Holy Cross College (Autonomous), Nagercoil
Kanyakumari District, Tamil Nadu.
Accredited with A$^+$ by NAAC - V Cycle – CGPA 3.53

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF PHYSICS

TEACHING PLAN (PG)
ODD SEMESTER
2025-2026

Vision

Envisions training students for quality Physics education and holistic development empowered to meet challenges and embark on luxuriant careers.

Mission

- To produce competent graduates infused with professionalism, ethical values and social responsibility.
- To prepare students to accentuate learning for life.
- To foster a research environment, to keep up with global development in Science.
- To evolve strategies for the growth of the department towards excellence.

Graduate Attributes

Graduates of our College develop the following attributes during the course of their studies.

- **Creative thinking:**

  Equipping students with hands-on-training through skill based courses and promote startup.
- **Personality development:**

  Coping with increasing pace and change of modern life through value education, awareness on human rights, gender issues and giving counselling for the needful.
- **Environmental consciousness and social understanding:**

  Reflecting upon green initiatives and understanding the responsibility to contribute to the society; promoting social and cultural diversity through student training and service learning programmes.
- **Communicative competence:**

  Offering effective communication skills in both professional and social contexts through bridge courses and activities of clubs and committees.
- **Aesthetic skills:**

  Engaging mind, body and emotions for transformation through fine arts, meditation and exercise; enriching skills through certificate courses offered by Holy Cross Academy.
- **Research and knowledge enrichment:**

  Getting in-depth knowledge in the specific area of study through relevant core papers; ability to create new understanding through the process of critical analysis and problem solving.
- **Professional ethics:**

  Valuing honesty, fairness, respect, compassion and professional ethics among students. The students of social work adhere to the *National Association of Social Workers Code of Ethics*
- **Student engagement in the learning process:**

  Obtaining extensive and varied opportunities to utilize and build upon the theoretical and empirical knowledge gained through workshops, seminars, conferences, industrial visits and summer internship programmes.
- **Employability:**

  Enhancing students in their professional life through Entrepreneur development, Placement & Career guidance Cell.
- **Women empowerment and leadership:**

  Developing the capacity of self-management, team work, leadership and decision making through gender sensitization programme

Programme Educational Objectives (PEOs)

PEOs	Upon completion of M. Sc. Physics Programme, the graduates will be able to:	Mapping with Mission
PEO1	apply scientific and computational technology to solve social and ecological issues and pursue research.	**M1, M2**
PEO2	continue to learn and advance their career in industry both in private and public sectors.	**M4 & M5**
PEO3	develop leadership, teamwork, and professional abilities to become a more cultured and civilized person and to tackle the challenges in serving the country.	**M2, M5 & M6**

Programme Outcomes (POs)

POs	Upon completion of M.Sc. Physics Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	apply their knowledge, analyze complex problems, think independently, formulate and perform quality research.	**PEO1 & PEO2**
PO2	carry out internship programmes and research projects to develop scientific and innovative ideas through effective communication.	**PEO1, PEO2 &PEO3**
PO3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe.	**PEO2**
PO4	develop innovative initiatives to sustain ecofriendly environment	**PEO1, PEO2**
PO5	through active career, team work and using managerial skills guide people to the right destination in a smooth and efficient way.	**PEO2**
PO6	employ appropriate analysis tools and ICT in a range of learning scenarios, demonstrating the capacity to find, assess, and apply relevant information sources.	**PEO1, PEO2 &PEO3**
PO7	learn independently for lifelong executing professional, socialand ethical responsibilities leading to sustainable development.	**PEO3**

Programme Specific Outcomes (PSOS)

PSOs	Upon completion of M.Sc. Physics Degree Programme,the graduates of Physics will be able to:	Mapping with POs
PSO1	have well– defined knowledge on theoretical concepts and experimental methods of advanced physics.	**PO1 & PO2**
PSO2	acquire skills in performing advanced physics experiments andprojects using modern technology and numerical simulations.	**PO3, PO4 &PO5**
PSO3	develop and communicate analytical skills ranging from nuclear to cosmology to progress in the expanding frontiers of physics.	**PO6**
PSO4	apply and interpret physics principles in various physical observations. Demonstrate proficiency in analyzing, applying andsolving Scientific problems.	**PO1, PO7**
PSO5	use the techniques, skills, and modern technology necessary to communicate effectively with professional and ethical responsibility. Understand the impact of Physics in a global, economic, environmental, and societal context.	**PO7**

Department : **Physics**
Class : **I M.Sc. Physics**
Title of the Course :**CORE COURSE I: MATHEMATICAL PHYSICS**
Semester : **I**
Course Code :**PP231CC1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP231CC1	7	-	-	-	5	7	105	25	75	100

Learning Objectives:

1. To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program.
2. To extend their manipulative skills to apply mathematical techniques in their fields.
3. To help students apply Mathematics in solving problems of Physics.

Course Outcomes

COs	Upon completion of this course, students will be able to:	
1	understand use of bra-ket vector notation and explain the meaning of complete orthonormal set of basis vectors, and transformations and be able to apply them.	K1, K2
2	able to understand analytic functions, do complex integration, by applying Cauchy Integral Formula. Able to compute many real integrals and infinite sums via complex integration.	K2, K3

3	analyze characteristics of matrices and its different types, and the process of diagonalization.	**K4**
4	solve equations using Laplace transform and analyze the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology	**K4, K5**
5	to find the solutions for physical problems using linear differential equations and to solve boundary value problems using Green's function. Apply special functions in computation of solutions to real world problems	**K2, K5**

Teaching plan

Total Contact hours: 105 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Linear Vector Space**								
	1.	Basic concepts – Definitions- examples of vector space – Linear independence.	4	1	K1 (R)	Lecture with Visual Aids such as PPT, Graphical illustration,	Think–pair–share: classify given sets as vector spaces. Group proof exercises; peer instruction	*Study.com* definition & examples free pdf from Hefferon	Quick quiz: identify valid vector spaces; group peer-check Seminar presentations; CIA II, Quiz using google

									forms.
	2.	Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure –linear operators – Dual space- ket and bra notation	4	1	K1 (R)	Step-by-step derivation, geometric interpretation	Flipped lesson: students read/ watch pre-class; in-class problem solving	PhET Simulations ; GeoGebra applets	Mini-quizzes with bra-ket problems, Seminar presentations; CIA II, Quiz using google forms. Activity 2: Problem solving using Schmidt orthogonalization procedure
	3.	orthogonal basis – change of basis – Isomorphism of vector space – projection operator	4	1	K2 (U)	Demonstrate basis change matrix & geometrical effect	Peer-teaching on basis conversion	IOLA wiki; Strang's video series	Quiz: compute and interpret projection matrices, Seminar presentations; CIA II, Quiz using google forms.
	4.	Eigen values and Eigen functions	2	1	K2 (U)	Relate to matrices, characteristic polynomials	Hands-on computation	MIT OCW + IOLA resources	Write proofs: properties and examples, Seminar presentations; CIA II, Quiz using google forms.
	5.	Direct sum and invariant subspace –	3		K2 (U)	Illustrate with graphical and algebraic	Group task: decompose space into direct sums; find	OCW / Active Calculus	Derive rotation matrices; verify orthogonalitySem

		orthogonal transformations and rotation.				examples	invariants	site	inar presentations; CIA II, Quiz using google forms.
II		**Complex analysis**							
	1.	Review of Complex Numbers -de Moivre's theorem.	2	1	K2(U)	Lecturing, Collaborative Learning	Think-pair-share, Group Discussion, Problem Solving-Pause-and-solve, Team-based Learning,	Interactive PPT, Lecture Slides	Evaluationthroughshort test, Formative Quiz IIusing Google Forms, MCQ,True/False, Conceptual Questions, CIA II
	2	Functions of a Complex Variable-Differentiability -Analytic functions-Harmonic Functions.	3		K2(U)	Lecturing, Collaborative Learning, Peer Teaching	Think-pair-share, Group Discussion, Problem Solving-Pause-and-solve, Team-based Learning, Jigsaw method	Lecture Slides	Evaluationthroughshort test, Formative Quiz IIusing Google Forms, Written Assignment-Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
	3	Complex Integration-Contour Integration, Cauchy – Riemann conditions – Singular	4	1	K3(Ap)	Lecturing, Problem Based Learning, Peer Teaching	Think-pair-share, Problem Solving-Solving complex problems Jigsaw method	Lecture Slides, Khan Academy	Evaluationthroughshort test, Formative Quiz IIusing Google Forms, Written Assignment-

		points .							Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
	4	Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue Theorem.	4	1	K3(Ap)	Lecturing, Problem Based Learning, Peer Teaching	Think-pair-share, Group Discussion, Explaining concepts, answering questions from peers, Problem Solving- Pause and solve, Jigsaw method	You tube videos, Lecture Slides	Evaluationthroughshort test, Formative Quiz IIusing Google Forms, MCQ, True/False, Conceptual Questions, CIA II
	5	Probability- Introduction- Addition Rule oflaw of probability- Problems- Introduction to statistics- Mean, Median, mode and Standard Deviation.	4	1	K3(Ap)	Lecturing, Problem Based Learning Flipped Class room, Peer Teaching	Think-pair-share, Group Discussion, Explaining concepts, answering questions from peers, Problem Solving- Pause and solve, Jigsaw method, Collaborative problem solving sessions	Lecture Slides	Evaluationthroughshort test, Formative Quiz II using Google Forms, MCQ, True/False, Conceptual Questions, CIA II
III		**Matrices**							
	1	Types of Matrices andtheir properties, Rank of aMatrix .	4	1	K4 (An)	Lecture using Chalk and talk, structured comparison	Paired classification tasks using matrix examples	Lecture notes (Manin)	Quiz: identify/describe matrix types, CIA I, Quiz using google forms,

						of types			Problem Solving,
	2	Conjugate of a matrix - Adjoint of a matrix - Inverse of a matrix.	3		K4 (An)	Lecture , Define these via complex conjugation/transposition, Problem Solving.	Use Sage/GeoGebra for conjugate and inverse calculations	Wikipedia adjugate & conjugate transpose	Assignment, CIA I, Quiz using google forms, Problem Solving,
	3	Hermitian and Unitary Matrices -Trace of a matrix- Transformation of matrices.	4	1	K4 (An)	Lecture using Chalk and talk, Problem Solving, Demonstrate linear maps via matrix multiplication	Peer challenges: verify matrix is Hermitian/unitary	Wikipedia Hermitian, unitary notes	Homework: compute these for given matrices, CIA I, Quiz using google forms, Problem Solving,
	4	Characteristic equation -Eigen values and Eigen vectors.	3	1	K4 (An)	Derive char poly and solve examples	Group eigen-analysis with computational tools	Cuemath on Cayley-Hamilton	Quiz: real eigenvalues, orthonormality tests, CIA I, Quiz using google forms, Problem Solving,
	5	Cayley–Hamilton theorem- Diagonalization	3	1	K4 (An)	Prove using adjugate and char polynomial	Hands-on: diagonalize via similarity transforms	Number Analytics guide	Homework: diagonalize given matrices; CIA I, Quiz using google forms, Problem Solving,

