examination & End Semester Examination (Practical)

Time: 4 Hours Total Marks: 75 Marks Minimum Pass: 24 Marks

Practical Marks	Maximum Mark	Minimum Mark
Internal	25	12
External	75	24
Total	100	40

Evaluation for End Semester Examinations (Practical)

Record	10 marks
Formula with expansion	10 marks
Circuit Diagrams/Diagrams	08 Marks
Observation-Tabulation and Readings	20 Marks
Calculations	15 Marks
Presentation	02 Marks
Result	05 Marks
Viva-Voce	05 Marks
TOTAL	**75 MARKS**

*Submission of record with due certification is a must for external practical examinations.

**A student should complete all requires experiments to get 10 marks for the record.

Scheme of Examination for M.Sc. Physics

First Year – Semester - I

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23PPHCT01	Core Paper I – Mathematical Physics	6	4	25	75	100
I	23PPHCT02	Core Paper II – Classical Mechanics and Relativity	5	4	25	75	100
I	23PPHCT03	Core Paper III - Linear and Digital ICs and Applications	5	4	25	75	100
I	23PPHCP01	Core Paper IV - Practical – I General Physics Experiments	6	3	25	75	100
I	23PPHE01	Elective I - Energy Physics	4	3	25	75	100
II	23PPHPC01	Professional Competency Course I – Semiconductor Devices	2	2	25	75	100
II	23PPHAE01	Soft Skills I - Ability Enhancement Compulsory Course I - Atmospheric Physics	2	2	25	75	100
Total			**30**	**22**	**175**	**525**	**700**

First Year – Semester - II

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23PPHCT04	Core Paper IV – Statistical Mechanics	5	4	25	75	100
I	23PPHCT05	Core Paper V – Quantum Mechanics – I	5	4	25	75	100
I	23PPHCP02	Core Paper VI - Practical – II Analog and Digital Experiments	6	3	25	75	100
I	23PPHE02	Elective II - Advanced Optics	4	3	25	75	100
I	23PPHE03	Elective III - Solid Waste Management	4	3	25	75	100
II	23PPHSEC01	Skill Enhancement Course I - Electronics in daily life	2	2	25	75	100
II	23PPHAE02	Soft Skill II - Ability Enhancement Compulsory Course - Laser Physics and Applications	2	2	25	75	100
III	23PSOCCC01	Fundamentals of Human Rights	2	1	25	75	100
III	23PPHIT01	Internship * /Industrial Activity	-	-			
Total			**30**	**22**	**200**	**600**	**800**

Second Year – Semester- III

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23PPHCT06	Core Paper VI – Quantum Mechanics - II	6	4	25	75	100
I	23PPHCT07	Core Paper VII - Numerical Methods and Computer Programming	5	4	25	75	100
I	23PPHCT08	Core Paper VIII – Electromagnetic Theory	5	4	25	75	100
I	23PPHCP03	Core Paper VI - Practical - III Microprocessor 8085 and Microcontroller 8051	6	3	25	75	100
I	23PPHE04	Elective IV - Solar Energy Utilization	4	3	25	75	100
II	23PPHSEC02	Skill Enhancement Course II - Communication Electronics	3	2	25	75	100
II	23PPHAE03	Soft Skill III - Ability Enhancement Compulsory Course - Sewage And Waste Water Treatment And Reuse	2	2	25	75	100
III	23PPHIT01	Internship / Industrial Activity	-	2	25	75	100
Total			**31**	**24**	**200**	**600**	**800**

Second Year – Semester - IV

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23PPHCT09	Core Paper IX - Nuclear and Particle Physics	5	4	25	75	100
I	23PPHCT10	Core Paper X - Spectroscopy	5	4	25	75	100
I	23PPHCT11	Core Paper XI – Condensed Matter Physics	5	4	25	75	100
I	23PPHCP04	Core Paper VI - Practical – IV Numerical Methods and Computer Programming (FORTRAN/C)	6	3	25	75	100
I	23PPHPR01	Project with Viva Voce	5	4	25	75	100
II	23PPHSEC03	Skill Enhancement Course – III Characterization of Materials	2	2	25	75	100
II	23PPHAE04	Soft Skill IV - Ability Enhancement Compulsory Course – Solar Physics	2	2	25	75	100
III	23PPHEA01	Extension Activity	-	1	25	75	100
Total			**30**	**24**	**200**	**600**	**800**

****Ins. Hrs –** Instructional Hours**, CIA-** Continuous Internal Assessment**, ESE-** End Semester Examination

Semester: I	Course Code: 23PPHCT01	Hours/Week: 5	Credit: 4

COURSE TITLE: CORE PAPER – I MATHEMATICAL PHYSICS

Course Overview:

1. This course will cover a good deal on the theory and applications of linear algebra.
2. This will lead us to explore tensors and, more generally, representations of groups.
3. Looking at transformations of coordinate systems will lead us to explore curvilinear coordinate systems and then to consider how differential operator transform which will force us to consider how to solve differential equations.
4. A differential equation of extraordinary interest will be the Sturm-Lowville equation, and we will discuss how to solve it and show that a broad, useful class of functions can be seen as a vector.

Learning Objectives:

1. The educational methodology of this subject proposes to integrate the domain of concepts and knowledge from mathematics into practical application of physics phenomena, and the development of abilities and skills to solve example problems.
2. Student discussion in interactive forums, which aim to improve the instrumental aspects learned through the lectures and experiences outside the walls
3. The purpose of the course is to introduce students to methods of mathematical physics and to develop required mathematical skills to solve problems in quantum mechanics, electrodynamics and other fields of theoretical physics.
4. To impart knowledge about various mathematical tools employed to Study physics problems.
5. Understand the linear equations, vector spaces, matrices, linear transformations, determinants, Eigen value, eigenvectors, etc.

Unit - I	Linear Vector Space	09 Hours

Basic concepts – Definitions– examples of vector space – Linear independence –Direct product- Orthogonally – Gram-Schmidt orthogonalization procedure – linear operators Scalar– Dual space – ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator – Eigen values and Eigen functions – sum and invariant subspace – orthogonal transformations and rotation.

Unit - II	Complex Analysis	09 Hours

Review of Complex Numbers –de Moivre's theorem –Functions of a Complex Variable – Differentiability –Analytic functions- Harmonic Functions –Complex Integration –Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula – Taylor's Series – Laurent's Expansion – Zeros and poles – Residue theorem and its Application: Potential theory – Electrostatic fields and complex potentials –Parallel plates, coaxial cylinders and an annular region (2) Heat problems – Parallel plates and co axial cylinders.

Unit - III	Matrices	09 Hours

Types of Matrices and their properties, Rank of a Matrix – Conjugate of a matrix – Adjoin of a matrix–Inverse of a matrix–Hermit Ian and Unitary Matrices–Trace of a matrix–Transformation of matrices – Characteristic equation – Eigen values and Eigen vectors – Clayey –Hamilton theorem–Diagonalization.

Unit - IV	Fourier trans forms & Laplace trans forms	09 Hours

Definitions – Fourier transform and its inverse – Transform of Gaussian functions and in Dirac delta function – Fourier transform of derivatives – Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and a semi - infinite medium – Wave equation: Vibration of a infinite string and of a semi- infinite string. Laplace transform and its inverse – Transforms of derivatives and integrals – Differentiation and integration of transforms–Dirac delta functions–Application – Laplace equation: Potential problem in a semi-infinite strip.

Unit - V	Differential equations	09 Hours

Second order differential equation – Sturm – Liouville's theory – Series solution with Simple examples – Hermit polynomials – Generating function – Orthogonally properties – Recurrence relations –Legendre polynomials–Generating function – Rodrigues formula–Orthogonally properties –Dirac delta function –One dimensional Green's function and Reciprocity theorem –Sturm-Liouville's type equation in one Dimension & their Green's function.

Text Book(s):

1. George Arfken and HansJ Weber, 2012, Mathematical Methods for Physicists–Comprehensive Guide (7thedition), Academic press.
2. P.K.Chattopadhyay, 2013, Mathematical Physics (2nd edition), New Age, New Delhi.
3. A.W.Joshi, 2017, Matrices and Tensor sin Physics, 4thEdition (Paperback), New Age International Pvt. Ltd., India.
4. B.D.Gupta, 2009, Mathematical *Physics* (4th edition), Vikas Publishing House, New Delhi.
5. H.K.Dass and Dr.Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S.Chand & Company Pvt. Ltd., New Delhi.

Reference Books::

1. E. Kreyszig, 1983, Advanced Engineering Mathematics, Wiley Eastern, New Delhi.
2. D.G. Zill and M.R. Cullen, 2006, Advanced Engineering Mathematics, 3rdEd.Narosa, New Delhi.

3. S.Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw- Hill, New York.
4. P.R.Halmos, 1965, Finite Dimensional Vector Spaces, 2ndEdition, Affiliated East West, New Delhi.
5. C.R. Wylie and L.C. Barrett, 1995, Advanced Engineering Mathematics, 6th Edition, International Edition, McGraw- Hill, New York.

Web Resources:

1. www.khanacademy.org
2. https://youtu.be/LZnRlOA1_2I
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath
4. https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qaZ
5. https://archive.nptel.ac.in/courses/115/106/115106086

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Solve differential equations like Legendre, Bessel and Hermit that are common in physical sciences.	K1
CO2	Solve the different partial differential equations encountered in physical problems and draw inferences from solutions.	K2
CO3	Solve transfer functions in Instrumentation using Laplace transforms	K3
CO4	Apply Fourier transforms in Holography	K4
CO5	Apply Matrices in the Study of electrical circuits, Quantum Mechanics and Optics	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**M**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23PPHCT02	Hours/Week: 5	Credit: 4

COURSE TITLE: CORE PAPER II - CLASSICAL MECHANICS AND RELATIVITY

Course Overview:

1. This first course in the physics curriculum introduces classical mechanics.
2. Historically, a set of core concepts — space, time, mass, force, momentum, torque, and angular momentum — were introduced in classical mechanics in order to solve the most famous physics problem, the motion of the planets.
3. Central force, Reduction of two body problem into equivalent one body problem, Motion in inverse square law force field and to state Kepler's laws.
4. Rotating coordinates system and to Derive the Corioli's force from Lagrangian formulation

Learning Objectives:

1. Apply the basic laws of physics in the areas of classical mechanics, Newtonian gravitation, Types of forces: Forces of Gravitation, Lorentz force, Hooks Force, Frictional Force, and Fundamental Forces of Nature.
2. Recognize how observation, experiment and theory work together to continue to expand the frontiers of knowledge of the physical universe.
3. Apply basic mathematical tools commonly used in physics, including elementary probability theory, differential and integral calculus, vector calculus, ordinary differential equations, partial differential equations, and linear algebra.
4. To solve Lagrange's equation, Properties and simple application of Lagrange's equation (simple pendulum, harmonic oscillator, compound pendulum, at woods machine)
5. To solve Hamiltonian, Hamilton's canonical equation of motion, and to understand Physical significance Advantages and Applications of Hamilton's equations of motion (simple pendulum, compound pendulum, Linear harmonic oscillator).

Unit - I	Principles Of Classical Mechanics	09 Hours

Mechanics of a single particle –mechanics of a system of particles – conservation– laws for asystemofparticles–constraints–holonomic&non-holonomicconstraints generalized coordinates – configuration space–transformation equations–principle of virtual work.

Unit - II	Lagrangian Formulation	09 Hours

Alembert's principle –Lagrangian equations of motion for conservative systems– applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.

Unit - III	Hamiltonian Formulation	09 Hours

Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) motion of particleina central force field

Unit - IV	Small Oscillations	09 Hours

Formulation of the problem –transformation to normal coordinates– frequencies of Normal modes –linear tri atomic molecule.

Unit - V	Relativity	09 Hours

Inertial and non-inertial frames – Lorentz transformation equations – length energy- contraction and time dilation –relativistic addition of velocities–Einstein's mass- relation –Minkowski's space– four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations.

Text Book(s):

1. H. Goldstein, Classical Mechanics, 3rd Edition, Pearson Edu., 2002.
2. J.C. Upadhyaya, Classical Mechanics, Himalaya Publishing. Co. New Delhi, 2016.
3. R. Resnick, Introduction to Special Theory of Relativity, Wiley Eastern, New Delhi, 1968.
4. R.G. Takwala and P.S. Puranik, Introduction to Classical Mechanics–Tata–McGraw Hill, New Delhi, 1980.
5. N.C. Ranaand P. S. Joag, Classical Mechanics-Tata Mc Graw Hill, 2001.

Reference Books:

1. K.R. Symon, Mechanics, Addison Wesley, London, 1971.
2. S.N. Biswas, Classical Mechanics, Books & Allied, Kolkata, 1999.
3. Gupta, Kumar and Sharma, Classical Mechanics, Pragathi Prakashan, 2017.
4. T.W.B. Kibble, Classical Mechanics, McGraw-Hill, New York, 2004.
5. Green wood, Classical Dynamics, Dover Publication, New York, 1985.

Web Resources:

1. http://poincare.matf.bg.ac.rs/~zarkom/Book_Mechanics_Goldstein_Classical_Mechanics_optimized.pdf
2. https://pdfcoffee.com/classical-mechanics-j-c-upadhyay-2014-editionpdf-pdf-free.html

3. https://nptel.ac.in/courses/122/106/122106027/
4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/
5. https://www.britannica.com/science/relativistic-mechanics

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Understand basic mechanical concepts related to discrete and continuous mechanical systems and also Cyclic coordinates and conservation theories	K1
CO2	Apply Newton's laws of motion and conservation law of energy, linear and angular momentum to solve advanced problems involving the dynamic motion of classical mechanical system.	K2
CO3	Solve the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulations of classical mechanics.	K3
CO4	Explore the application of Hamilton's equations in solving the equation of motion of a particle in a central force field, projectile motion of a body.	K4
CO5	Will learn about small oscillation, Inertia tensor, rigid body which will be helpful to know about the motion of our galaxy, stars etc.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**S**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23PPHCT03	Hours/Week: 5	Credit: 4

COURSE TITLE: CORE PAPER III – LINEAR AND DIGITAL ICS & APPLICATIONS

Course Overview:

1. Acquire the basic knowledge of digital logic levels and its application.
2. Gain knowledge on digital arithmetic operations for algebraic simplification.
3. Understand digital IC terminology and characteristics of TTL, MOS, and ECL families.
4. Design Decoders, Encoders, Digital multiplexers, Adders and Sub tractors, Binary comparators, Latches and Flip-Flops

Learning Objectives:

1. To introduce the basic building blocks of linear integrated circuits.
2. To teach the linear and non-linear applications of operational amplifiers.
3. To teach the theory of ADC and DAC.
4. To introduce the concepts of waveform generation and introduce some special function ICs.
5. To understand and implement the working of basic digital circuits.

Unit - I	Integrated Circuits and Operational Amplifier	09 Hours

Introduction, Classification of IC‘s, basic information of Op-Amp 741 and its features, the Ideal Operational amplifier, Op-Amp internal circuit and Op-Amp Characteristics.

Unit - II	Applications of Op-Amp	09 Hours

LINEAR APPLICATIONS OF OP-AMP: Solution simultaneous equations and Differential equations, Instrumentation amplifiers, V to I and I to V converters. NON-LINEAR APPLICATIONS OF OP-AMP: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Triangular and Square wave form generators.

Unit - III	Active Filters &Timer and Phase Locked Loops	09 Hours

ACTIVE FILTERS: Introduction, Butterworth filters– 1st order, 2nd order low pass And high pass filters, band pass, band reject and all pass filters. TIMER AND PHASE LOCKED LOOPS: Introduction to IC555 timer, description of functional diagram, monostable and

astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage controlled oscillator (IC566), low pass filter, monolithic PLL and applications of PLL.

Unit - IV	Voltage regulator & D To A and A to D Converters	09 Hours

VOLTAGE REGULATOR: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723generalpurposeregulators, Switching Regulator. D to A AND A to D CONVERTERS: Introduction, basic DAC techniques –weighted resistor DAC,R-2R ladder DAC, inverted R-2R DAC, A to D converters –parallel comparator type ADC, counter type ADC, successive approximation ADC and dual Slope ADC, DAC and ADC Specifications.

Unit - V	Cmos Logic, Combinational Circuits Using l74xxics & Sequential circuit susingttl74xxics	09 Hours

CMOS LOGIC: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic. COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, IC74154), BCD to7-segmentdecoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), and DE multiplexer (IC74154). SEQUENTIAL CIRCUITSUSINGTTL 74XXICs: Flip-flops (IC7474, IC7473), Shift Registers, Universal Shift Register(IC 74194), 4-bitasynchronous binary counter (IC7493). Field Visit at nearby industries.

Text Book(s):

1. D.Roy Choudhury, Shail B.Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt. Ltd., New Delhi, India.
2. Ramakant A. Gayakwad, (2012), OP-AMPandLinearIntegratedCircuits,4thedition,Prentice Hall/Pearson Education, New Delhi.
3. B.L.TherajaandA.K.Theraja,(2004),ATextbookofElectricaltechnology,S.Chand & Co.
4. V.K.Mehta and Rohit Mehta,(2008),Principles of Electronics, S.Chand& Co,12thEdition.
5. V.Vijayendran,(2008),IntroductiontoIntegratedelectronics(Digital&Analog), S.Viswanathan Printers &Publishers Private Ltd, Reprint.V.

Reference Books:

1. Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
2. Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.
3. Malvinas and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw-Hill, New Delhi.
4. Floyd, Jain (2009), Digital Fundamentals, 8thedition, Pearson Education, New Delhi.
5. Millman & Hankies (2000), Integrated Electronics, Tata Mc Graw Hill, 17thReprint.

Web Resources:

1. https://nptel.ac.in/course.html/digitalcircuits/
2. https://nptel.ac.in/course.html/electronics/operationalamplifier/
3. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/
4. https://www.electrical.com/applications-of-op-amp/
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	A thorough understanding of operational amplifiers with linear integrated circuits.	K1
CO2	Understanding of the different families of digital integrated circuits and their characteristics.	K2
CO3	Also students will be able to design circuits using operational amplifiers for various applications	K3
CO4	Understand, analyze and design of programmable logic devices and VHDL	K4
CO5	Identify basic requirements for a designing a combinational logic circuit	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	S	S	L	M	S	L	L	L
CO2	S	S	S	L	M	S	L	L	L
CO3	S	S	S	L	M	M	M	L	L
CO4	S	S	S	L	M	M	M	L	L
CO5	S	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23PPHCP01	Hours/Week: 4	Credit: 3

COURSE TITLE: CORE PAPER IV - PRACTICAL I – GENERAL PHYSICS EXPERIMENTS

Course Overview:

1. Demonstrate general physics phenomena
2. Apply basic physics law in daily life
3. Understand the mechanisms of electrical devices
4. Understand the general physics and its reactions.

Learning Objectives:

1. To understand the laws in Physics
2. To understand properties of matter physics
3. To understand electromagnetic concepts
4. To understand the electricity
5. To understand the nuclear physics

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes- Corn's Method.
2. DeterminationofYoung'smodulusandPoisson'sratiobyHyperbolicfringes- Cornu'sMethod.
3. Charge of an Electron by Spectrometer.
4. Determination of Viscosity of the given liquid– Meyer's disc.
5. Measurement of Coefficient of linear expansion- Air wedge Method.
6. B-H loop using Anchoring.

7. Determination of Thickness of the enamel coating on a wire by diffraction.
8. Determination of Rydberg's Constant-Hydrogen Spectrum.
9. F. P. Etalon-Spectrometer-Determination of Thickness.
10. Determination of Thickness of air film-Solar spectrum–Hartmann's formula-Edser and Butler fringes.
11. Measurement of Band gap energy–Thermistor.
12. Determination of Planck's Constant–LED Method.
13. Determination of Specific charge of an electron–Thomson's method.
14. DeterminationofCompressibilityofaliquidusingUltrasonicsInterferrometer
15. Determination of Wavelength, Separation of wavelengths– Michelson Interferometer.
16. GM counter-Characteristics, inverse square law and absorption coefficient.
17. Measurement of Resistivity of semiconductor-Four probe method.
18. Arc spectrum-Iron/Copper.
19. Molecular spectra-AlO band.
20. Measurement of wavelength of Diode Laser/He–Ne Laser using Diffraction grating.
21. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
22. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
23. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square, Receiver end transmitter behavior, Radiation Pattern-Microwave test bench.
24. Susceptibility measurement by Quinke's method.
25. Susceptibility determination of solid by Gouy's method
26. Determination of Stefan's constant.
27. Study the temperature characteristics and determine the band gap of given thermistor
28. Determination of band gap in a semiconductor.
29. Study the spectrum of hydrogen atom.
30. I-V Characteristics of Solar cell and determine its maximum efficiency.
31. Determination of Hall Effect in a semiconductor and measurement of Hall Coefficient.
32. Characterization of LVDT.
33. E/m- Zeeman Effect.

34. Characteristics of laser and tunnel diode.
35. Determination of Solar constant.

Text Book(s):

1. Practical Physics, Gupta and Kumar, Pragmatic Pakistan, 2020.
2. An Advanced Course in Practical Physics, D.Chattopadhyay, P, C.Rakshit, New Central Book Agency (P) Ltd., 2007.
3. Kit Developed for doing experiments in Physics-Instruction manual, R.Srinivasan K.RPriolkar, Indian Academy of Sciences.
4. A Text book of Advanced Practical Physics, S.K.Ghosh, New Central, Fourth Edition, 2000.

Reference Books:

1. Advanced Practical Physics, S.PSingh, Pragmatic Pakistan.
2. An advanced course in Practical Physics, D.Chattopadhayay, C.RRakshit, New Central Book Agency Pvt. Ltd.
3. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons(Asia) Pvt.Ltd.

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Understand the properties of matter	K1
CO2	Understand the magnetic properties	K2
CO3	Demonstrate general physics phenomena	K3
CO4	Apply basic physics in daily life	K4
CO5	To understand the concepts of electronics	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	L	M	S	L	L	L
CO2	S	S	S	L	M	S	L	L	L
CO3	S	S	S	L	M	M	M	L	L
CO4	M	S	S	L	M	M	M	L	L
CO5	S	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L - Low

Semester: I	Course Code: 23PPHPC01	Hours/Week: 3	Credit: 2

COURSE TITLE: PROFESSIONAL COMPETENCY COURSE– SEMICONDUCTOR DEVICES

Course Overview:

1. Acquire knowledge about different experimental approaches in the Study of Fermi surfaces in different materials. .
2. Derst and piezo, pyro and Ferro electricity, ferroelectric domains and hysteresis.
3. Understand basic theories of magnetic materials like ferromagnetism, ferrimagnetism, anti-ferromagnetism.
4. Acquire basic knowledge on (low temperature) superconductivity in type I and type II super conductors and also different theoretical approaches to super conductivity (BCS).