IV		**Fourier Transforms and Laplace Transforms**							
	1	Definitions -Fourier transform and its inverse.	2	1	K4(An)	Lecturing, Collaborative Learning	Think-pair-share, Group Discussion, Problem Solving-Pause-and-solve, Team-based Learning,	You tube videos, Lecture Slides	Evaluationthroughshort test, Formative Quiz I using Google Forms, MCQ, True/False, Conceptual Questions, CIA I
	2	Transform of Gaussian function and Dirac delta function -Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem.	4		K5(E)	Lecturing, Collaborative Learning, Peer Teaching	Think-pair-share, Group Discussion, Problem Solving-Pause-and-solve, Team-based Learning, Jigsaw method	Lecture Slides	Evaluationthroughshort test, Formative Quiz Iusing Google Forms, Written Assignment-Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA I
	3	Application: Diffusion equation: Flow of heat inan infinite and in a semi -infinite medium – Waveequation: Vibration of an	3	1	K4(An)	Lecturing, Problem Based Learning, Peer Teaching	Think-pair-share, Problem Solving-Solving complex problems Jigsaw method	You tube videos, Lecture Slides	Evaluationthroughshort test, Formative QuizIIusing Google Forms, MCQ, True/False, Conceptual Questions, CIA II

		infinite string and of asemi - infinite string.							
	4	Laplace transform and itsinverse - Transforms ofderivatives and integrals .	2	1	K5(E)	Lecturing, Problem Based Learning, Peer Teaching	Think-pair-share, Group Discussion, Explaining concepts, answering questions from peers, Problem Solving- Pause and solve, Jigsaw method	Lecture Slides, Interactive PPT	Evaluationthroughshort test, Formative Quiz Iusing Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA I
	5	Differentiation and integration of transforms - Dirac delta functions	3	1	K5 (E)	Lecturing, Problem Based Learning, Flipped Class room, Peer Teaching	Think-pair-share, Group Discussion, Explaining concepts, answering questions from peers, Problem Solving- Pause and solve, Jigsaw method, Collaborative problem solving sessions	You tube videos, Interactive PPT, Lecture Slides	Evaluationthroughshort test, Formative Quiz I using Google Forms, MCQ, True/False, Conceptual Questions, CIA I
	6	Application - Laplace equation: Potential problem in a semi - infinite strip.	3	1	K4 (An)	Lecturing, Flipped Class room	Think-pair-share, Collaborative Problem solving sessions, application of concepts in	Lecture Slides	Evaluationthroughshort test, Formative Quiz IIusing Google Forms, Written

							everyday contexts		Assignment-Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
V		**Differential Equations**							
	1	Second order differential equation- Sturm-Lowville's theory.	2	1	K2 (U)	Lecture, Introduce general form,	Group exploration of boundary-value problems; derive eigenfunctions	Math Libre Texts & OK State PDF ; Number Analytics overview	Worksheet: solve SL problem for simple BCs; Seminar presentations; CIA II, Quiz using google forms.
	2	Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations	4		K5 (E)	Derive Hermite DE via series; use generating function; present recurrence & orthogonality	Peer-coding sessions to compute first few Hermite polynomials; verify weight orthogonality	Wikipedia on Hermite ; Mathematica tutorial ; YouTube on Rodrigues	Homework: derive H_0–H_4, verify recurrence; short quiz on generating function, Seminar presentations; CIA II, Quiz using google forms.
	3	Legendre polynomials - Generating function -Rodrigue formula –	4	1	K5 (E)	Introduce Legendre DE; use Rodrigues'	Small groups derive first polynomials; plot them and check orthogonality	Wikipedia Legendre ; Algor Cards overview	Seminar presentations; CIA II, Quiz using google

		Orthogonality properties				formula & generating function;	numerically		forms.
	4	Dirac delta function- One dimensional Green’s function and Reciprocity theorem	3	1	K5 (E)	Present δ as distribution; set up L G = δ; derive reciprocity theorem	Use computational tools to compute simple Green’s functions; compare solutions	CPM Cambridge index reference ; Special Functions PDF	Quiz on properties of δ & reciprocity; solve y"=f via Green’s function, Assignment: derive P_0–P_3, verify orthogonality on [-1,1]; quiz on generating function, Seminar presentations; CIA I, Quiz using google forms.
	5	Sturm-Liouville’s typeequation in one dimension & theirGreen’s function.	4	1	K5 (E)	Connect SL form to Green’s function derivations and physical boundary conditions	Group derivation of SL Green’s function and application	Trinity lecture PDF & UNC PDF	Problem set: construct Green’s function and solve inhomogeneous SL problems Seminar presentations; CIA I, Quiz using google forms.

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**

Activities (Em / En /SD): **Hands on Training on Problem solving.**

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Assignment: Apply theorem to compute A^{-1} of the matrices. (Last date to submit – 03-09-2025)

Seminar Topics: **Applications in Fourier Transform, Laplace Transform, Linear vector space and second order differential equation.**

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. State the difference between ket and bra notation **(K2-U, CO-1)**
2. If $f(z)= z^2- 2z + 1$, then $f(1-i)$=_____ **(K3-Ap, CO-2)**
   a. -1 b. +1 c. 0 d. i
3. Check the hermitian condition of 2x3 matrix. **(K4-An, CO-3)**
4. If $F(\lambda)$ is the fourier transform of f (x), then the fourier transform of f (ax) is _____ **(K4-An, CO-4)**
5. State one dimensional greens theorem. (K2-U, CO-5)

Part B (3 marks)

1. State and derive Gram-Schmidt orthogonalization procedure. (K2-U, CO-1)
2. Evaluate $\oint_c \frac{z^2}{(z-1)^2(z+1)^2}dz$ by applying Cauchy's Residue theorem. (K3-Ap, CO-2)
3. Derive Cayley–Hamilton equation and the application in Diagonalization. (K4-An, CO-3)
4. Prove that L (sinhat) = $\frac{a}{s^2-a^2}$(K4-An, CO-4)
5. Find out the solution for Legendre polynomials. (K2-U, CO-5)

Part C (7 marks)

1. Define vector space and explain the meaning of complete orthonormal set of basis vectors.(K1-R, CO-1)

2. Explain the multiplication law of probability. (K2-U, CO-2)
3. Analyze the characteristics of the given matrices and find out Eigen value and Eigen function. (K4-An, CO-3)
4. Discuss about the differentiation and integration of Laplace transform. (K4-An, CO-4)
5. Solve Hermite differential equation. (K5-E, CO-5)

Head of the Department
Dr. V.Shally

Course Instructor
Dr.M.Abila Jeba Queen & Dr.R.Krishna Priya

Department : Physics
Class : I M.Sc. Physics
Title of the Course : Core Course II: CLASSICAL MECHANICS AND RELATIVITY
Semester : I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP231CC2	6	-	-	-	5	6	90	25	75	100

Objectives

1. To understand fundamentals of classical mechanics.
2. To understand Lagrangian and Hamiltonian formulation of mechanics and apply it to solve equation of motion.

Course Outcomes

Upon completion of this course the students will be able to:		
CO1	Understand the fundamentals of classical mechanics.	**K2**
CO2	Apply the principles of Lagrangian mechanics to solve the equations of motion of physical systems.	**K3**
CO3	Apply the principles of Hamiltonian mechanics to solve the equations of motion of physical systems.	**K3**
CO4	Analyze the small oscillations in systems and determine their normal modes of oscillations.	**K2, K4**
CO5	Understand and apply the principles of relativistic kinematics to the mechanical systems.	**K2, K3**

3. **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Teaching plan
Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation
I	**Principles of Classical Mechanics**								
	1.	Mechanics of a single particle, mechanics of a system of particles	5	2	K2(U)	Visual and Derivation-Based Teaching using real-life examples (collisions, rocket motion)	Think-Pair-Share on collision types, Group Activity to analyze real-world momentum scenarios	YouTube – Michel van Biezen's lectures on momentum, Khan Academy modules	MCQ quiz, Group Presentation on work energy theorem, CIA I
	2.	Conservation laws for a system of particles, constraints	3		K2 (U)	Conceptual and Mathematical Pedagogy with real-world illustrations	Think-Aloud Problem Solving, Group Discussion on constraint forces, Peer Teaching on momentum/energy conservation	YouTube videos	Short derivation-based questions on constraints, Worksheet on conservation laws, Oral Quiz with diagrams, CIA I
	3.	Holonomic & non-holonomic constraints	2		K2 (U)	Conceptual Clarification through Classification and Examples, Mathematical Derivation Approach	Think-Pair-Share on identifying types of constraints in systems, Peer Comparison Exercises, Concept Mapping	NPTEL: Classical Mechanics by Prof. V. Balakrishnan, YouTube: "Holonomic vs Non-Holonomic Constraints" animations	Match-the-following activity, Short-answer conceptual quiz, CIA I
	4.	Generalized coordinates	2	1	K2 (U)	Mathematical Derivation-Based Teaching, Visual and Analytical Explanation through Coordinate Transformation	Think-Aloud Problem Solving (coordinate transformation tasks), Collaborative Derivation, Guided Inquiry	YouTube videos	Derivation assignments, Problem-based worksheet on converting to generalized coordinates, Conceptual quiz, CIA I