Learning Objectives:

1. To introduce the operation of semiconductor devices
2. To provide the knowledge about number system, arithmetic operation and sequential codes of digital electronic circuits
3. To introduce the fundamental concepts and working principle of JT, JFET, FET, MOSFET
4. To provide the understanding of basic Boolean laws, K-maps, SOP and POS method
5. To design logic circuits and different class of digital circuits like unipolar, bipolar logic families -DTL, RTL.

Unit - I	Semiconductor diode	03 Hours

Semiconductors–characteristics and applications of PN Junction diode–Zenerdiode–Gunn diode–Varactor diode–Schottky diode–LED.

Unit - II	Metal-Semiconductor devices	03 Hours

JFET-Structure and Characteristics–MOSFET–-Depletion and Enhancement type MOSFFT.

Unit - III	Power control devices	03 Hours

Construction, V-I characteristics and applications of UJT, SCR, DIAC, TRIAC.

Unit - IV	Micro ware devices	03 Hours

Tunnel diode – I-V characteristics of Tunnel diode–IMPATT diode – MISS diode.

Unit - V	Photonic devices	03 Hours

Photoconductor, Photodiode, quantum efficiency, PIN photo diode, hetero junction photodiode, Avalanche photo diode-Photo transistors.

Text Book(s):

1. Principles of Electronics, V.K.Mehta, S.Chandand Company, New Delhi (2015).
2. Textbook of Applied Electronics, R.S.Sedha, S.Chand & Company, New Delhi (2017).
3. Modern Digital Electronics, R.P.Jain, Tata McGraw-Hill End, Publishing Company Ltd., New Delhi (2010).
4. Solid-state Electronic Devices, B.G. Streetman, Banerjee, Prentice Hall (2009).
5. Physics of Semiconductor Devices, S.M.Sze, KwokK.Ng, John Wiley & Sons, New Delhi (2011).

Reference Books:

1. Semiconductor Physics and Devices: Basic Principles, D.A.Neamen, McGraw-Hill (2003).
2. Physics of Semiconductor Devices, Dilip K.Roy, University's Press (India) Private Limited, Hyderabad (2004).
3. Principles of Electronics, Partha Kumar and Gangly, PHIL earning (P) Ltd., New Delhi (2015).
4. PhysicsofPhotonicDevices,ShunLienChuang,JohnWiley&Sons,2ndEdition(2009).
5. Photonic Devices, Jia-MingLiu, Cambridge University Press (2005).

Web Resources:

1. https://open.umn.edu/opentextbooks/textbooks/573
2. https://www.khanacademy.org/science/electrical-engineering/ee-semiconductor-devices
3. https://www.cambridge.org/core/books/abs/computational-electromagnetics-for-rf-and- microwave-engineering/web-resources/5DFE109913C5411D2E60C828A4F96F77
4. https://technav.ieee.org/topic/microwave-devices
5. https://www.nature.com/subjects/photonic-devices

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Demonstrate and analyses the behavior of semiconductor devices	K1
CO2	To get an insight about the operation of JT, JFET, MOSFET in order to design the basic circuits	K2
CO3	Develop the digital logic to analyses the problems of number system and arithmetic operation	K3
CO4	Solve the sequential codes based problems of digital electronics	K4
CO5	Demonstrate the ability to use basic Boolean laws, K-maps and SOP, POS methods	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**S**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L - Low

Semester: I	Course Code: 23PPHE01	Hours/Week: 3	Credit: 3

COURSE TITLE: ELECTIVE I - ENERGY PHYSICS

Course Overview:

1. Improve scientific literacy including questioning and critical thinking skills in the areas of energy and the environment
2. Develop a conceptual understanding of certain physics principles including:
   Energy - definitions, types, conversion, conservation of...
   the first and second laws of thermodynamics, heat engines
   weather, climate and global warming
   exponential growth- its basis and what it implies
3. The Study line in energy physics focus on the physical principles behind energy technologies, with the purpose of enabling the student to develop and optimize energy-related components and processes.
4. The subjects include plasma physics and fusion energy; nuclear energy; photo voltaic; batteries; fuel cells; hydrogen technology; energy production, conversion and storage; as well as catalysis and photo catalysis. Experimental, theoretical and numerical methods are part of the education.

Learning Objectives:

1. To understand what is not changing before and after any process takes place.
2. Energy was the conserved entity that originates from the concept of work and they devised rules off how to calculate it.
3. The student should be able to define kinetic energy, identify the standard unit of kinetic energy and identify the variables which effect (and do not effect) the kinetic energy of an object.
4. The student should be able to define potential energy, identify the standard unit of potential energy and identify the variables which effect (and do not effect) the potential energy of an object.
5. The student should be able to define mechanical energy and relate it to the amount of kinetic energy and potential energy.

Unit - I	Introduction to energy sources	04 Hours

Conventional and non-conventional energy sources and their availability–prospects of Renewable energy sources– Energy from other sources–chemical energy–Nuclear energy– Energy storage and Distribution.

Unit - II	Energy from the oceans	04 Hours

Energy utilization–Energy from tides–Basic principle of tidal power–utilization of tidal energy – Principle of ocean thermal energy conversion systems.

Unit - III	Wind energy sources	04 Hours

Basic principles of wind energy conversion–power in the wind–forces in the Blades– Wind energy conversion–Advantages and disadvantages of wind energy conversion systems (WECS) – Energy storage– Applications of wind energy.

Unit - IV	Energy from biomass	04 Hours

BiomassconversionTechnologies–wetanddryprocess–Photosynthesis-BiogasGeneration: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion– factors affecting bio digestion and generation of gas- bio gas from waste fuel– properties of biogas- Utilization of bio gas.

Unit - V	Solar energy sources	04 Hours

Solar radiation and its measurements–solar cells: Solar cells for direct conversion of solar energy to electric powers–solar cell parameter–solar cell electrical characteristics– Efficiency–solar water Heater –solar distillation–solar cooking–solar greenhouse–Solar pond and its applications.

Text Book(s):

1. G.D.Rai, Non–convention sources of, 4thedition, Khannapublishers, New Delhi (1996).
2. S.Rao and Dr.ParuLekar, Energy technology, Khanna publishers (1994).
3. M.P.Agarwal, Solar Energy, S.ChandandCo. New Delhi (1983).
4. Solar energy, principles of thermal collection and storage by S. P. Sukhumi, 2ndedition, TataMcGraw-HillPublishing Co.Lt., New Delhi (1997).
5. Ramesh Bansaland AhmedFZobaa, Handbook Of Renewable Energy Technology & System, World Scientific (2021).

Reference Books::

1. Renewable energy resources, John Twiddle and Tony weir, Taylor and Francis group, London and New York.
2. Applied solar energy, A. B. MeinelandA. P.Meinal

3. John Twiddle and Tony Weir, Renewables ergyres sources, Taylor rand Francis group, London and New York.
4. Renewal Energy Technologies: A Practical Guide or Beginners C.S.Solanki-PHIL earning.
5. Introduction to Non-Conventional Energy Resources-Rajaet. al., Sci. Tech Publications.

Web Resources:

1. https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable=1
2. https://www.nationalgeographic.org/encyclopedia/tidal-energy/
3. https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy
4. https://www.reenergyholdings.com/renewable-energy/what-is-biomass/
5. https://www.acciona.com/renewable-energy/solar-energy/

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	The student should be able to define work and identify its units	K1
CO2	The student should be able to predict whether a force is doing positive, negative or zero work.	K2
CO3	The student should be able to analyze a physical situation and identify whether the total mechanical energy of an object is increasing, decreasing or remaining constant	K3
CO4	The student should be able to categorize forces as being conservative or non-conservative and explain the significance of such a categorization scheme.	K4
CO5	The student should be able to predict whether an object's total mechanical energy would be conserved or not conserved based upon the types of forces which are doing work upon the object.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	L	M	S	L	L	L
CO2	S	S	S	L	M	S	L	L	L
CO3	S	S	S	L	M	M	M	L	L
CO4	S	S	S	L	M	M	M	L	L
CO5	S	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23PPHAE01	Hours/Week: 3	Credit: 2

COURSE TITLE: SOFT SKILL I - ABILITY ENHANCEMENT COMPULSORY COURSE - ATMOSPHERIC PHYSICS

Course Overview:

1. This course introduces the basics of Earth's atmosphere to graduate and post-graduate students.
2. It starts from the evolution of atmosphere and gives understanding of various physical and chemical processes responsible for the observed changes we see in weather and climate.
3. This course provides an introduction to the physics and chemistry of the atmosphere, including experience with computer codes. It is intended for undergraduates and first year graduate students.
4. This course attempts to impart knowledge on advanced aspects of atmospheric and space physics.

Learning Objectives:

1. Atmospheric physics is a vital part of a weather forecast model and is often referred to as the physical parameterization.
2. Our research focuses on how to represent unresolved physical processes in the atmosphere, such as radiation, clouds and sub grid turbulent motions.
3. To understand the fundamentals of Atmospheric Physics emphasizes the interrelationships of physical and dynamical meteorology.
4. The objectives of such studies incorporate improving weather forecasting, developing methods for predicting seasonal and inter annual climate fluctuations, and understanding the implications of human-induced perturbations.

5. To discusses physical and chemical processes - in both clear and cloudy atmospheres - including radiation, optical and electrical effects, precipitation and cloud microphysics.

Unit - I	Introduction	03 Hours

The atmosphere as a physical system - Atmospheric models - Two simple atmospheric models - Some atom spheric observations-Weather and climate.

Unit - II	Atmospheric Thermo Dynamics	03Hours

The ideal gas law-Atmospheric composition- Hydro static balance-Entropy and potential Temperature-Parcel concepts-Tephigram-Cloud formation.

Unit - III	Atmospheric radiation	03 Hours

Atmospheric radiation - Basic physical concepts – Plank's and Boltzmann - Basic spectroscopy Of molecules –vibrational and rotational states–Line shapes –Transmittance.

Unit - IV	Basic fluid dynamics	03 Hours

Mass conservation - The material derivative - An alternative form of the continuity equation - The Navier – Stokes equation - Equations of motion in coordinate form – Spherical - Thermo dynamic energy equation.

Unit - V	Atmospheric remote sounding	03 Hours

Atmospheric remote sounding from space-Thermal emission measurements-Backscatter measurements-Atmospheric remote sounding from the ground-The Dobson ozone spectrophotometer– Radars – Lidars.

Text Book(s):

1. DavidG.Anderws, 2000, an Introduction to Atmospheric Physics Second Edition, Cambridge University Press.
2. MurryL. Salby, 1995, Fundamental so Atmospheric Physics, Academic Press.
3. R.M.GoodyandY.L.Yung, 1989, Atmospheric Radiation Theoretical Basis Second Edition, Library of Congress Cataloging-in-Publication.
4. D.G.Andrews, 2000, an Introduction to Atmospheric Physics, Cambridge University Press.
5. C.F.BohrenandB.A.Albrecht1998, Atmospheric Thermodynamics, Oxford University Press, New York.

Reference Books:

1. Shaun Lovejoy 2019, Weather, Macro weather, and the Climate: Our Random Yet Predictable Atmosphere, Oxford University Press Inc.
2. Neil C. Wells, 2011, The Atmosphere and Ocean: A Physical Introduction, John Wiley and Sons Inc.
3. JohnE Frederick**,** 2007, Principles of Atmospheric Science, Jones & Bartlett Publishers.
4. J.V.Iribarne, H.R.Cho, 1980, Atmospheric Physics, D.Reidel Publishing Company, London,
5. Blundell, S.J. and Blundell, K.M, 2009, Concept sin Thermal Physics, Oxford University Press, 2nd edition.

Web Resources:

1. http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/home.rxml
2. https://www.britannica.com/science/atmospheric-pressure
3. http://site.ebrary.com/lib/berkeley/Doc?id=10378944
4. http://www.sciencedirect.com/science/book/9780127329512
5. https://www.embibe.com/exams/atmospheric-pressure/

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	It presents an elementary quantitative treatment of radioactive transfer in planetary atmospheres and focuses on radioactive heating rates and remote sensing.	K1
CO2	It describes the radiation balance at the top of the atmosphere as determined from measurements made by satellite-borne sensors.	K2
CO3	Our research focuses on how to represent unresolved physical processes in the atmosphere, such as radiation, clouds and sub grid turbulent motions.	K3
CO4	Demonstrate an integrated understanding of the fundamental physical and dynamical processes governing the atmosphere across spatial and temporal scales by passing a comprehensive exam.	K4
CO5	Adopt the principles of proper ethical behavior and understand the broader impacts of the atmospheric sciences on society	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	L	M	S	L	L	L
CO2	S	S	S	L	M	S	L	L	L
CO3	M	S	S	L	M	M	M	L	L
CO4	S	S	S	L	M	M	M	L	L
CO5	S	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23PPHSEC01	Hours/Week: 2	Credit: 2
COURSE TITLE: SKILL ENHANCEMENT COURSE I – ELECTRONICS IN DAILY LIFE			

Course Overview:

1. Electronics is the branch of physics and technology that deals with circuits, transistors, microchips and the behavior and movement of electrons.
2. It handles electric circuits containing active and passive elements and uses underlying techniques.
3. Electronics is a vast field that contains a huge amount of components like conductors, switches, circuits, diodes, processors, inductors etc.,
4. This is an introductory course which about the different types of electronic devices that are being used in our day- to - day life.

Learning Objectives:

1. To build the strong foundation in Mathematics of students needed for the field of electronics and Telecommunication Engineering.
2. Analyze the ability of learning skills to be job ready with real corporate exposure.
3. Develop advanced skills of technical communication in English.
4. Communicate confidently and competently in English language in all spheres.
5. To present a clear consistent picture of the internal ... microcontroller in real life application.

Unit – I	Electronic Components	09 Hours

Resistors – Capacitors – Resistance values – Capacitor value – Fuse wire – Transistors – Integrated chips.

Unit - II	Electrical Appliances	09 Hours

Switch board – Main box – Metal circuit breakers (MCB) – AC – DC currents – Two Phase –Three Phase electrical connections – generators – un intrepid power supply (UPS)- stabilizer –voltage regulators – Electrical devices – Iron box – Fan - Electrical Oven – water Heaters Air conditioners – Refrigerators – washing machines.

Unit - III	Electronic Home Appliances	09 Hours

Radio – Audio taper- speaker- televisions – VCR – CD Players – DVD – calculators Computers– scanner – Printer – Digital Camera – LCD Projectors – Display devices.

Unit - IV	Communications Electronics	09 Hours

Principles of optical fiber Cables (OFC) – Telephone – Mobile phones – wireless phone – Antenna - Internet - Intranet.

Unit - V	Safety Mechanism	09 Hours

Handling Electrical appliances - Power saving methods – Hazards Prevention Methods - Protection of Hi –Fi electronic devices.

Text Book(s):

1. S.S. Kemble – Electronics and Mathematics Data book – Allied publishers Ltd, 1997.
2. William David Cooper, Electronic Instrumentation and Measurement Technique, Second Edition, Prentice-Hall, 1978.
3. Electronics In Every Day Life, William Charles Verger, Dover Publications, 1983.
4. The Importance of Electronics in Modern Life, Edubirdie, 2022.

Reference Books:

1. Electronics in Every Day Life, Text book solutions, HW Solutions, 2003-2023, Chegg Inc.
2. Making Every day Electronics Work: A Yourself Guide, Stan Gibilisco, First Edition, 2013.
3. Human Activity Recognition: Using wearable Sensors and Smart phones, Miguel

A .Labrador, Oscar D. Lara Yejas, Chapman and Hall / CRC Computer and Information Science Series, First Edition, 2013.

4. Study of Electrical Appliances and Devices –Bhatia, Kanna Publications, 2014.

Web Resources:

1. https://byjus.com/physics/electronics-in-daily-life/
2. https://www.linkedin.com/pulse/e-commerce-our-daily-life-dash-technologies-inc
3. https://edubirdie.com/examples/the-importance-of-electronics-in-modern-life

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Relate elastic behavior in terms of three moduli of elasticity and working of torsion pendulum.	K1
CO2	Able to appreciate concept of bending of beams and analyze the expression, quantify and understand nature of materials.	K2
CO3	Explain the surface tension and viscosity of fluid and support the interesting phenomena associated with liquid surface, soap film Providian analogue solution to many engineering problems.	K3
CO4	Analyzesimpleharmonicmotionsmathematicallyandapplythem.Understand the concept of resonance and use it to evaluate the frequency of vibration. Set up experiment to evaluate frequency of acmains	K4
CO5	Understand the concept of acoustics, importance of constructing buildings with good acoustics.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	L	M	S	L	L	L
CO2	M	S	S	L	M	S	L	L	L
CO3	S	M	S	L	M	M	M	L	L
CO4	S	S	S	L	M	M	M	L	L
CO5	S	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23PPHCP02	Hours/Week: 6	Credit: 3

COURSE TITLE: CORE PAPER VI - PRACTICALS – II ANALOG AND DIGITAL EXPERIMENTS

Course Overview:

1. Aimed at future integrated circuit (IC) designers, this course takes a balanced approach to both analogue and digital IC design.
2. This course aims to enable students to be familiar with fundamental concepts and issues, to develop good understanding of basic analogue and digital circuits.
3. Analog and digital signals, band limited signals and systems, bandwidth. 2. 2. Amplitude modulation.
4. It is an introductory experimental laboratory that explores the design, construction, and debugging of analog electronic circuits.

Learning Objectives:

1. To illustrate the students different electronic circuit and their application in practice.
2. To impart knowledge on assessing performance of electronic circuit through monitoring of sensitive parameters.
3. To evaluate the use of computer-based analysis tools to review performance of semiconductor device circuit.

1. Construction of relaxation oscillator using UJT
2. FET CS amplifier- Frequency response, input impedance, output impedance
3. Study of important electrical characteristics of IC741

4. V- I Characteristics of different colors of LED.
5. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge Oscillator using Op-Amp.
6. Study of attenuation characteristics of Phase shift network and design of Phase shift Oscillator using Op-Amp.
7. Design of monostable multivibrator using IC 741 and 555 timers.
8. Construction of Schmidt triggers circuit using IC 741.
9. Construction of square wave and Triangular wave generator using IC 741.
10. Construction of a quadrature wave using IC 324.
11. Construction of pulse generator using the IC 741.
12. Construction of half adder and full adder circuits using NAND gates.
13. Construction of half sub tractor and full sub tractor circuits using NAND gates.
14. Construction of Op-Amp - 4 bit Digital to Analog converter (Binary Weighte And R/2R ladder type).
15. Study of R-S, clocked R-S and D-Flip flop using NAND gates
16. Study of J-K, D and T flip flops using IC 7476/7473
17. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
18. Study of Arithmetic logic unit using IC 74181.
19. Construction of Encoder and Decoder circuits using ICs.
20. IC 7490 as scalar and seven segment display using IC7447
21. Solving simultaneous equations – IC 741 / IC LM324
22. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
23. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
24. Construction of second order butter worth multiple feedback narrow band pass filter
25. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous Counter IC74193.
26. Construction of square wave generator using IC 555.

27. Construction of Schmidt triggers circuit using IC555.
28. Construction of pulse generator using the IC 555.
29. BCD to Excess- 3 and Excess 3 to BCD code conversion.
30. Study of binary up / down counters - IC 7476 / IC7473.
31. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474.
32. Study of synchronous parallel 4-bit binary up/down counter using IC 74193.
33. Study of asynchronous parallel 4-bit binary up/down counter using IC 7493.
34. Study of Modulus Counter.
35. Construction of Multiplexer and DE multiplexer using ICs.

Text Book(s):

1. Practical Physics, Gupta and Kumar, Parget i Pakistan.
2. Kit Developed for doing experiments in Physics- Instruction manual, R. Srinivasan, K.R Priolkar, Indian Academy of Sciences.
3. Op-Amp and linear integrated circuit, Ramakanth A Gay wad, Eastern Economy Edition.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing.
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition.

Reference Books:

1. An advanced course in Practical Physics, D. Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd.
2. Advanced Practical Physics, S.P Singh, and Pragmatic Pakistan.
3. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.
4. Electronic lab manual Vole II, Kuriachan T.D, Siam Mohan, Ayodhya Publishing.
5. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Relate elastic behavior in terms of three moduli of elasticity and working of torsion pendulum.	K1
CO2	Able to appreciate concept of bending of beams and analyze the expression, quantify and understand nature of materials.	K2
CO3	Explain the surface tension and viscosity of fluid and support the interesting phenomena associated with liquid surface, soap films provide an analog solution to many engineering problems.	K3
CO4	Analyze simple harmonicmotionsma the matically and apply them .Understand the concept of resonance and use it to evaluate the frequency of vibration. Set up experiment to evaluate frequency of ac mains	K4
CO5	Understand the concept of acoustics, importance of constructing buildings with good acoustics.	K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**M**	**M**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**M**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23PPHCT05	Hours/Week: 5	Credit: 4

COURSE TITLE: CORE PAPER V - QUANTUM MECHANICS – I

Course Overview:

1. This course covers the experimental basis of quantum concepts.
2. It introduces wave mechanics, Schrödinger's equation in a single dimension, and Schrödinger's equation in three dimensions.
3. It is the first course in the undergraduate Quantum Physics sequence.

Learning Objectives:

1. To develop the physical principles and the mathematical background important to quantum mechanical descriptions.
2. To describe the propagation of a particle in a simple, one-dimensional potential.
3. To formulate and solve the Schrodinger's equation to obtain eigenvectors and energies for particle in a three-dimensional potential..
4. To explain the mathematical formalism and the significance of constants of motion, and see their relation to fundamental symmetries in nature
5. To discuss the Approximation methods like perturbation theory, Variation and WKB methods for solving the Schrödinger equation

Unit - I	Basic Formalism	09 Hours

Interpretation of the wave function – Time dependent Schrodinger equation Time independent Schrodinger equation – Stationary states – Ehrenfest's theorem – Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermit Ian Operator – Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation.

Unit - II	One Dimensional and Three-Dimensional Energy eigen Value Problems	09 Hours

Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig - penny square – well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles – Hydrogen atom – Rigid rotator.

Unit - III	General Formalism	09 Hours

Dirac notation – Equations of motions – Schrodinger representation – Dirac notation- equations of motions – Schrodinger representation – Heisenberg representation- Interaction representation –Coordinate representation – Momentum representation – Symmetries and conservation laws –Unitary transformation – Parity and time reversal.

Unit - IV	Approximation Methods	09 Hours

Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state Variation method – Helium atom –WKB approximation – Connection formulae (no derivation) – WKB quantization – Application to simple harmonic oscillator.

Unit - V	Angular Momentum	09 Hours

Eigen value spectrum of general angular momentum – Ladder operators and their algebra – Matrix representation – Spin angular momentum – Addition of angular V Momenta - CG Coefficients –Symmetry and anti – symmetry of wave functions – Construction of wave-functions and Pauli's exclusion principle.

Text Book(s):

1. P. M. Mathews and K. Venkatesan, A Tex t book of Quantum Mechanics 2nd Edition (37th Reprint), Tata McGraw-Hill, New Delhi, 2010.
2. G. Arul has, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009.
3. David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
4. SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S. Chand & Co., New Delhi, 1982.
5. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan, India, 1984.