	5.	Transformation equations, Principle of virtual work	3		K2 (U)	Mathematical Derivation and Application-Based Pedagogy	Peer Problem Solving on constraint forces, Think-Pair-Share on virtual displacements, Concept Mapping of principles	MIT OCW – Lagrangian Mechanics Lectures, YouTube: Virtual Work explained	Derivation-based quiz on virtual work principle, Group presentation on applications, CIA I
II	**Lagrangian Formulation**								
	1.	D'Alembert's principle	3	2	K3 (Ap)	Derivation-Centric Teaching using Force Diagrams	Guided Derivation in Pairs, Think-Aloud Problem Solving on dynamic systems	YouTube: "D'Alembert's Principle – Concept & Derivation", HyperPhysics	Short derivation test, Conceptual quiz on inertial forces, CIA I
	2.	Lagrangian equations of motion for conservative systems	5		K3 (Ap)	Analytical and Derivation-Based Teaching, Use of Energy-Based Reasoning to Develop Equations of Motion	Think-Pair-Share on kinetic and potential energy identification, Problem Solving in Pairs	YouTube Videos: Lagrangian Mechanics Lectures	Conceptual quiz, Application worksheet on conservative systems, CIA I
	3.	Applications: simple pendulum	3	1	K3 (Ap)	Application-Oriented Pedagogy with Visual and Mathematical Modeling, Derivation-Driven Instruction	Hands-On Activity: Measuring pendulum period and comparing with theory, Step-by-Step Derivation in Groups	PhET Simulation: "Pendulum Lab"	short-answer quiz with graphs and equations, CIA II
	4.	Atwood's Machine, projectile motion	4		K3 (Ap)	Visualization-Based and Derivation-Driven Teaching, Real-Life Demonstration for Physical Intuition	Inquiry-Based Learning using "What if?" scenarios, Think-Pair-Share for motion equations, Group Experiment using pulley or projectile setups	PhET Simulations: "Forces and Motion", YouTube: Atwood's Machine and Projectile Motion (Michel van Biezen)	Graphical question interpretation, Derivation of motion laws, CIA II

III	**Hamiltonian Formulation**								
	1.	Phase space, cyclic coordinates, Conjugate momentum, Hamiltonian function	3	2	K3 (Ap)	Abstract-to-Concrete Approach using Graphical Visualization and Equation Derivation, Conceptual-Linking Pedagogy	Concept Mapping between Lagrangian and Hamiltonian formalisms, Think-Pair-Share on cyclic coordinates	YouTube Videos: Hamiltonian Mechanics Lectures	Derivation-based assignment on Hamilton's equations, Conceptual quiz on cyclic coordinates and conjugate momentum, CIA II
	2.	Hamilton's canonical equations of motion	3		K3 (Ap)	Derivation-Based and Structure-Oriented Pedagogy using Transition from Lagrangian to Hamiltonian Mechanics	Guided Derivation in Groups, Think-Pair-Share on physical meaning of generalized coordinates and momenta	Interactive PPT and notes	Short quiz on variable pairs (q,p), CIA II
	3.	Applications: Simple pendulum	3		K3 (Ap)	Application-Based and Analytical Pedagogy through Step-by-Step Transformation from Lagrangian to Hamiltonian framework	Collaborative Derivation of the Hamiltonian for a pendulum	Interactive PPT and notes	Derivation assignment of Hamiltonian equations for simple pendulum, CIA II
	4.	One dimensional simple harmonic oscillator	3	1	K3 (Ap)	Conceptual and Mathematical Derivation-Based Pedagogy using Energy Approach and Hamiltonian/Lagrangian Methods	Think-Aloud Problem Solving, Collaborative Derivation of SHO equations	YouTube: Simple Harmonic Oscillator (Derivation + Visualization)	Derivation assignment of Hamiltonian equations for SHO, CIA II
	5.	Motion of particle in a central force field	3		K3 (Ap)	Analytical and Visual Pedagogy using Polar Coordinates and Effective Potential Diagrams	Think-Pair-Share to identify central force characteristics, Collaborative Derivation of	Interactive PPT and notes	Derivation task (conservation of angular momentum, CIA II

							equations in polar coordinates		
IV	**SMALL OSCILLATIONS**								
	1	Formulation of the problem	5	1	K2 (U)	Derivation-Based Explanation with Examples from Coupled Oscillators	Think-Pair-Share on degrees of freedom, Group Derivation of equations	YouTube: Normal Modes and Coupled Oscillators (Michel van Biezen), NPTEL Lectures	Derivation worksheet, Quiz on basic terminology, CIA I
	2	Transformation to normal coordinates	5	1	K4 (A)	Analytical Derivation with Matrix Diagonalization Techniques	Peer Solving of matrix problems, Guided group activity on diagonalizing the system	YouTube: Diagonalizing Matrices for Oscillations, MIT OCW	Derivation-based short test, Oral quiz on coordinates, CIA I
	3	Frequencies of normal modes – Linear triatomic molecule	5	1	K3 (Ap)	Visual and Mathematical Modelling with Physical Interpretation	Concept Mapping of vibrational modes, Group Diagram Analysis	YouTube: Triatomic Molecule Vibration Analysis, PhET Simulation if available	MCQ and short answer test, Assignments with frequency calculations, CIA I
V	**Relativity**								
	1	Inertial and non-inertial frames	3	1	K2 (U)	Conceptual Introduction with Real-World Comparisons	Brainstorming on reference frames, Real-Life Example Analysis	YouTube: Classical vs. Non-Classical Frames	Conceptual quiz, Frame identification task, CIA II
	2	Lorentz transformation equations	3		K4 (A)	Step-by-Step Derivation Approach	Think-Aloud Problem Solving, Peer Quiz on transformation application	YouTube: Lorentz Transformation Explained Visually	Derivation-based test, Short problems, CIA II
	3	Length contraction and time dilation – Relativistic addition of velocities	3	1	K3 (Ap)	Visual and Formula-Based Pedagogy	Simulation analysis using examples like GPS systems, Problem-solving sessions	PhET Simulations, YouTube: Time Dilation/Length Contraction Videos	Numerical problems, Conceptual test, CIA II
	4	Einstein's mass-energy relation – Minkowski space	3	1	K3 (Ap)	Derivation-Centric and Geometric Approach	Group derivation of $E=mc^2$, Diagrams of spacetime	YouTube: Minkowski Spacetime, NPTEL on	Derivation quiz, Group poster presentation, CIA II

							structure	Relativity	
	5	Four-vectors – position, velocity, momentum, acceleration, and force in four-vector notation and their transformations	3		K3 (Ap)	Mathematical Representation with Transformation Matrices	Peer Teaching of 4-vector definitions, Group activity on transformations	MIT OCW, YouTube Lectures on 4-Vectors	Equation identification task, Oral presentation, CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development : **Employability**

Activities (Em/ En/SD): **Project**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity):-

Activities related to Cross Cutting Issues : -

Assignment : **Normal Coordinates- Formulation : Online Assignment**

Seminar Topic: **-**

Sample questions (minimum one question from each unit)

Part A

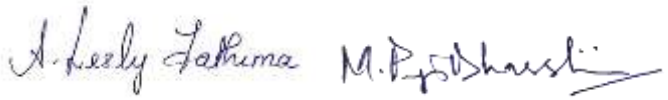
1. The total linear momentum of the system is equal to the product of total mass of the system and the velocity of..**(K2-U, CO1)**
2. An expression for principle of virtual work is_____. **(K3- Ap, CO2)**
3. The equation of motion of a simple pendulum is_____.**(K3 – Ap, CO2)**
4. The Hamiltonian of a one dimensional harmonic oscillator is ----------**(K4- A, CO3)**
5. The frequency associated with the period of motion is ---------- **(K2- U, CO5)**

Part B

1. Interpret work- kinetic energy theorem. **(K2- U, CO1)**
2. Solve the equation of motion of a simple pendulum by using Lagrangian method and hence deduce the formula for its time period for small amplitude oscillations.**(K3 – Ap, CO2)**
3. Explain the physical significance of Hamiltonian. **(K4- A, CO3)**
4. Deduce normal coordinates and normal frequencies of vibration. **(K3- Ap, CO2)**
5. Explain Lorentz transformation. **(K2-U, CO-2)**

Part C

1. Classify constraints with suitable examples.**(K2 – U, CO1)**
2. Illustrate the Lagrangian equation of motion using D'Alemberts principle.
   (K3 – Ap, CO2)
3. Formulate the Hamilton's Canonical equation of motion.**(K4- A, CO3)**
4. Discuss the free vibrations of linear triatomic molecule. **(K3 – Ap, CO2)**
5. Explain Minkowski's space. **(K4 – A, CO4)**



Head of the Department

Dr. V.Shally

Course Instructor

Dr. A. Lesly Fathima &Dr. M. Priya Dharshini

Department : Physics
Class : I M.Sc. Physics
Title of the Course : Core Course III: Linear and Digital ICs and Applications
Semester : I
Course Code : PP231CC3

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP231CC3	6	-	-	-	4	6	90	25	75	100

Learning Objectives:

1. To introduce the basic building blocks of linear integrated circuits.
2. To introduce the concepts of waveform generation and introduce one special function ICs.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1	Remember the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems	**K1 & K2**
2	Develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits.	**K2 & K3**
3	Apply knowledge about PLL, and develop the skills to design the simple circuits using IC 555 timer and can solve problems related to it.	**K2 & K5**
4	Analyze about various techniques to develop A/D and D/A converters.	**K4 & K5**
5	Evaluate and to create the knowledge about the CMOS logic, combinational and sequential circuits	**K3 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**–Create