Reference Books:

1. E. Merzbacher, Quantum Mechanics, 2nd, edition John Wiley and Sons, New York, 1970.
2. V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985.
3. L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergamum Press, Oxford, 1976.
4. S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata, 1999.

5. V. Deva Nathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford, 2011.

Web Resources:

1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf
2. http://www.feynmanlectures.caltech.edu/III_20.html
3. http://web.mit.edu/8.05/handouts/jaffe1.pdf
4. https://hepwww.pp.rl.ac.uk/users/haywood/Group_Theory_Lectures/Lecture_ 1.pdf
5. https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics	K1
CO2	Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems	K2
CO3	Can discuss the various representations, space time symmetries and formulations of time evolution	K3
CO4	Can formulate and analyze the approximation methods for various quantum mechanical problems	K4
CO5	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	L	M	S	L	L	L
CO2	M	S	S	L	M	S	L	L	L
CO3	S	S	S	L	M	M	M	L	L
CO4	S	S	S	L	M	M	M	L	L
CO5	S	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23PPHCT04	Hours/Week:5	Credit:4
COURSE TITLE: CORE PAPER IV – STATISTICAL MECHANICS			

Course Overview:

1. This course is a first level course in the Dirac's bra(ket) notation which will set foundation to take up advanced level courses
2. It is a first introduction to quantum mechanics aimed at students with a good grasp of Newtonian mechanics, electricity & magnetism, and waves
3. This course develops concepts in quantum mechanics such that the behavior of the physical universe can be understood from a fundamental point of view.
4. Introduction to Quantum Mechanics is an accessible and to-the-point journey through the most famous theory in science.

Learning Objectives:

1. To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics
2. To identify the relationship between statistic and thermodynamic quantities
3. To comprehend the concept of partition function, canonical and grand canonical ensembles
4. To grasp the fundamental knowledge about the three types of statistics
5. To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time

Unit - I	Phase Transitions	09 Hours

Thermodynamic potentials- Phase Equilibrium- Gibb'sphaserule- Phase transitions And Ehrenfest'sclassifications–Third law of Thermodynamics. Order parameters– Landau's theory of phase transition- Critical indices- Scale trans formations and dimensional analysis.

Unit - II	Statistical Mechanics and Thermodynamics	09 Hours	

Foundations of statistical mechanics-Specification of states of a system-Micro canonical ensemble-Phase space–Entropy-Connection between statistics and thermodynamics–Entropy fan ideal gas using the micro canonical ensemble-Entropy Of an ideal gas using the micro canonical ensemble-Entropy of mixing and Gibb's Paradox.

Unit - III	Canonical and Grand Canonical Ensembles	09 Hours

Trajectories and ensityo states -Liouville'stheorem-Canonical and grand Canonical ensembles-Partition function-Calculation of statistical quantities-Energy and density fluctuations.

Unit - IV	Classical and Quantum Statistics	09 Hours

Density matrix-Statistics of ensembles-Statistic so find distinguishable particles- Maxwell Boltzmannstatistics-Fermi-Diracstatistics–IdealFermigas–Degeneracy- Bose-Einstein statistics-Plank radiation formula-Ideal Bose gas-Bose-Einstein Condensation.

Unit - V	Real gas, I sing Model and Fluctuations	09 Hours

Cluster expansion for a classical gas-Variable question of state–Calculation of the first Virial coefficient tin the cluster expansion-Isingmodel-Mean-field the ories of the I sing Model in three, two and one dimensions-Exact solutions in one dimension. Correlation of space-timed ependent fluctuations-Fluctuations and transport phenomena -Fluctuation-dissipation theorem-The Fokker-Planck equation.

Text Book(s):

1. Statistical Mechanics, Tata McGraw Hill, New Delhi S.K. Sinha, 1990,
2. B.K.Agarwal and M.Eisner, 1998, Statistical Mechanics, Second Edition New Age International, New Delhi.
3. J.K.Bhattacharjee, 1996, Statistical Mechanics: An Introductory Text, Allied Publication, and New Delhi.

4. F.Reif, 1965, Fundamentals of Statistical and Thermal Physics, McGraw-Hill, New York.

5. M.K.Zemansky, 1968, Heat and Thermodynamics, 5thedition, McGraw-Hill New York.

Reference Books:

1. R.K.Pathria, 1996, Statistical Mechanics, 2ndedition, Butter Worth Heinemann, New Delhi.

2. L.D.Land auandE.M.Lifshitz, 1969, Statistical Physics, PergamonPress, Oxford.

3. K.Huang, 2002, Statistical Mechanics, Taylor and Francis, London.

4. W.Greiner, L.NeiseandH.Stoecker, Thermodynamics and Statistical Mechanics, Springer Verlang, New York.

5. A.B.Gupta, H.Roy, 2002, Thermal Physics, Books and Allied, Kolkata.

Web Resources:

1.https://byjus.com/chemistry/third-law-of-thermodynamics/

2.https://web.stanford.edu/~peastman/statmech/thermodynamics.html

3.https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics

4.https://en.wikipedia.org/wiki/Grand_canonical_ensemble

5.https://en.wikipedia.org/wiki/Ising_model

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition	K1
CO2	To analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc. Describe the peculiar behavior of the entropy by mixing two gases Justify the connection between statistics and thermodynamic quantities	K2
CO3	Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermo dynamical quantities and partition function	K3
CO4	To recall and apply the different statistical concepts to analyze the behavior of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics.	K4
CO5	To discuss and examine the thermo dynamical behavior of gases under fluctuation and also using I sing model	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23PPHAE02	Hours/Week:2	Credit:2

COURSE TITLE: SOFT SKILL II - ABILITY ENHANCEMENT COMPULSORY COURSE - LASER PHYSICS AND APPLICATIONS

Course Overview:

1. This course will cover a brief overview of different laser systems (solid-state and fiber lasers, gas lasers etc.,
2. This course, which is intended to be an introduction to research in optical sciences, covers the statistics of optical fields and the physics of lasers.
3. The course provides students with a working knowledge of laser physics and provides introduction into nonlinear optics and laser applications.
4. This course will cover a Light emission and absorption in quantum Theory.

Learning Objectives:

1. To endow the students with knowledge about industrial laser systems and interaction of laser radiation with matter and applications of lasers in various materials processing like cutting, welding, surface treatment etc.
2. To understand the fundamental concepts of Laser principles, Laser Physics and Spectroscopy.
3. To explain operational principles and construction of lasers · give an account of technological issues behind laser
4. To understand the research in optical sciences covers the statistics of optical fields and the physics of lasers.
5. The chief purpose is for students to obtain a solid understanding of the basic principles of lasers.

Unit - I	Principle	02 Hours

Interaction of light with matter –absorption – transmission - Stimulated absorption - spontaneous and Stimulated emission - Einstein coefficients – their relations – population inversion.

Unit - II	Characteristics	02 Hours

Mono chromaticity – Coherence – Directionality - Brightness - Short Time Duration – Light Amplification - laser pumping two level laser – three level lasers – four level lasers.

Unit - III	Components	02 Hours

Components of laser - resonators – vibrational modes of resonators – open resonators – control resonators – Q- factor – losses in the resonance cavity - Modes of Laser beam – transverse modes.

Unit - IV	Types	02 Hours

Five types of lasers - Gas laser – C02 – Solid state laser – Helium Neon laser - Fiber laser – Liquid laser – Dye laser – Semiconductor laser – diode laser.

Unit - V	Applications	02 Hours

Application of lasers in industry – medicine – Science - Research – instrumentation.

Text Book(s):

1. M.N. Aravamudhan, An introduction to Laser theory and application, S. Chand & Co. Pvt. Ltd, 2012

2. Lasers and Nonlinear Optics - B.B. Laud, Cambridge University Press, Second Edition, 2004.

3. Laser Physics, Peter W. Milonni, Joseph H. Eberly, John Wiley & Sons, Inc., 2010.

4. Subramanian and Brijlal, A textbook of Optics, S. Chand & Co., 2001.

5. R. Murugeshan and Kiruthigasivaprasath, Modern Physics, S. Chand & co 2014.

Reference Books:

1. Lasers, Fundamentals and Applications, K. Thyagarajan, Ajoy Ghatak, Springer, 2011.

2. Lasers and Nonlinear Optics - B.B. Laud, Cambridge University Press, Second Edition, 2004.

3. Laser Physics, Peter W. Milonni, Joseph H. Eberly, John Wiley & Sons, Inc., 2010.

4. An Advances in Optics, Photonics and Optoelectronics ,Perm B Bishit, IOP Publishing

5. An introduction to Laser Spectroscopy, David L. Andrews and Andrey, A. Demidov, Springer (India) Private Limited, New Delhi, 1995.

Web Resources:

1. https://ocw.mit.edu/courses/res-6-005-understanding-lasers-and-fiberopticsspring-
2. https://ehs.msu.edu/_assets/docs/laser/laser-fundamentals-pt1-springer- 2005.pdf
3. https://technav.ieee.org/topic/laser-applications

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Analyze the intensity variation of light due to interference, diffraction and polarization	K4
CO2	They will be able to implement these phenomena to design advanced optical instruments	K3
CO3	Understand the principle, construction and working of lasers in order to implement Laser Technology in engineering field	K2
CO4	Understand fundamentals of quantum mechanics and apply to one dimensional motion of particles.	K2
CO5	Understand the principle, production and transmission of ultrasonic waves and understand the working of various instruments based on ultrasonic	K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**S**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23PPHE02	Hours/Week:4	Credit:3

COURSE TITLE: ELECTIVE II - ADVANCED OPTICS

Course Overview:

1. This course presents a rigorous treatment of topics in Photonics and Optics targeted at students with an existing photonics or optics background.
2. Solve many problems in wave optics, Nano photonics, and atom-field interaction · Assess the pros and cons of existing and new optical techniques.
3. It covers three major sections: crystal optics; coherence; and Fourier optics
4. This course provides both theoretical and hands on experience of lasers and non-linear optics

Learning Objectives:

1. To know the concepts behind polarization and could pursue research work on application aspects of laser
2. To impart an extensive understanding of fiber and non-linear optics
3. To study the working of different types of LASERS
4. To differentiate first and second harmonic generation
   Learn the principles of magneto-optic and electro-optic effects and its applications

Unit - I	Polarization and Double Refraction	04 Hours

Classification of polarization – Transverse character of light waves – Polarizer and analyzer - Malu's law – Production of polarized light – Wire grid polarizer and the Polaroid - Polarization by reflection – Polarization by double refraction – Polarization by scattering .

Unit - II	Lasers	04 Hours

Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action – Types of lasers and its applications – Solid state lasers – Ruby laser – Nd: YAG laser – gas lasers – He-Ne laser – CO2 laser – Chemical lasers – HCl laser –Semiconductor laser.

Unit - III	Fiber Optics	04 Hours

Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle –The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical fibers – Ray dispersion in multimode step index fibers – Parabolic index fibers – Fiber-optic sensors: precision displacement sensor – Precision vibration sensor.

Unit - IV	Non-Linear Optics	04 Hours

Basic principles – Harmonic generation – Second harmonic generation – Phase matching- Third harmonic generation – Optical mixing – Parametric generation of light – Self- focusing of light.

Unit - V	Magneto-Optics and Electro-Optics	04 Hours

Magneto-optical effects – Zeeman effect – Inverse Zeeman effect – Faraday effect - Voigt effect – Cotton-mouton effect – Kerr magneto-optic effect – Electro-optical effects Stark effect – Inverse stark effect – Electric double refraction – Kerr electro-optic effect – Pockels electro-optic effect.