Teaching Plan
Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Integrated Circuits and Operational Amplifier:**								
	1	Introduction; Classification of IC's	3	1	K2 (U)	Lecture with Visual Aids such as PPT, Flipped Classroom.	Inquiry-Based Learning	YouTube: Neso Academy: Introduction to IC's	Google Classroom for quizzes and discussions CIA I
	2	Basic information of Op-Amp741 and its features,	4	1	K1 (R)	Activity-Based Learning	Hands-on Approach	YouTube Lectures	MCQs via Google Forms CIA I
	3	The ideal Operational amplifier, Op-Amp Internal circuit	4		K3 (Ap)	Concept-based discussion , Problem-solving sessions using real-world applications.	Collaborative Learning, Concept Mapping	-	Conceptual quizzes via Kahoot / CIA I.
	4	Op-Amp; Characteristics.	4	1	K4 (An)	Inquiry-Based Learning-Collaborative Learning	Peer teaching	NPTEL Lecture Notes	Problem-solving CIA I.
II	**Applications of OP-AMP:**								
	1	Solution to simultaneous equations and differential equations	3	1	K3 (Ap)	Lecture ,discussion	Whiteboard Activity	-	MCQ via Hot potatoes CIA I
	2	Instrumentation amplifiers, V to I andI to V converters.	3		K6 (C)	Inquiry-Based Learning , Flipp	Think-Pair-Share	You Tube – All About Electroni	Derivation-Based Question CIA I

						ed classroom		cs	
	3	Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider	3	1	K5 (E)	Lecturing, Problem solving	Creating a map linking	Electronics Tutorials (Log/Antilog Amplifier)	Problem Solving Assignment CIA II
	4	Comparators, Schmitt trigger, Multivibrators,	3		K4(An)	Collaborative learning	Think-Pair-Share	-	Probing Questions CIA II
	5	Triangular and Square waveform generators	3	1	K5 (E)	Inquiry-Based Learning	Formulating questions, Discussing the concepts	YouTube – Ekeeda or Neso Academy	CIA II
III	**Active filters, Timer and Phase locked loops:**								
	1	Introduction, Butter worth filters –1storder, 2nd Order low pass and High pass filters	3	1	K1 (R), K2 (U)	Active Learning	Brainstorming Activity	You-tube video	Probing Questions CIA II
	2	Band pass, band Reject and all pass filters.	3		K2 (U), K3 (Ap)	Inquiry-Based Learning	Think-Pair-Share	-	Slip test CIA II
	3	Introduction to IC 555 timer, description of Functional diagram, monostable operation	2	1	K2 (U)	Reflective Pedagogical Approach	Concept Visuals / Animation	Electronics Hub – 555 Timer Functional Block	MCQ via Slido CIA II
	4	Astable operations and applications, Schmitt trigger	2		K3 (Ap)	Peer Teaching /Peeragogy	Learning by Doing	--	CIA II
	5	PLL-introduction, basic principle, phase detector/comparato r,	3	1	K3 (Ap)	Inquiry-Based Learning	Think-Pair-Share	Electronics Tutorials – PLL and Phase Detectors	Slip test CIA II

	6	Voltage controlled oscillator (IC 566), low pass filter, Monolithic PLL and applications of PLL	2		K5 (E)	Inquiry-Based Learning	Flipped classroom, KWL Chart	-	CIA II
IV	**Voltage regulator: D to A and A to D converters:**								
	1	Introduction, Series Op-Amp regulator, IC Voltage Regulators	2		K1 (R)	Inquiry-Based Learning	Concept Map :	YouTube – Electroboom	Probing Questions CIA I
	2	IC 723 general purpose regulators, Switching Regulator.	3	1	K2 (U)	Inquiry-Based Learning	In-class Problem Solving	YouTube – Neso Academy**:** "IC 723 Voltage Regulator"	MCQ through Nearpod CIA I
	3	Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R- 2RDAC	2	1	K3 (Ap)	Problem-Based Learning (PBL)	Brainstorming Section, KWL Chart	-	Class test CIA I
	4	A to D Converters, Parallel comparator type ADC, counter type ADC	3		K5 (E)	Inquiry-Based Learning	Concept Exploration	-	MCQ via google forms CIA I
	5	Successive approximation ADC and dual slope ADC, DAC an ADC Specifications.	2	1	K6 (C)	Reflective Pedagogical Approach	Collaborative circuit Design	YouTube videos	CIA I
V	**CMOS logic, combinational circuits using TTL 74XX ICs and Sequential circuits using TTL 74XX ICs:**								
	1	Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483)	3	1	K2 (U)	Problem-Based Learning (PBL)	Concept Mapping & Discussion	Interactive Tutorials	Leading Questions CIA I
	2	Comparator (IC7485), Decoder (IC74138, IC 74154) BCD to 7-segment decoder (IC7447), Encoder	3		K3 (Ap)	Reflective Pedagogical Approach	Problem Solving		MCQ CIA I

		(IC74147)							
	3	Multiplexer (IC74151), Demultiplexer (IC 74154)	2	1	K3 (Ap)	Problem-Based Learning (PBL)	Think-pair - Share	Electronics Tutorials – Demultiplexer	Descriptive Answer Test CIA II
	4	Sequential circuits using TTL 74XX ICs: Flip Flops (IC 7474,IC7473)	2		K2 (U)	Problem-Based Learning (PBL)	Concept Mapping - create maps linking flip-flop types, inputs, outputs, and characteristic equations.	-	Slip Test CIA II
	5	Shift Registers: Universal Shift Register (IC 74194), 4- bit asynchronous binary counter(IC 7493).	2	1	K5 (E)	Problem-Based Learning (PBL)	Simulation Exercises	YouTube video- Ekeeda or Neso Academy	Open Book Exam CIA II

Course Focussing on Employability/ Entrepreneurship/ SkillDevelopment: **Entrepreneurship**

Activities (En): **Problem solving in relativity**

Course Focusing on Cross Cutting Issues (Professional Ethics/HumanValues/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues :-

Assignment: Elementary ideas of general relativity.

Sample questions

Part A

1. If the output voltage is feedback to the non-inverting input terminal as part of the input, then the feedback is _____**(K1-R, CO-1)**
2. Which one of the following is an electronic circuit that generates square waves? **(K2-U, CO-2)**

a) Amplifier b) Oscillator c) Multivibrator d)Conductor

3. A ----------clipper removes the positive half-cycles of the input voltage.**(K2-U,CO-3)**
4. The practical use of binary-weighted digital-to-analog converters is limited to**(K4-An,CO5)**

a) 4-bit D/A converters b)2-bitD/A converters

c)8-bitD/A converters d)Op-amp comparators

5. A circuit with many inputs but only one output is_____**(K3-Ap,CO-5)**

a) Multiplexer b) Demultiplexer c)Encoder d)Decoder

Part B

1. Compare inverting and non-inverting operational amplifier.**(K2-U,CO-1)**

2. Determine the output waveform of an astable multivibrator.**(K2-U,CO-2).**

3. Write on quantization in signal conversion**(K5-E,CO-3)**

4. Discuss in detail about the Schmit trigger.**(K4-An,CO-4)**
5. What is a flip-flop. Compare the truth table of RS flip-flop implementing using NOR and NAND gates. **(K4-An, CO-4)**

Part C

1. Differentiate how the op-amp acts as an integrator and differentiator**(K2-U,CO-1)**

2. Determine the output waveform of a astable multivibrator.**(K3-Ap,CO-2)**

3. Explain the working of active filters as low, high and band pass first and second order filters. **(K5- E, CO- 3)**

4. Explain in detail with circuit diagram, the construction and working of an op-amp as the Triangular wave generator. **(K5- E, CO -4)**

5. Describe the working of AM receiver using a Phase-Locked Loop**.(K6-C,CO-5)**

Dr. S. Sonia & Dr. S.Virgin Jeba

Dr. V. Shally
Head & Associate Professor
Department of Physics
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Head of the Department **Course Instructors**

Department : Physics
Class : I M.Sc. Physics
Title of the Course : CORE LAB COURSE I: ADVANCED PHYSICS LAB I

Semester : I
Course Code : PP231CP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP231CP1	-	-	6	-	3	6	90	25	75	100

Learning Objectives:

1. To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
2. To calculate the thermodynamic quantities and physical properties of materials.
3. To analyze the optical and electrical properties of materials.

Course Outcomes

On the successful completion of the course, students will able to:		
1	understand the strength of material using Young's modulus.	**K2**
2	acquire knowledge of thermal behavior of the materials.	**K1**
3	understand theoretical principles of magnetism through the experiments.	**K2**
4	acquire knowledge about the applications of laser	**K1**
5	improve the analytical and observation ability in Physics experiments	**K4**

K**1**–Remember**; K2–**Understand**; K3-**Apply**; K4-**Analyze**, K5-** Evaluate**, K6-**Create

Total Contact hours: 90 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes-Cornu's Method	7	2	K1(R)& K2 (U)	Introduce the concept of elasticity and interference.	Set up the experiment, observe hyperbolic fringes, and calculate Young's modulus and Poisson's ratio.	https://www.maths.tcd.ie/~oconbhup/labs/Cornu%20Method/The%20Cornu%20Method.pdf	Lab reports evaluating data accuracy, understanding of interference patterns, and calculations, Model Practical Exam.
2	Determination of Compressibility of a liquid using Ultrasonics	7	2	K1(R)& K2 (U)	Discuss the ultrasonic interferometer's role in measuring compressibility.	Hands-on experience with the ultrasonic interferometer.	https://www.youtube.com/watch?v=HqMIxVAjnOs	Evaluation of experimental data, accuracy in calculations, and understanding of ultrasonic principles, Model Practical Exam.
3	Measurement of Conductivity - Four probe method.	7	2	K4 (An)	Discuss electrical conductivity and the significance of the four-probe method in eliminating contact	Perform measurements using the four-probe setup and analyze the resistivity	https://www.youtube.com/watch?v=ub4d7h2iXaM	Lab reports focusing on data interpretation, error analysis, and understanding of material properties,

					resistance.			Model Practical Exam.
4	Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.	6	1	K4 (An)	Introduce diffraction and interference principles.	Set up the experiment, record diffraction patterns, and calculate the laser's wavelength.	https://www.youtube.com/watch?v=ya_v3mgr79I	Evaluation based on accuracy of wavelength calculations and understanding of diffraction principles, Model Practical Exam.
5	Measurement of Susceptibility of liquid - Quincke's method	6	1	K1(R)& K2 (U)	Discuss magnetic susceptibility and its measurement using Quincke's method	Perform the experiment, observe liquid column changes in a magnetic field, and calculate susceptibility.	https://www.youtube.com/watch?v=9Z1qqhmoIQI	Lab reports assessing data accuracy, comprehension of magnetic properties, and calculation, Model Practical Exam.
6	Determine the slit width of a Fraunhofer single, double slit grating.	6	1	K1(R)& K2 (U)	Explain Fraunhofer diffraction and its application in determining slit widths.	Conduct experiments to observe diffraction patterns and calculate slit dimensions,	https://www.youtube.com/watch?v=sU6ZSGPY6jY	Evaluation of experimental setup, data accuracy, and understanding of diffraction

								concepts, Model Practical Exam.
7.	Construction of Schmidt trigger circuit using IC 741	6	1	K4 (An)	Introduce the concept of hysteresis and its implementation using a Schmitt trigger circuit.	Design and build the circuit, observe input-output waveforms, and analyze threshold voltages.	https://eopcw.com/assets/stores/Electrical%20Engineering%20Laboratory%20III/lecturenote_520626135Exp%209.pdf	Lab report with threshold measurements, waveform analysis, and comparison to theoretical hysteresis width, Model Practical Exam.
8.	Construction of sine wave using IC 741	6	1	K4 (An)	Introduce oscillator basics, comparator, integrator loops leading to sine waveform generation	Assemble the dual op-amp circuit, experiment with R/C values to vary frequency, and observe waveforms on an oscilloscope.	https://www.youtube.com/watch?v=VL1ePAhZNkM&utm_source=chatgpt.com	Include oscilloscope screenshots, frequency calculations, and design reflections in the lab report, Model Practical Exam.
9.	Study of Binary to Gray and Gray to Binary code conversion.	6	1	K4 (An)	Derive converter logic using XOR gates via truth tables	Implement both converters using XOR ICs, build truth	https://www.iitg.ac.in/cseweb/vlab/Digital-System-Lab/binary_gre	Evaluation via truth table completion, demo conversion

						tables, test all combinations, and find practical applications.	y.php?id=17&utm_source=chatgpt.com	accuracy, Model Practical Exam.
10.	Study of R-S, clocked R-S and D-Flip flop using NAND gates	6	1	K4 (An)	Cover SR latch fundamentals, then extend to clocked SR (edge-triggered) and derive the D-flip-flop using gating techniques	Construct each variant on breadboards, verify truth tables and behavior using pulse inputs and LEDs/logic probe.	https://www.geeksforgeeks.org/electronics-engineering/rs-flip-flop/?utm_source=chatgpt.com	Check correct implementation, truth table verification, Model Practical Exam.
11.	Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.	6	1	K4 (An)	Introduce binary addition, subtraction and check how 7483 supports both with a control input	Apply carry for both add/subtract modes, and interpret outputs including carry/borrow.	https://www.geeksforgeeks.org/digital-logic/4-bit-binary-adder-subtractor/?utm_source=chatgpt.com	Grading based on correct outputs and understanding of control signal role, Model Practical Exam.
12.	Study of Modulus Counter	6	1	K4 (An)	Define modulus in counters and compare synchronous vs asynchronous designs.	Design a specific Mod counter, write the diagrams and truth tables, then test on breadboard.	https://www.electronics-tutorials.ws/counter/mod-counters.html?utm_source=chatgpt.com	Evaluate correct sequence operation, state diagram accuracy, debugging process, and class presentation of

								findings, Model Practical Exam.

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (Em / En /SD): Hands on Training

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): NIL

Environment Sustainability activities related to Cross Cutting Issues: NIL

Sample questions

1. Find the velocity of ultrasonic waves inside an organic liquid using an ultrasonic interferometer. Calculate the compressibility of the liquid. Repeat the experiment for another liquid.
2. Calculate the magnetic susceptibility of the given liquids by Quincke's method.
3. Calculate the electrical conductivity and band gap of the given semiconductor materials using four probe method.
4. Determine the slit width of single, double, mess and grating using a laser beam.
5. Determine the elastic constants of the material of the given bar by forming hyperbolic fringes.
6. Measurement of wavelength of Diode Laser / He– Ne Laser using Diffraction grating.
7. Construct a sine wave generators using IC 741 and measure the frequency of oscillation in each case compare them with the theoretical values. Take at least five readings.
8. Construct a Schmidt Trigger using IC 741 and draw the hysteresis graph. Trace the input and output wave forms.
9. Design a 4 bit binary adder and subtractor using IC 7483. Verify the addition and subtraction tables.
10. Construct a mod 2, mod 3, mod 4 and mod 5, mod 6, mod 7, mod 8 mod 9 counters using a decade counter IC 7490.
11. Construct gray code to BCD and BCD to gray code converter using IC 74193 and IC 7486.
12. Construct RS, clocked RS and D flip flops using NAND gate and verify its truthtable.

Head of the Department

Dr.V.Shally & Dr.M. Abila Jeba Queen
Course Instructor

Department : Physics
Class : I M.Sc. Physics
Title of the Course : Elective Course: Energy Physics
Semester : I
Course Code : PP231EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP231EC1	5	-	-		3	5	75	25	75	100

Learning Objectives:

1. To learn about various renewable energy sources
2. To know the ways of effectively utilizing the oceanic energy
3. To study the method of harnessing wind energy and its advantages
4. To learn the techniques useful for the conversion of biomass into useful energy
5. To know about utilization of solar energy

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	identify and understand the various forms of renewable and non-renewable energy sources	**K1 & K2**
CO2	understand the principle of utilizing the oceanic energy and apply it for practical applications.	**K2 & K3**
CO3	discuss the working of a windmill and analyze the advantages of wind energy.	**K4**
CO4	Evaluate the aerobic digestion process from anaerobic digestion.	**K5**
CO5	understand the components of solar radiation, their measurement and apply them to utilize solar energy.	**K2 & K3**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Teaching Plan
Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**INTRODUCTION TO ENERGY SOURCES**								
	1	Conventional and non-conventional energy sources and their availability	4	1	K1 (R)	PPT, Illustration	Think-Pair-Share, Peer Teaching	NPTEL Videos, YouTube Lectures	Online quiz, Short answers, Concept explanations
	2	Prospects of Renewable energy sources– Energy from other sources	4	1	K3 (Ap)	Group discussion	Role Play, Brainstorming	Research articles	Group Presentation, Short essays

	3	Chemical energy– Nuclear energy	2		K5 (E)	PPT, Illustration	Case Study, Flashcards	MOOC modules, Diagrams	Descriptive answers, MCQ
	4	Energy storage and Distribution	2	1	K6 (C)	Group discussion	Chart Making, Group Projects	PDF Notes, e-Books	Online Quiz, Peer-reviewed Assignments
II	**ENERGY FROM THE OCEANS**								
	1	Energy utilization– Energy from tides	3	1	K2 (U)	PPT, Derivation discussion	Concept Mapping	NPTEL Videos	Formative Quiz using Nearpod / Kahoot / Google Forms,Written Assignment-Problem-based worksheet, Oral Presentation, Conceptual Questions, CIA I
	2	Basic principle of tidal power	3		K3 (A)	Group discussion, PPT	Debate	YouTube Lectures	Quizzes Concept check polls during class using Slido, Problem-solving worksheets CIA I
	3	Utilization of tidal energy	3	1	K4 (An)	Illustration	Role Play	e-Journals	Formative Worksheet, Visualization Task, ConceptualQuiz, Group Presentation, CIA I
	4	Principle of ocean thermal energy conversion systems	3	1	K5 (E)	Group discussion, PPT, Illustration	Brainstorming	eBooks, Research papers	Project based Presentation, Problem-Solving Assignments, Open Book

									Exam Questions, CIA II
III	**WIND ENERGY SOURCES**								
	1	Basic principles of wind energy conversion	3	1	K2 (U)	Discussion	Interactive Simulation	NPTEL Modules	Online quiz, MCQ
	2	Power in the wind– forces in the Blades	3	1	K3 (Ap)	Illustration, PPT	Model Making	YouTube Tutorials	Descriptive answers
	3	Wind energy conversion– Advantages and disadvantages of wind energy	3	1	K6 (C)	Group discussion, PPT	Peer Presentation	Web Articles	Group discussion summary
	4	Conversion systems (WECS) - Energy storage– Applications of wind energy.	3		K4 (An)	PPT, Illustration	Chart Preparation	Slide Decks	Online quiz, short answers
IV	**ENERGY FROM BIOMASS**								
	1	Biomass conversion Technologies– wet and dry process–	4	1	K1 (R)	Discussion	Case-based Learning	Videos, Articles	Quiz, Group work report
	2	Photosynthesis - Biogas Generation: Introduction–basic process	4	1	K3 (Ap)	Group discussion, PPT	Picture-based analysis	Digital Posters	MCQ, Short notes
	3	Aerobic and anaerobic digestion – Advantages of anaerobic digestion–	4	1	K5 (E)	Group Discussion	Comparison Charts	Research notes	Diagram explanation, Written review
V	**SOLAR ENERGY SOURCES**								
	1	Solar radiation and its measurements	3		K2 (U)	PPT	Lab Observation	NPTEL, Manuals	Concept tests, Objective quiz
	2	Solar cells for direct conversion of solar energy to electric power	3	1	K1 (R)	Group discussion, PPT	Virtual Lab	Animations, Online Labs	Diagram evaluation
	3	Solar cell parameters–solar cell electrical	3	1	K3 (Ap)	Group Discussion	Simulation-based	Simulation Tools	Practical problems

		characteristics– Efficiency–solar water Heater					tasks		
	4	Solar distillation– solar cooking–solar greenhouse – Solar Pond and its applications	3	1	K5 (E)	Group discussion, PPT	Poster Making	e-Articles, Video Docs	Creative assessment, Descriptive test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: **Employability**
Activities (En): **Project, Exhibition, Field visit**
Course Focusing on Cross Cutting Issues (Professional Ethics/Human Values/Environment Sustainability/ Gender Equity): - **Environment Sustainability**
Activities related to Cross Cutting Issues: - - **Field Visit**
Assignment: **Current Global Iissues – Submission through Google Classroom**
Seminar Topic: - **Sustainable Energy for Future**

Sample questions

Part A (1 mark)