Text Book(s):

1. B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) ltd.
2. Ajoy Ghatak, 2017, Optics, 6th Edition, McGraw – Hill Education Pvt. Ltd.
3. William T. Silfvast, 1996, Laser Fundamentals Cambridge University Press, New York.
4. J. Peatros, Physics of Light and Optics, a good (and free!) electronic book.
5. B. Saleh, and M. Teach, Fundamentals of Photonics, Wiley-Inter science

Reference Books:

1. F. S. Jenkins and H. E. White, Fundamentals of Optics, (4th Edition), McGraw – Hill International Edition, 1981.
2. Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH.
3. Lipson, S. G. Lipson and H. Lipson ,Optical Physics, 4th Edition, Cambridge University Press, New Delhi, 2011.
4. Y. B. Band, Light and Matter, Wiley and Sons (2006).

Web Resources:

1. https://www.youtube.com/watch?v=WgzynezPiyc
2. https://www.youtube.com/watch?v=ShQWwobpW60
3. https://www.ukessays.com/essays/physics/fiber–optics–and–it-applications.php
4. https://www.youtube.com/watch?v=0kEvr4DKGRI
5. http://o ptics.byu.edu/textbook.aspx

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Discuss the transverse character of light waves and different polarization phenomenon	K1
CO2	Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices	K2
CO3	Demonstrate the basic configuration of a fiber optic – communication system and advantages	K3
CO4	Identify the properties of nonlinear interactions of light and matter	K4
CO5	Interpret the group of experiments which depend for their action on an applied magnetics and electric field	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**S**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**M**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23PPHE03	Hours/Week:4	Credit:3

COURSE TITLE: ELECTIVE III - SOLID WASTE MANAGEMENT

Course Overview:

1. The aim of this course is to make the students understand the activities and actions required to manage waste from its inception
2. The course would cover-general introduction including definition of solid wastes–municipal waste, biomedical waste, hazardous waste, e-waste; legal issues etc.,
3. Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation
4. Describe and discuss the difference sources and types of waste

Learning Objectives:

1. Understand basics of waste management.
2. Understand basic principles of waste.
3. Acquire design of Landfills and Integrated Solid Waste Management
4. Understand the effectiveness of different waste diversion and disposal methods (landfill, recycling, reusing, and up cycling)
5. Understand the scientific principles involved in processing solid, liquid, and gaseous waste

Unit - I	Solid Waste Management	04 Hours

Introduction - Definition of solid waste - Types – Hazardous Waste: Resource conservation and Renewal act – Hazardous Waste: Municipal Solid waste and non-municipal solid waste.

Unit - II	Solid Waste Characteristics	04 Hours

Solid Waste Characteristics: Physical and chemical characteristics - SWM hierarchy – factors affecting SW generation.

Unit - III	Tools and Equipment	04 Hours

Tools and equipment - Transportation - Disposal techniques - Composting and land filling technique.

Unit - IV	Economic Development	04 Hours

SWM for economic development and environmental protection – Linking SWM and climate Change and marine litter.

Unit - V	Industrial Visit	04 Hours

SWM Industrial visit – data collection and analysis – presentation.

Text Book(s):

1. Handbook of Solid Waste Management /Second Edition, George Tchobanoglous, McGraw Hill (2002).
2. Prospects and Perspectives of Solid Waste Management, Prof. B. B.Hosett, New Age International (P) Ltd (2006).
3. Solid and Hazardous Waste Management, Second Edition, M.N Rao, BS Publications / BSP Books (2020).
4. Integrated Solid Waste Management Engineering Principles and Management, Tchobanoglous, McGraw Hill (2014).
5. Solid Waste Management (SWM), VasudevanRajaram, PHI learning private limited, 2016.

Reference Books:

1.Municipal Solid Waste Management, Christian Ludwig, Samuel Stucki, Stefanie Hellweg, Springer Berlin Heisenberg, 2012.
2. Solid Waste Management Bhide A. D Indian National Scientific Documentation Centre, New Delhi Edition 1983 ASIN: B0018MZ0C2/
3. Solid Waste Techobanoglous George; Kreith, Frank McGraw Hill Publication, New Delhi 2002, ISBN 9780071356237.
4. Environmental Studies Manjunath D. L. Pearson Education Publication, New Delhi, 20061SBN-I3: 978-8131709122.
5. Solid Waste Management Sasikumar K. PHI learning, New Delhi, 2009 ISBN8120338693.

Web Resources:

1. https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-PrinciplesAnd-Management-Issues-125648
2. https://testbook.com/learn/environmental-engineering-solid-waste-management/
3. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsA
4. gM0iVpismAJN93CHA1sX6NuNeOKLXfQJ_jxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
5. https://amzn.eu/d/5VUSTDI

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	State solid waste characteristics and its sources	K1
CO2	Identify and analyze different methods of treatment of solid waste.	K2
CO3	Illustrate Industrial practices in solid waste management.	K3
CO4	Discuss the significance of recycling reuse and reclamation of solid wastes.	K4
CO5	Assess the relationships between environmental guidelines, human activities and quality of impacted soil, water and air.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**S**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**S**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23PPHCT06	Hours/Week:6	Credit:4
COURSE TITLE: CORE PAPER VI - QUANTUM MECHANICS – II			

Course Overview:

1. Quantum physics is physics at a microscopic scale.
2. Quantum mechanics is the theory that describes matter and energy at atomic and subatomic levels where classical physics does not always apply due to wave-particle duality and the uncertainty principle.
3. The course emphasizes conceptual understanding rather than a heavily mathematical approach, but some amount of mathematics is essential for understanding and using quantum mechanics.
4. The course presumes a mathematics background that includes basic algebra and trigonometry, functions, vectors, matrices, complex numbers, ordinary differential and integral calculus, and ordinary and partial differential equations.

Learning Objectives:

1. This course primarily aims to provide the basic concepts of quantum mechanics and various formalism of quantum mechanics with simple examples.
2. The angular momentum and spin dynamics of the quantum systems will be discussed. Some standard approximation techniques such as time independent perturbation, Variational method and WKB approximation for solving quantum static systems will be discussed.
3. To introduce the Quantum Mechanical concepts of measurements for physical systems.
4. To introduce the role of Quantum Mechanics on evolution of the physical systems in our Universe.
5. To understand the concepts of various theories associated with daily life.

Unit - I	Scattering Theory	09 Hours

Scattering amplitude – Cross sections – Born approximation and its validity– Scattering by a screened coulomb potential –Yukawa potential – Partial wave analysis Scattering length and Effective range theory for S wave – Optical theorem– Transformation from center of mass to laboratory frame.

Unit - II	Perturbation Theory	09 Hours

Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule – Transition probability Einstein's A and B Coefficients – Adiabatic Approximation – Sudden approximation – Semi – classical treatment of an atom with Electromagnetic radiation – Selection rules for dipole radiation.

Unit - III	Relatistic Quantum Mechanics	09 Hours

Klein – Gordon Equation – Charge and Current Densities – Dirac Matrices- Dirac Equation – plan wave Solutions – Interpretation of Negative Energy States– Antiparticles – Spin of Electro – Magnetic Moment Of An Electron Due To Spin.

Unit - IV	Dirac Equation	09 Hours

Covariant form of Dirac Equation – Properties of the gamma matrices – Traces– Relativistic invariance of Dirac equation – Probability Density – Current four vector – Bilinear Covariant – Feynman's theory of Positron (Elementary ideas only without propagation formalism).

Unit - V	Classical Fields and Second Quantization	09 Hours

Classical fields – Euler Lagrange equation – Hamiltonian formulation – No ether's Theorem Quantization of real and complex scalar fields – Creation, Annihilation and number operators - Fock states – Second Quantization of K-G field.

Text Book(s):

1. .M. Mathews and K. Venkatesan ,A Text book of Quantum Mechanics, 2nd Edition, Tata McGraw - Hill, New Delhi, 2010.

2 .G. Arul has, Quantum Mechanics, 2nd Edition, Prentice – Hall of India, New Delhi, 2009.

3. L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw Hill Kogakusha, Tokyo, 1968.

4 .V. Deva Nathan, Quantum Mechanics, 1st Edition, Narosa Publishing House, New Delhi, 2005.

5. Nouredine Zettili, Quantum mechanics concepts and applications, 2nd Edition, Wildey, 2017.

Reference Books:

1.P.A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition, Oxford University press, London, 1973.

2. B. K. Agarwal & HariPrakash, Quantum Mechanics, 7th reprint, PHIL earning Pvt. Ltd., New Delhi, 2009.

3.Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics, 1st edition I.K. International Publishing house Pvt. Ltd., 2006.

4. Ghatak and S. Lokanathan, Quantum Mechanics : Theory and Applications, 4th edition Macmillan India, New Delhi.

5. E. Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970.

Web Resources:

1.https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf

2.http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf

3.http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf

4.https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf

5.https://web.mit.edu/dikaiser/www/FdsAmSci.pdf

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Will be able to understand the basic concepts and principles of quantum mechanics and its applications to simple systems like simple harmonic oscillator.	K1
CO2	Will be able to understand angular momentum and spin dynamics of quantum systems. Will be able to solve angular momentum using CG coefficients	K2
CO3	Will be able to distinguish odd half and integral spin particles. Can understand the symmetric and anti-symmetric particles.	K3
CO4	Will be able to find the energy and wave functions of quantum conservative systems.	K4
CO5	Will understand various approximation techniques and solve simple systems.	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**M**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**M**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester : III	**Course Code: 23PPHCT07**	**Hours/Week:5**	**Credit:4**
COURSE TITLE: CORE PAPER VII – NUMERICAL METHODS AND COMPUTER PROGRAMMING			

Course Overview:

1. Introduction to significant digits and errors solution of system of linear equations.
2. Roots of nonlinear equations can derive in these concepts.
3. Eigen values and Eigen vectors are also used.
4. Interpretations of Newton's formulations are used.

Learning Objectives:

1. This course is an introduction to a broad range of numerical methods for solving mathematical problems that arise in Science and Engineering.
2. The goal is to provide a basic understanding of the derivation, analysis, and use of these numerical methods, along with a rudimentary understanding of finite precision arithmetic and the conditioning and stability of the various problems and methods.
3. This will help you choose, develop and apply the appropriate numerical techniques for your problem, interpret the results, and assess accuracy.
4. The problems cover (i) systems of linear equations, linear least squares problems, and eigenvalue calculation; (ii) interpolation, approximation, and integration of functions; (iii) initial values problems governed by ordinary differential equations; (iv) nonlinear scalar equations.

Unit - I	Solutions of Equations	09 Hours

Zeros or Roots of an equation - Non-linear algebraic equation and transcendental equations – Zeros of polynomials –Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Rap son methods–Convergence of solutions in Bisection and Newton-Rap son methods – Limitations of Bisection and Newton-Rap son methods.

Unit - II	Linear System of Equations	09 Hours

Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations – Gaussian elimination method – Gauss Jordan method – Inverse of a matrix by Gauss elimination method - Eigen values and eigenvectors of matrices – Direct method - Power method and Jacobi Method to find the Eigen values And Eigenvectors.

Unit - III	Inter Polation and Curve Fitting	09 Hours

Interpolation with equally spaced points-Newton forward and backward interpolation-Interpolation with unevenly spaced points- Lagrange interpolation – Curve fitting – Method of least squares–Fitting a polynomial.

Unit - IV	Differentiation, Integration and Solution of Differential Equations	09 Hours

Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule – Error estimates – Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite and Gauss-Chebyshev quadrature – Solution of ordinary differential equations–Euler and Runga Kutta methods.

Unit - V	Programming With C	09 Hours

Flow-charts – Integer and floating point arithmetic expressions – Built-in functions – Executable and non-executable statements–Subroutines and functions–Programs for the following computation AL methods:(a) Zeros of polynomials by the bisection method, (b)Zeros of polynomials/non-linear questions by the Newton-Rap son method,(c)Newton's forward and backward interpolation, Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.

Text Book(s):

1. V. Raja Raman, 1993, Computer oriented Numerical Methods, 3rd Edition. PHI, New Delhi.

2. M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi

3. S. S. Sastry, Introductory Methods of Numerical analysis, PHI, New Delhi.

4. F. Shied, 1998, Numerical Analysis, 2nd Edition, Schaum's series, McGraw Hill, New York.

5. W. H. Press, S. A. Teukolsky, W. T. Vetter ling and B. P. Flannery, 1992, Numerical Recipes in FORTRAN, 2nd Edition, Cambridge Univ. Press.

Reference Books:

1. S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis-an algorithmic approach, 3rd Edition, McGraw Hill

2. B. F. Gerald, and P. O. Wheatley, 1994, Applied Numerical analysis, 5th Edition, Addison- Wesley, MA.

3. B. Carnagan, H. A. Luther and J. O. Wilkes, 1969, Applied Numerical Methods, Wiley, New York.

4. S. S. Kuo, 1996, Numerical Methods and Computers, Addison-Wesley.

5. V. Raja Raman, Programming in FORTRAN / Programming in C, PHI, New Delhi

Web Resources:

1. https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-V-RajaRaman

2. https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/referencespapers.aspx?referenceid=1682874

3. https://nptel.ac.in/course/122106033/

4. https://nptel.ac.in/course/103106074/

5. https://onlinecourses.nptel.ac.in/noc20_ma33/preview

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.	K1
CO2	Apply numerical methods to obtain approximate solutions to mathematical problems.	K2
CO3	An ability to apply knowledge of mathematics, science, and engineering	K3
CO4	An ability to design and conduct experiments, as well as to analyze and interpret data.	K4
CO5	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	L	M	S	L	L	L
CO2	M	S	S	L	M	S	L	L	L
CO3	S	M	S	L	M	M	M	L	L
CO4	S	S	S	L	M	M	M	L	L
CO5	S	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L- Low

Semester : III	Course Code: 23PPHCT08	Hours/Week: 5	Credit:4
COURSE TITLE: CORE PAPER VIII - ELECTRO MAGNETIC THEORY			

Course Overview:

1. The course covers static and dynamic electric and magnetic fields and their interaction.
2. Major topics include Electromagnetic Waves, Transmission Lines, Waveguides, and Antenna fundamentals.
3. The application of Maxwell's equations to solve time-independent boundary-value problems and to Study the interactions of electric and magnetic fields with bulk matter.
4. Technological applications of electromagnetism include cell phones, MRI scanners, maglev trains, TVs, video and audio tapes, data storage devices, speakers, microphones, and doorbells.

Learning Objectives:

1. To introduce the basic mathematical concepts related to electromagnetic vector fields.
2. To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
3. To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications.
4. To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations.
5. To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines.

Unit - I	Electrostatics	09 Hours

Boundary value problems and Laplace equation–Boundary condition and uniqueness theorem – Laplace equation in three dimension–Solutions in Cartesian and spherical polar coordinates - Examples of solutions for boundary value problems. Polarization and displacement vectors - Boundary conditions – Dielectric sphere in a Uniform field– Molecular polarizability and electrical susceptibility – Electrostatic energy in The presence of dielectric – Multipole expansion.

Unit - II	Magnetostatics	09 Hours

Biot - Savart's Law - Ampere's law-Magnetic vector potential and magnetic field of a Localized current distribution – Magnetic moment, force and torque on a current Distribution in an external field – Magneto static energy-Magnetic induction and magnetic Field in macroscopic media – Boundary conditions – Uniformly magnetized sphere.

Unit - III	Maxwell equations	09 Hours

Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations – Vector and scalar potentials – Gauge in variance – Wave equation and plane wave solution - Coulomb and Lorentz gauges – Energy and momentum of the field – Poynting's theorem - Lorentz force – Conservation laws for a system of charges and electromagnetic fields.

Unit - IV	Wave Propagation	09 Hours

Plane waves in non – conducting media – Linear and circular polarization, reflection and Refraction at a plane interface - Waves in a conducting medium – Propagation of waves in a Rectangular wave guide .Inhomogeneous wave equation and retarded potentials - Radiation From a localized source – Oscillating electric dipole.

Unit - V	Elementary Plasma Physics	09 Hours

The Boltzmann Equation – Simplified magneto – hydrodynamic equations – Electron plasma Oscillations – The Debye shielding problem – Plasma confinement in a magnetic field - Magneto – hydrodynamic waves – Alfven waves and Magneto sonic waves.

Text Book(s):

1.D. J. Griffiths, 2002, Introduction to Electrodynamics, 3rd Edition, Prentice –Hall of India , New Delhi.

2. J. R. Reitz, F. J. Milford and R. W. Christy, 1986, Foundations of Electromagnetic Theory, 3rd edition, Narosa Publishing House, New Delhi.

3. J. D. Jackson, 1975, Classical Electrodynamics, Wiley Eastern Ltd. New Delhi.

4. J. A. Bitten court, 1988, Fundamentals of Plasma Physics, Pergamon Press, Oxford.

5. Gupta, Kumar and Singh, Electrodynamics, S. Chand & Co., New Delhi.

Reference Books:

1.W. Panofsky and M. Phillips, 1962, Classical Electricity and Magnetism, Addision Wesley, London.

2. J. D. Kraus and D. A. Fleisch, 1999, Electromagnetics with Applications, 5th Edition, WCB McGraw - Hill, New York.

3. B. Chakra borty, 2002, Principles of Electrodynamics, Books and Allied, Kolkata.

4. P. Feynman, R. B. Leighton and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 2 Narosa Publishing House, New Delhi.

5. Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA.

Web Resources:

1.http://www.plasma.uu.se/CED/Book/index.html

2.http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html

3.http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html

4.http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/

5.https://www.cliffsnotes.com/Study-guides/physics/electricity-and- magnetism/electrostatics

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Understand the basic mathematical concepts related to electromagnetic vector fields.	K1
CO2	Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.	K2
CO3	Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.	K3
CO4	Understand the concepts related to Faraday's law, induced emf and Maxwell's equations.	K2
CO5	Apply Maxwell's equations to solutions of problems relating to transmission lines and uniform plane wave propagation.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	L	M	S	L	L	L
CO2	M	S	S	L	M	S	L	L	L
CO3	S	M	S	L	M	M	M	L	L
CO4	S	S	S	L	M	M	M	L	L
CO5	M	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23PPHCP03	Hours/Week:4	Credit:3
COURSE TITLE: CORE PAPER VI - PRACTICAL – III MICROPROCESSOR 8085 AND MICROCONTROLLER 8051			

Course Overview:

1. The microprocessor is a multipurpose, clock-driven, register-based, digital integrated circuit that accepts binary data as input, processes it according to instructions stored in its memory, and provides results (also in binary form) as output.
2. Microprocessors support versatile computing operations in personal computers and enterprise servers
3. Microprocessor is the heart of computer systems. We are learning this so that we could understand the complete mechanism and structure of the systems that we use daily like a computer, washing machine, television, etc.
4. The 8051 microcontroller is commonly used in embedded systems, such as home automation systems, security systems, and industrial control systems. Its low cost, small size, and ease of programming make it an ideal choice for these applications

Learning Objectives:

1. To provide solid foundation on the fundamentals of microprocessors and applications, interfacing the external devices to the processor according to the user requirements thus, enabling to create novel products and solutions for real time problems.
2. Understand the fundamentals of Microprocessors.
3. Understand the internal design of 8051 microcontroller along with the features and their programming.
4. Competent with the on chip peripherals of microcontrollers.
5. Design different interfacing applications using microcontrollers and peripherals. Demonstrate the limitations and strengths of different types of microcontrollers and their comparison. Build systems using microcontrollers for real time applications.

1. 8-bit addition and subtraction, multiplication and division
2. Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array Sorting in

ascending and descending order

3. Code conversion (8-bit number): a) Binary to BCD b) BCD to binary
4. Addition of multi byte numbers, Factorial
5. Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal counters
6. Interfacing of LED – Binary up/down counter, BCD up/down counter and N/2N up/down counters
7. Interfacing of seven segment display
8. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves
9. DAC 0800/ DAC 1048 interface and wave form generation (Unipolar/ Bipolar output)
10. ADC 0809 interface
11. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action
12. Interfacing of Temperature Controller and Measurement
13. Water level detector
14. Elevator
15. Traffic Light Controller
16. Key board Interface
17. Addition, Subtraction, Multiplication and Division of 8-bit numbers.
18. Sum of a series of 8-bit numbers
19. Average of N numbers
20. Factorial of number
21. Fibonacci series of N terms
22. Multi byte Addition / Subtraction Sorting
23. g in ascending and descending order – Picking up smallest and largest number
24. LED interface – Binary up/down counter, BCD up/down counter, Ring and twisted ring counter
25. Interfacing seven segment displays
26. DAC 0800 / 1408 interface and wave form generation
27. ADC interfacing
28. Stepper motor interfacing
29. Temperature controller and Measurements
30. Traffic light controller

Text Book(s):

1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata McGraw Hill Publications (2008).

2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).

3. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085,3rd Edition, S. Visvanathan Pvt, Ltd.

4. The 8085 Microprocessor, Architecture, Programming and Interfacing – K. Udaya Kumar, S. Uma Shankar, Pearson.

5. Fundamentals of Microprocessors and Microcontrollers - B. Ram, DhanpatRai Publications.

Reference Books:

1. W. A. Tribel, Avtar Singh, The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications, Prentice-Hall of India, New Delhi.

2. Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications

3. Microprocessor Architecture, Program And Its Application With 8085 - R.S. Gaonkar, New Age International (P) Ltd.

4. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.

5. J. Uffrenbeck, The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications, Pren Tice-Hall of India, New Delhi.

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes: Upon successful completion of this course, the student will be able to:		
COs	**Statements**	**Bloom's Level**
CO1	Understand the basic mathematical concepts related to electromagnetic vector fields.	K1
CO2	Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.	K2
CO3	Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.	K3
CO4	Understand the concepts related to Faraday's law, induced emf and Maxwell's equations.	K4
CO5	Apply Maxwell's equations to solutions of problems relating to transmission lines and uniform plane wave propagation.	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	**S**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**M**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**M**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23PPHSEC02	Hours/Week:2	Credit:2

COURSE TITLE: SKILL ENHANCEMENT COURSE – II
COMMUNICATION ELECTRONICS

Course Overview:

1. This course introduces the fundamentals of electronic communication systems.
2. Topics include the frequency spectrum, electrical noise, and modulation techniques, Characteristics of transmitters and receivers, and digital communications.
3. Upon completion, students should be able to interpret analog and digital communication Circuit diagrams, analyze transmitter and receiver circuits, and use appropriate communication test equipment.
4. Can calculate voltage, current, gain and attenuation in decibels as applied to communication circuits.

Learning Objectives:

1. Analyzing components and their specifications for communication systems in the radiofrequency (RF) and microwave band.
2. Choosing circuits, subsystems and radiofrequency/microwave systems
3. Identifying RF circuits and knowing their general features: linear/non-linear regions, active/passive, RF/bias inputs/outputs, figures of merit…
4. Carrying out the whole implementation cycle of a RF device: design, computer simulation and experiments with RF/microwave equipment and components
5. Analyzing and interpreting RF measurements and comparing them with theoretical and computer simulated results and identifying the reason for the discrepancies.