1. What is the main source of nuclear energy? (K1- R, CO 1)
   A) Water
   B) Uranium
   C) Coal
   D) Natural gas

2. What is the major difference between conventional and non-conventional energy source**s?** (K2- U, CO 2)
   A) Cost
   B) Availability
   C) Usage
   D) Renewability and sustainability

3. Choose the right answer: Wind is the form of _____ energy. **(K5- E, CO3)**
   a) Renewable energy b) Non-renewable energy

4. To convert sound energy into electrical energy, which device is used? **(K6- C, CO 4)**
   a) Micro oven b) Refrigerator c) Microphones d) Compact Fluorescent Lamps

5. The SI unit of energy is _____ **(K2- U, CO 1)**
   a) Volts b) Watts c) Joule d) Radians

Part B (3 marks)

6. Explain the chemical energy. **(K5- E, CO 3)**
7. Discuss the basic principle of tidal power **(K2- U, CO 1)**
8. List the advantages and disadvantages of wind energy conversion systems **(K2- U, CO 1)**
9. Distinguish aerobic and anaerobic digestion. **(K6- C, CO 4)**

10. Write a note on characteristics of solar cell **(K4- An, CO 5)**

Part C (7 marks)

11. Describe the prospects of Renewable energy sources. **(K6- C, CO 4)**
12. Explain the principle of ocean thermal energy and its conversion systems. **(K5- E, CO 3)**
13. Explain the basic principles and working of wind energy conversion **(K6- C, CO 4)**
14. Discuss the factors affecting the bio digestion and generation of gas **(K4- An, CO 5)**
15. Describe the working of solar water Heater **(K5- E, CO 3)**

Head of the Department

Dr. V. Shally & Dr. S. Sebastiammal
Course Instructors

Department : Physics
Class : II M.Sc Physics
Title of the Course : CORE COURSE VII: CONDENSED MATTER PHYSICS
Semester : III
Course Code : PP233CC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
PP233CC1	6	-	-	5	6	90	25	75	100

Learning Objectives:

1. To gain a comprehensive understanding of the fundamental principles in condensed matter physics, including crystallography, lattice dynamics, the theory of metals, semiconductors, magnetism and superconductivity.
2. To apply advanced concepts and theories learned in condensed matter physics to analyze and interpret experimental observations and phenomena in material science.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	identify various crystal structures, symmetry and differentiate different types of bonding.	**K1**
2.	understand the lattice dynamics and apply it to concept of specific heat.	**K2**
3.	articulate different types of magnetic materials and explain the underlying phenomena.	**K3**
4.	relate the concepts of superconductivity, the underlying theories – related to current areas of research.	**K4**
5.	assess various theories of electrons in solids and their impact in distinguishing solids.	**K5**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**CRYSTAL PHYSICS**								
	1	Types of lattices - Miller indices - Symmetry elements and allowed rotations	**3**	**1**	K1(R)	Lecture with Visual Aids such as PPT, Simulation-Based Learning	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching	Video Lectures, Simulations	Formative Quiz using Google Forms, CIA I
	2	Simple crystal structures - Atomic Packing Factor- Crystal diffraction- Bragg's law	**2**		K3 (Ap)	Active learning, Flipped classroom, concept based discussions, problem solving sessions	Peer teaching Quiz, Brain storming, Explaining concepts and derivations	PowerPoint with graphical representations	Short questions CIA I
	3	Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc)	**2**	**1**	K3(Ap)	Lecture with Visual Aids such as PPT, Simulation-Based Learning**,** Blended Learning	Think-Pair-Share, Inquiry-Based Learning, simulations	Video Lectures, Power Point with graphical representations	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I
	4	Structure and properties of liquid crystals Diffraction Conditions - Laue equations	**3**		K5(E)	Visual Lecture with Graphical Derivation	Brainstorming Group discussions	Video Lecture	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I
	5	Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals	**3**	**1**	K4(An)	Lecture with Visual Aids such as PPT,Simulation-Based	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching	Video Lectures, Simulations,	Formative Quiz using Google Forms, CIA I

						Learning			
	6	Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).	**2**		K1(R)	Active learning, Flipped classroom	Brainstorming Group discussions	Video Lecture	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I
II	**LATTICE DYNAMICS**								
	1	Lattice with two atoms per primitive cell - First Brillouin zone	**3**	**1**	K2(U)	Lecture with Visual Aids such as PPT, Conceptual Demonstration**,** Flipped Classroom.	Think-Pair-Share, Inquiry-Based Learning	Video Lectures, Simulations, web tools	Formative Quiz using Google Forms, CIA I
	2	Group velocity - Long Wavelength Limit Derivation of Force Constants from Experiment	**2**		K3(A)	Lecture with visualization, Concept-based discussion, Problem-solving sessions using real-world applications.	Collaborative Learning, Concept Mapping	PowerPoint with graphical representations	Short questions CIA I
	3	Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons	**3**	**1**	K4(An)	Visual Lecture with Graphical Derivation	Think-Pair-Share, Inquiry-Based Learning	Video Lecture, Simulations, web tools	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I
	4	Phonon Heat capacity- Planck Distribution- Normal Mode Enumeration	**2**		K5(E)	Derivation based teaching, Analogical Pedagogy, Integration with	Study Analysis Peer Learning, Real-World Application	Video Lecture, web tools	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I

						Mathematical Insights			
	5	Density of States in Three Dimensions Debye's theory of lattice heat capacity	**3**	**1**	K5(E)	Lecture with visualization, Concept-based discussion, Problem-solving sessions using real-world applications	Collaborative Learning, Concept Mapping	PowerPoint with graphical representations	Short questions CIA II
	6	Thermal Conductivity - Umkalapp processes	**2**		K4(An)	Visual Lecture with Graphical Derivation	Think-Pair-Share, Inquiry-Based Learning	Video Lectures, Simulations, web tools	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA II
III	**THEORY OF METALS AND SEMICONDUCTORS**								
	1	Free electron gas in three dimensions - Electronic heat capacity -	**3**	**1**	K2(U)	Lecture with Visual Aids such as PPT, Simulation-Based Learning**,** Blended Learning	Think-Pair-Share, Inquiry-Based Learning, simulations	Video Lectures, Power Point with graphical representations	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA II
	2	Wiedemann-Franz law - Band theory of metals and semiconductors Bloch theorem -	**2**		K3(Ap)	Active learning, Flipped classroom, concept based discussions, problem solving sessions	Peer teaching Quiz, Brain storming, Explaining concepts and derivations	Power Point with graphical representations	Quizzes CIA II
	3	Kronig-Penney model -	**2**	**1**	K5(E)	Problem based Learning,	Problem solving, Derivatio	PowerPoint with	Quizzes CIA II

		Semiconductors - Intrinsic carrier concentration -				Inquiry based Learning	ns	graphical representations	
	4	Temperature Dependence Mobility - Impurity conductivity - Impurity states	**3**		K4(An)	Active learning, Flipped classroom	Brainstorming Group discussions	Video Lecture	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA II
	5	- Hall effect Fermi surfaces and construction - Experimental methods in	**3**	**1**	K1(R)	Collaborative learning Problem based learning	Problem solving, Derivations	PowerPoint with graphical representations	Quizzes CIA II
	6	Fermi surface studies - de Hass-van Alphen effect.	**2**		K4(An)	Project based learning, reflective Pedagogical approach	Collecting and analysing research data Reflecting on videos	Youtube Videos	Problem-Solving Assignments, Open Book Exam Questions, CIA II
IV	**MAGNETISM**								
	1	Diamagnetism - Quantum theory of paramagnetism -	**3**	**1**	K1(R)	Lecture with Visual Aids such as PPT, Simulation-Based Learning	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching	Video Lectures, Simulations	Formative Quiz using Google Forms, CIA II
	2	Rare earth ion - Hund's rule - Quenching of orbital angular momentum	**2**		K3 (Ap)	Active learning, Flipped classroom, concept based discussions, problem solving sessions	Peer teaching Quiz, Brain storming, Explaining concepts and derivations	PowerPoint with graphical representations	Short questions CIA II
	3	Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point	**3**	**1**	K5(E)	Lecture with Visual Aids such as PPT, Simulation-Based Learning, Blended	Think-Pair-Share, Inquiry-Based Learning, simulations	Video Lectures, PowerPoint with graphical	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA II

						Learning		representations	
	4	Exchange integral Heisenberg's interpretation of Weiss field Ferromagnetic domains	**2**		K4(An)	Visual Lecture with Graphical Derivation,	Brainstorming Group discussions	Video Lecture	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA II
	5	Bloch wall - Spin waves - Quantization Magnons - Thermal excitation of magnons -.	**2**	**1**	K1(R)	Lecture with Visual Aids such as PPT, Simulation-Based Learning	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching	Video Lectures, Simulations,	Formative Quiz using Google Forms, CIA II
	6	Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism	**3**		K4(An)	Active learning, Flipped classroom	Brainstorming Group discussions	Video Lecture	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA II
V	**SUPERCONDUCTIVITY**								
	1	Meissner effect - Critical field – Critical current - Entropy and heat capacity -	**3**	**1**	K2(U)	Lecture with Visual Aids such as PPT, Simulation-Based Learning, Blended Learning	Think-Pair-Share, Inquiry-Based Learning, simulations	Video Lectures, Power Point with graphical representations	Formative Quiz using Nearpod / Kahoot / Google Forms,CIA I
	2	Energy gap - Type I and II Superconductors - Thermodynamics of super conducting transition -	**2**		K3 (Ap)	Active learning, Flipped classroom, concept based discussions problem solving sessions	Peer teaching Quiz, Brain storming, Explaining concepts and derivations	PowerPoint with graphical representations	Quizzes CIA I

	3	London equation - Coherence length – Isotope effect - Cooper pairs	**3**	**1**	K1(R)	Problem based Learning, Inquiry based Learning	Problem solving, Derivations	PowerPoint with graphical representations	Quizzes CIA I
	4	Bardeen Cooper Schrieffer (BCS) Theory - Single particle tunnelling -	**2**		K3 (Ap)	Active learning, Flipped classroom	Brainstorming Group discussions	Video Lecture	Formative Quiz using Nearpod / Kahoot / Google Forms,CIA I
	5	Josephson tunnelling-DC and AC Josephson effects	**3**	**1**	K4 (An)	Collaborative learning Problem based learning	Problem solving, Derivations	Power Point with graphical representations	Quizzes CIA I
	6	- High temperature Superconductors – SQUIDS	**2**		K5(E)	Project based learning, reflective Pedagogical approach	Collecting and analysing research data Reflecting on videos (Application of superconductors)	Youtube Videos	Project based Presentation, Problem-Solving Assignments, Open Book Exam Questions, CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**