Unit - I	Antennas and wave Propagation	03 Hours

Radiation field and radiation resistance of short dipole antenna-grounded antenna-ungrounded antenna

antenna arrays-broadside and end side arrays-antenna gain-directional high frequency antenna – sky wave - ionosphere- Ecles and Larmor theory- Magnento ionic theory-ground wave Magnento Ionic theory - ground wave propagation.

Unit - II	Microwaves	03 Hours

Microwave generation—multi cavity Klystron-reflex klystron-magnetron travelling wave tubes (TWT)
and other microwave tubes-MASER-Gunn diode-wave guides-rectangular wave guides standing wave
Indicator and standing wave ratio (SWR).

Unit - III	Radar and Television	03 Hours

Elements of a radar system-radar equation-radar performance Factors radar transmitting systems radar antennas-duplexers-radar receivers and indicators-pulsed systems-other radar systems – colour TV transmission and reception - colour mixing principle - colour picture tubes – Delta gun picture tube – PIL colour picture tube-cable TV, CCTV and theatre TV.

Unit - IV	Optical Fiber	03 Hours

Propagation of light in an optical fibre-acceptance angle-numerical aperture-step and graded index fibers - optical fibres as a cylindrical wave guide-wave guide equations-wave guide equation in step Index fibers - fibre losses and dispersion-applications.

Unit - V	Satellite Communication	03 Hours

Orbital satellites-geostationary satellites-orbital patterns-satellite system link models-satellite system Parameters-satellite system link equation link budget-INSAT communication satellites.

Text Book(s):

1. Hand book of Electronics, Gupta and Kumar, 2008 edition.
2. Electronic communication systems – George Kennedy and Davis, Tata McGraw Hill, 4th edition, 1988.
3. Taub and Schilling, principles of communication systems, second edition, Tata McGraw Hill, 1991.
4. M. Kulkarani, Microwave and radar engineering, Umesh Publications, 1998.
5. Mono Chrome and colour television, R. R. Ghulathi, Prabhat Prakasan, 1990.

Reference Books:

1. Electronic communications, Dennis Roody and Coolen, Prentice Hall of India, IV edition, 1995.

2. Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall of India, 1998.

3. Dennis Roddy and Coolen, 1995, Electronics communications, Prentice Hall of India IV Edition.

4. Wayne Tomasi, 1998 "Advanced Electronics communication System" 4th edition, Prentice Hall Of India, 1998.

5. S. Salivahanan, N. Suersh Kumar & A. Vallavaraj, 2009, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition.

Web Resources:

1. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
2. https://www.polytechnichub.com/difference-analog-instruments-digital-instruments/
3. http://nptel.iitm.ac.in/
4. http://web.ewu.edu/
5. http://nptel.iitm.ac.in/

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Students will demonstrate basic knowledge of Laplace Transform., Vector differentiation and differentiation Integration.	K1
CO2	Students will demonstrate an ability to identify and Model the problems of the field of Electronics and Telecommunication and solve it.	K2
CO3	Students will be able to apply the application of Mathematics in Telecommunication Engineering to Electro-Magnetic fields.	K3
CO4	Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.	K4
CO5	Perform vector differentiation and integration, analyze the vector fields and apply	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	**S**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**M**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low

Semester: III	**Course Code: 23PPHE04**	**Hours/Week:2**	**Credit:3**

COURSE TITLE: ELECTIVE IV - SOLAR ENERGY UTILIZATION

Course Overview:

1. The course explores economic considerations, touching on solar PV costs for residential and commercial use, incentives, and contrasts solar power with fossil
2. Learn about solar energy technologies such as photovoltaic's, concentrating solar power, solar process heat, and passive solar and solar water heating.
3. Solar energy is the transformation of sun rays into power, either in a direct way using photovoltaic (PV) or in a roundabout way utilizing concentrated energy
4. This course provides an introduction of solar energy power generating systems, principles, materials, theories, and details of Indian government

Learning Objectives: By the end of this lesson, you should be able to:

1. Discriminate between (1) Solar Resource, (2) Solar Energy Conversion Systems, and (3) Solar Goods and Services;
2. Explain the goal of solar design in terms of locale, stakeholders/clients, and solar utility**;**
3. Connect the historical and modern contexts for solar energy growth/recession to stakeholder preference, fuel constraints, and solar rights/access.

4. Explain the principles that underlie the ability of various natural phenomena to deliver solar energy

5. Outline the technologies that are used to harness the power of solar energy

Unit - I	Heat Transfer & Radiation Analysis	02 Hours

Conduction, Convection and Radiation – Solar Radiation at the earth's surface – Determination of Solar time – Solar energy measuring instruments.

Unit - II	Solar Collectors	02 Hours

Physical principles of conversion of solar radiation into heat flat plate collectors - General Characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.

Unit - III	Solar Heaters	02 Hours

Types of solar water heater – Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.

Unit - IV	Solar Energy Conversion	02 Hours

Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and thermo- electric conversion - process flow of silicon solar cells- different approaches on the process- texturization, diffusion, Antireflective coatings, metallization.

Unit - V	Nano Structures and Nanomaterials	02 Hours

Use of nano structures and nanomaterials in fuel cell technology - high and low temperature fuel cells, Cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of Nano technology in Hydrogen production and storage. Industrial visit – data collection and analysis - presentation.

Text Book:

1. Solar energy utilization -G.D. Rai –Khanna publishers – Delhi 1987.

2. Maheshwar Sharon, Madhuri Sharon, Carbon "Nano forms and Applications", McGraw-Hill, 2010.

3. Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems", Academic press London, 2009.

4. Tiwari G.N, "Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.

5. Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

Reference Books:

1. Energy – An Introduction to Physics – R.H. Romer, W.H. Freeman, 1976.

2. Solar energy thermal processes – John A. Drife and William. 1974.

3. John W. Twidell & Anthony D. Weir, Renewable Energy Resources, 2005.

4. John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, John Wiley and Sons, 2013.

5. Duffie, J.A., Beckman, W.A., Solar Energy Thermal Process, John Wiley and Sons, 2007.

Web Resources:

1. https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb

2. https://books.google.vg/books?id=l-XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read

3. www.nptel.ac.in/courses/112105051

4. www.freevideolectures.com

5. http://www.e-booksdirectory.com

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Analyze Solar radiation data and its measurement	K1
CO2	Understand Operation of solar thermal energy systems	K2
CO3	Understand the working of solar concentrators and their applications to produce energy	K3
CO4	Understand the photovoltaic theory and implementation process	K4
CO5	Understand the design of Solar conscious buildings	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	L	M	S	L	L	L
CO2	S	S	S	L	M	S	L	L	L
CO3	S	S	S	M	M	M	M	L	L
CO4	S	S	S	L	M	M	M	L	L
CO5	S	S	M	L	M	M	M	L	L

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23PPHAE03	Hours/Week:2	Credit:2

COURSE TITLE: SOFT SKILL III - ABILITY ENHANCEMENT COMPULSORY COURSE - SEWAGE AND WASTE WATER TREATMENT AND REUSE

Course Overview:

1. This course has emphasizes on Integrated Solid Waste Management aspects Within the broad subject area of Integrated Waste.
2. The fundamental scientific processes underlying the design and operation of wastewater treatment plant.
3. The management of residuals from water and wastewater treatment.
4. The major aim of wastewater treatment is to remove as much of the suspended solids.

Learning Objectives: By the end of this lesson, you should be able to:

1. To improve quality of waste water.
2. Elimination of pollutants, toxicants and many such particles.
3. Preservation of water quality of natural water resources.
4. To make wastewater usable for other purposes.
5. Prevention of harmful diseases.

Unit-I	Recovery and Reuse of Water	02 Hours

Recovery & Reuse of water from Sewage and Waste water: Methods of recovery: Flocculation - Sedimentation – sedimentation with coagulation - Filtration - sand filters - pressure filters - horizontal filters - vector control measures in industries - chemical and biological methods of vector eradication.

Unit -II	Disinfection	02 Hours

Disinfection: Introduction to disinfection and sterilization: Disinfectant - UV radiation - Chlorination - Antisepsis - Sterilant - Aseptic and sterile -Bacteriostatic and Bactericidal - factors affecting disinfection.

Unit -III	Chemical Disinfection	02 Hours

Chemical Disinfection: Introduction - Theory of Chemical Disinfection - Chlorination Other Chemical Methods - Chemical Disinfection Treatments Requiring - Electricity - Coagulation/Flocculation Agents as Pretreatment - Disinfection By- Products(DBPs)

Unit -IV	Physical Disinfection	02 Hours

Physical Disinfection: Introduction - Ultraviolet Radiation - Solar Disinfection - Heat Treatment - Filtration Methods - Distillation - Electrochemical Oxidation Water Disinfection by Microwave Heating.

Unit -V	Industrial Visit	02 Hours

Industrial visit – data collection and analysis – presentation.

Text Book(s):

1. Drinking water and disinfection technique, Anirudhha Balachandra. CRC press (2013)
2. Design of Water and Wastewater Treatment Systems (CV-424/434), Shashi Bushan, Jain (2015) Bros
3. Integrated Water Resources Management, Sarbhukan M M, CBS PUBLICATION (2013)
4. C.S. Rao, Environmental Pollution Control Engineering, New Age International, 2007
5. S.P. Mahajan, Pollution control in process industries, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.

Reference Books:

1. Handbook of Water and Wastewater Treatment Plant Operations, Frank. R Spellman, CRC Press, 2020.
2. Wastewater Treatment Technologies, Mritunjay Chaubey, Wiley, 2021
3. Metcalf and Eddy, Wastewater Engineering, 4th ed., McGraw Hill Higher Edu, 2002.
4. W. Wesley Eckenfelder, Jr., Industrial Water Pollution Control, 2nd Edn. McGraw Hill Inc., 1989.
5. Lancaster, Green Chemistry: An Introductory Text, 2nd edition, RSC publishing, 2010.

Web Resources:

1. https://www.google.co.in/books/edition/Drinking_Water_DisinfectionTechniques/HVbNBQAAQBAJ?hl=en

2. https://www.meripustak.com/Integrated-Solid-Waste-Management-EngineeringPrinciples-And-Management-Issues-125648?
3. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsACM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
4. https://www.amazon.in/Design-Wastewater-Treatment-Systems-CV424/dp/B00IG2PI6K/ref=asc_df_B00IG2PI6K/?tag=googleshopmob21&linkCode=df0&hvadid=397013004690&hvpos=&hvnetw= g & hvrand=4351305881865063672& hvpone=& hvptwo=& hvqmt= &hvdev=m& hvdvcmdl=& hvlocint=& hvlocphy=9061971&hvtargid=pla890646066127&psc=1&ext_vrnc=hi

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to:

COs	Statements	Bloom's Level
CO1	Know the types of waste water treatment process.	K1
CO2	To make the student understand conveyance system of sewage.	K2
CO3	Sewage treatment by biological process generates liquid effluent and sludge.	K3
CO4	The fundamental scientific processes underlying the design and operation of wastewater treatment plant.	K4
CO5	Upon successful completion of this course, students will be able to the concept of a unit operation and unit process.	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	**M**	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO2	**S**	**M**	**S**	**L**	**M**	**S**	**L**	**L**	**L**
CO3	**S**	**S**	**S**	**M**	**M**	**M**	**M**	**L**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**M**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**M**	**M**	**M**	**L**	**L**

S - Strong, M – Medium, L – Low