Activities (Em/ En/SD): **Practical and Project**

Course Focussing onCross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues:-

Assignment: (Mention Topic and Type): **Debye's theory of lattice heat capacity -descriptions through Google Classroom** (Last date to submit – 05-09-2025)

Seminar Topic: (if applicable): **Exercise Problem solving and derivation of physical parameters**

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. There are _____ type of Bravais lattice. **(K4- An, CO 5)**

a) 9 b) 12 c) 14 d) 10

2. The expression for Bragg's Law is nλ= _____. **(K2- U, CO 1)**

a) d sinθ b) d cosθ c) 2d sinθ d) 2d cosθ

3. The transmission velocity of a wave packet is _____. **(K4- An, CO3)**
4. Ferromagnetic materials exhibits magnetization even after the applied field is removed. Say True or False. **(K4- An, CO3)**
5. The superconducting transition temperature was experimentally found to vary with the isotope mass. Say true or false. **(K2- U, CO 1)**

Part B (6 marks)

6. Infer about Bravais lattice in three dimensions. **(K5- E, CO 3)**
7. Analyze the quantization of elastic waves. **(K4- An, CO 5)**
8. What do you understand by intrinsic and extrinsic semiconductors? **(K2- U, CO 1)**
9. Criticize the Antiferromagnetism. **(K6- C, CO 4)**
10. Describe Type–I and Type–II Superconductors. **(K4- An, CO 5)**

Part C (12 marks)

11. Estimate the expression for cohesive energy in ionic crystals. **(K5- E, CO 3)**
12. Explain Phonon Heat capacity and Planck Distribution. **(K2- U, CO 1)**
13. Define Bloch theorem and derive Kronig-Penney model. **(K4- An, CO 5)**
14. Discuss the Weiss Molecular (exchange) Field. **(K5- E, CO2)**
15. Construct DC Josephson Effect in superconductors Tunneling. **(K2- U, CO 1)**

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Course Instructors

Department : Physics
Class : II M.Sc. Physics
Title of the Course : Core Course VIII: Electromagnetic Theory
Semester : III
Course Code : PU233CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU233CC2	6	–	–	–	5	6	90	25	75	100

Learning Objectives:

1. To acquire knowledge about boundary conditions between two media and the technique of method of separation of variables
2. To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	understand the basic laws of electromagnetism.	**K1**
2.	recognize the behaviour of electric and magnetic fields in simple configurations under different boundary conditions.	**K2**
3.	apply the concepts of electrodynamics and derive the Maxwell's equation.	**K3**
4.	analyse the concept of propagation in linear media.	**K4**
5.	prioritize the magnetic properties of matter.	**K5**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours:90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**ELECTROSTATICS**								
	1	Coulomb's law-Electric field – field lines, flux and Gauss's Law in differential form – application of Gauss's law	3	1	K1(R) & K3 (Ap)	Lecture with Visual Aids such as PPT, Simulation-Based Learning, Conceptual Demonstration, Flipped Classroom.	Think-Pair-Share, Inquiry-Based Learning, PeerTeaching, GamifiedQuiz, Concept Mapping.	Video Lectures, Simulations, Notes/Slides, Electric Field Simulator Android app.	Formative Quiz using Nearpod / Kahoot / Google Forms,Written Assignment-Problem-based worksheet, Oral Presentation, Conceptual Questions, CIA I
	2	Curl of E - Poisson's equation-Laplace's equation -one and two	3		K2(U)	Visual Lecture with Graphical Derivation,	Problem-Solving Pairs, JigsawMethod, Guided Inquiry	Video Lecture, Simulation Tool,	Formative Worksheet, Visualization Task,

		dimensions				Mathematical Software Demonstration, Socratic Questioning, Mini-Lecture Segments	Worksheets, Think-Aloud Problem Solving, Graph Interpretation Challenge	InteractiveNotes, Maxwell's Equations app (Android/iOS) for vector calculus visualization, Problem Bank	ConceptualQuiz, Group Presentation, CIA I
	3	Boundary conditions and uniqueness theorem -solution in cartesian and spherical polar coordinates	3	1	K3(Ap)	Lecture with visualization, Concept-based discussion , Problem-solving sessions using real-world applications.	Collaborative Learning, Concept Mapping	PowerPoint with graphical representations of coordinate systems and potential surfaces, - 3D simulations for visualizing boundary surfaces, - Use of Mathematica/ Matlab/Python for plotting potential fields.	Quizzes on uniqueness theorem, coordinate transformations. Concept check polls during class using Slido, Problem-solving worksheets on Laplace's equation, CIA I.

	4	Electric displacement - gauss's law in the presence of dielectrics	3		K3(Ap)	Spiral Curriculum Approach, SocraticQuestioning, Constructivist Learning	Hands-On Demonstration (design of capacitors, insulation in cables), Problem-Based Learning, Case Study Analysis of dielectric breakdown in practical devices.	Youtube Videos of Learn Engineering – Animation-based concepts, Physics Galaxy – Conceptual clarity in field theory.	Project based Presentation, CIA I.
	5	Linear dielectrics - electrostatic energy in the presence of dielectric.	3	1	K4(An)	Analogical Pedagogy, Integration with Mathematical Insights	Peer Learning, DIY Activity, Real-World Application Projects	Online Tutorials and Notes: HyperPhysics (AllAboutCircuits	Problem-Solving Assignments, Open Book Exam Questions, CIA I
II	**MAGNETOSTATICS**								
	1	Lorentz force Law -Biot-Savart's Law –Steady currents – The magnetic field of a steady current .	3	1	K1(R) & K3(Ap)	Demonstration-based Learning: Simulations, Concept Mapping,Flipped Classroom	Peer Instruction, Blended Learning,	NPTEL Lectures, Simulations, YouTube Lectures	Poster Presentation, Practical Evaluation, Oral Viva, CIA I

	2	Effect of a magnetic field o n atomic orbits– Ampere's law in magnetized materials - Uniformly magnetized sphere	3		K2(U)	Graphical Approach for using vector diagrams and 3D field line, Illustrations for surface and volume bound currents, Think-Aloud Problem Solving: Model solution to magnetic field inside and outside the sphere.		PhET Interactive Simulations	Quick quizzes, Peer discussions and concept maps, - Diagram-based labeling tasks, CIA I
	3	divergence and curl of B -Magnetic vector potential – The vector potential –	3	1	K3(Ap)	Analogical Teaching, . Visual Demonstratio n, Historical Context, Derivation + Application-Based Learning	Model Making, Project/Activit y, Interdisciplinar y Link.	NPTEL Video Lectures	Problem-Solving Assignments, Open Book Exam Questions, CIA I
	4	Magnetostatic boundary conditions –	3		K3(Ap)	Real-world Contextualiza tion, Step-	Analogical Reasoning, Peer Teaching	PhET Interactive Simulations	Derivation-based quizzes on boundary

		Multipole expansion of the vector potential-				by-Step Scaffolded Derivation			conditions, Fill-in-the-blank concept maps for field relationships at interfaces, CIA II
	5	Magnetization - torques and forces on magnetic dipoles	1		K4(An)	Vector Field Visualisation: Using diagrams to show bound surface and volume currents, Analogy-Based Teaching: Comparing with polarization in dielectrics, Derivation-Based Learning:	Hands-On Experiments	Interactive tools for dipole interactions.	Group poster: "How Magnetic Dipoles Respond to Fields – Visual and Mathematical Views", Oral viva with field diagrams and torque direction reasoning, .CIA II
	6	Effect of a magnetic field o n atomic orbits– Ampere's law in magnetized materials -	2	1	K5 (E)	Historical-Anecdotal Method, Animation/ Graphical Aids	Simulation-Based Exploration, Group Work and Presentations,	Youtube Videos on Michel van Biezen – Step-by-step physics	Poster/chart Presentation, Short-answer conceptual questions, CIA II

		Uniformly magnetized sphere.					Compare and Connect.	derivations, Khan Academy Physics – Conceptual videos on magnetostatics.	
III	**MAXWELL EQUATIONS**								
	1	Faraday's laws of Induction - Maxwell's displacement current	3	1	K1(R) & K3 (Ap)	Mathematical Derivations, Concept Mapping	Flipped Classroom, Peer Teaching	Video Lectures	Rubric-Based Assessment, Conceptual MCQs - One-minute paper on Lenz's law application - Fill-in-the-blank vector equations, CIA II
	2	Maxwell's equations - Energy and momentum of the field	3		K2(U)	Core Conceptual Approach, Application-Based Teaching	Socratic Questioning, Analogies	Visual and animated tutorials on EM theory, Walter Lewin's Lectures on Maxwell's Equations and Radiation Pressure	Written exams: Derivations of Poynting theorem, Maxwell's wave equations - Numerical problems on energy

									density and Poynting vector, CIA II
	3	Poynting's theorem - Maxwell's stress tensor - Conservation of momentum	3	1	K3(Ap)	Concept Building, Mathematical Insights	Physical Analogy, Interactive Simulation	NPTEL Lectures	Numerical problem Exam CIA II
	4	Electromagnetic waves -Waves in one dimension – wave equation – sinusoidal waves – Reflection and transmission	3		K3(Ap)	Spiral Curriculum Approach, Concept based learning	Problem Solving	OpenCourse Ware	Quick quizzes - Concept check MCQs - Exit slips: "Describe in your own words how reflection occurs.", CIA II
	5	Polarization - scalar and vector potentials	1	1	K4(An)	Core Conceptual Approach	Concept Mapping	PhET Simulations – Light polarization, wave simulation	Oral/Viva Test CIA II
	6	Gauge Transformation - Coulomb and Lorentz gauge	2		K5 (E)	Mathematical Analysis, Physical meaning	Inquiry-Based Learning	MinutePhysics, 3Blue1Brown – Gauge	Presentation/ Poster, CIA II

								Theory Concepts	
IV	**WAVE PROPAGATION**								
	1	Electromagnetic waves in vacuum – The wave equation for E and B –	1	1	K1(R) & K3 (Ap)	Constructivist Learning, Inquiry-Based Learning	Think-Pair-Share, Simulation-Based Learning	NPTEL - Electromagnetic Theory – Prof. S.C. Dutta Roy, IIT Delhi PhET Simulations – Radio Waves & Electromagnetic Fields MIT OpenCourse Ware – Physics II: Electricity and Magnetism YouTube Channels: Michel van Biezen, MinutePhysics, Physics Galaxy	Conceptual Quiz on derivation and assumptions for wave equations, Problem Solving: Given boundary conditions, solve for E and B fields, Viva voce: Interpretation of curl and divergence in wave equations, Peer Evaluation: Group presentations on physical significance of EM wave solutions, Rubrics-

									Based Assignment, CIA II
	2	Monochromatic plane waves	1		K2(U)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning to visualize E and B vectors oscillating in phase, Think-Pair-Share: Derive wave solutions and interpret vector directions, Simulation based study using PhET to show wave behavior	PhET – Wave on a String NPTEL Lectures: Electromagnetic Theory by Prof. S.C. Dutta Roy MIT OCW – Electromagnetics and Applications	Conceptual quiz on plane wave properties (E, B orientation, phase velocity), Assignments on wave equations in vector form, Viva on directional relations between E, B, and wave vector , CIA II
	3	energy and momentum in electromagnetic waves	1		K3(Ap)	Conceptual Pedagogy, Problem-Based Learning	Application-based problems (e.g., solar radiation pressure), Group derivation tasks using Maxwell's equations	NPTEL: Energy and Momentum of EM Waves YouTube: Michel van Biezen – Poynting Vector and	Numerical problems involving Poynting vector and radiation pressure, Derivation assignment on energy

								Radiation Pressure	density, Peer review of solved derivations, CIA II
	4	Electromagnetic waves in matter – Propagation in Linear Media –	3	1	K3(Ap)	Blended Learning	Compare vacuum vs medium propagation via simulations, Think-Pair-Share to derive wave speed in dielectrics, Group worksheet on permittivity, permeability, and refractive index	PhET: Light in Linear Media, NPTEL: Electromagnetic Theory - Waves in Materials, MIT OCW resources on dielectric materials	Derivation of wave speed and impedance in dielectrics, Group report on wave propagation in different media, MCQ quiz on permittivity and wave properties, CIA II
	5	Reflection and transmission at normal incidence – Reflection and transmission at oblique incidence -	5	1	K4(An)	Application-Oriented Learning, Analytical Learning	Derivation, Interactive graphing	NPTEL: Wave Reflection & Transmission – Prof. A. Nandi, YouTube: Optics Academy – Fresnel Equations	Peer-assessed derivation and graphs, CIA II

								Explained	
	6	Propagation of waves in a rectangular wave guide - the co–axial transmission line.	4		K5 (E)	Model-Based Learning, Flipped Classroom	Assign pre-class video viewing and in-class problem-solving, Peer group project to analyze mode patterns	NPTEL: Microwave Engineering – Waveguides EM Waveguide Mode Visualizer YouTube: ECE Tutorials – Rectangular Waveguide Modes	Problems on cutoff frequency and dominant mode, Draw field configuration , Viva on TE vs TM vs TEM, CIA II
V	**RELATIVISTIC ELECTRODYNAMICS**								
	1	Special theory of relativity-Einstein's Postulates	1	1	K1(R)	Core Conceptual Approach	Historical Method – discuss Michelson-Morley experiment to introduce postulates, Think-Pair-Share – students interpret and reformulate	NPTEL: Special Relativity – Prof. V. Balakrishnan MIT OCW: 8.20 Introduction to Special Relativity YouTube:	Conceptual quiz on both postulates, Timeline assignment: pre- and post-Einsteinian physics, Short essay: "Why classical mechanics fails at

							postulates in their own words.	PBS Space Time – Einstein's Postulates	relativistic speeds", CIA II
	2	Geometry of relativity	1		K2(U)	Visual Pedagogy	Spacetime Diagrams Drawing Activity, Use of Minkowski Diagrams in pairs, 3D simulations of light cones and simultaneity lines	PhET Simulation: Moving Man (for understanding frames), Light cone visualizations : falstad.com/relativity	Draw and interpret spacetime diagrams, MCQs on light cones, interval invariance, Peer quiz on spacelike/ timelike intervals, CIA II
	3	Relativity of simultaneity-time dilation –Lorentz contraction-	3		K3(Ap)	Constructivist Learning	Interactive simulations to visualize simultaneity paradox Group derivations of Lorentz transformation Role play activity (e.g., twin paradox as a skit)	NPTEL: Time Dilation module Animations of Relativity	Derivation-based short questions, Numerical problems on time dilation, length contraction, Conceptual MCQs (train-light clock paradox), CIA II

	4	Relativistic mechanics-proper time and velocity-relativistic energy-momentum-	3	1	K3(Ap)	Problem-Based Learning	Guided problem solving sessions, Conceptual derivations in group, Numerical-based challenge quizzes	MIT OCW: Relativistic Mechanics Modules NPTEL: Relativistic Energy and Momentum	Problems involving conservation of momentum and energy, Assignments on 4-vectors , Group viva: rest mass vs relativistic mass, CIA II
	5	Kinematics-dynamics-relativistic electrodynamics-magnetism as a relativistic phenomenon -field transformation	3		K4(An)	Integrated Interdisciplinary Learning	Inter-domain linking: relate E and B transformation Interactive derivation activity on field transformations Concept maps: classical vs relativistic force equations	YouTube: MinutePhysics – Magnetism is Relativistic NPTEL: Electromagnetic Field Transformation	Derivation of E′ and B′ from Lorentz transformation, MCQs: Electric field in one frame becomes magnetic in another, Discussion-based evaluation on implications, CIA II
	6	Electrodynamics in tensor potentials - relativistic	4		K5 (E)	Abstract Mathematical Learning	Matrix representation and	NPTEL: Electromagnetic Field	Derivation of d'Alembertian for scalar

		potentials – d'Alembertian					manipulation of tensors, Coding exercise: simulation of d'Alembertian operator, Peer-led mini-lecture.	Tensor and Potentials, MIT OCW: Advanced E&M: Tensor Formulations	and vector potentials, Tensor transformation quiz, Group problem solving: show Maxwell's equations in covariant form, CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability, Skill Development**

Activities (Em / En /SD): **Hands on Training on Problem solving**

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): - Environment Sustainability activities related to Cross Cutting Issues:-

Assignment: Relativity of simultaneity(Last date to submit – example: 01-09-2025)

Seminar Topics: Gauss law in the presence of dielectrics, Ampere's law in magnetize materials, Coulomb and Lorentz gauge, energy and momentum in electromagnetic waves, relativistic potentials(only for PG)

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. Choose the expression for Laplace equation.**(K1-R, CO-1)**

   a) $\nabla^2 V=0$ b) $\nabla^2 V=\alpha E$ c) $\nabla^2 V=\rho/\varepsilon_0$ d) $\nabla V=0$.

2. State True/False.

In electrostatics, steady currents produce magnetic fields that are constant in time.

(K2-U, CO-2)

3. One of the following are the waves that are travelling in the z direction and have no x or y dependence. **(K1-R, CO-1**)

   a) EM wavesb) plane wavesc) polarized wavesd) unpolarized waves

4. Which of the following is the expression for Snell's law?**(K4-An,CO-4)**

   a)$\frac{Sin\theta_T}{Sin\theta_I} = \frac{n_1}{n_2}$ b) $\frac{Sin\theta_T}{Sin\theta_I} = \frac{n_2}{n_1}$ c) $\frac{Cos\theta_T}{Sin\theta_I} = \frac{n_1}{n_2}$ d) $\frac{Sin\theta_T}{cos\theta_I} = \frac{n_1}{n_2}$

5. What is referred as the angle at which the reflected wave completely extinguished? (**K5-E, CO4)**

   a) Incident angle b) critical angle c) Brewster's angle d) transmitted angle

Part B (3 marks)

1. Show that curl of E is zero.**(K1-R, CO-1)**
2. Illustrate that magnetic forces do no work.**(K3-Ap,CO-3)**
3. Elucidate the wave equation for E and B.**(K2-U, CO-1)**
4. Outline energy and momentum in electromagnetic waves.**(K4-An, CO-4)**
5. Evaluate time dilation.**(K5-E, CO-5)**

Part C (7 marks)

1. Explain the Laplace equation in one dimension and two dimensions. (**K1-R, CO-1)**
2. Derive an expression for the effect of magnetic field on atomic orbits.

(K2-U, CO-2)

3. State and prove Poynting's theorem.**(K3-Ap, CO-3)**
4. Outline the reflection and refraction of E.M. waves at normal incidence.**(K4-An, CO-4)**

5. Describe the relativity of simultaneity. **(K2-U, CO-1)**

Head of the Department

Dr. M.Priya Dharshini & Dr. S. Virgin Jeba
Course Instructor

Department : **Physics**
Class : **M.Sc. Physics**
Semester : **III**
Course Code : **PP233CP1**
Core Lab Course III : **ADVANCED PHYSICS LAB-III**
PROGRAMMING IN MICROPROCESSOR AND MICROCONTROLLER

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP233CP1	**-**	**-**	**6**	**-**	**5**	**6**	**90**	**25**	**75**	**100**

Pre-requisite:

Fundamentals of digital principles.

Learning Objectives:

1. To become familiar with the instruction set of Intel 8085 microprocessor and microcontroller 8051.
2. To provide practical hands on experience with Assembly Language Programming and interfacing with 8085 microprocessors.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	illustrate the features ofmicroprocessor and microcontroller in different applications.	**K1**
2.	understand the theory and working of Microprocessor, Microcontroller.	**K2**
3.	apply assembly language programming on microprocessor (Data Manipulation, Square of numbers, Counters).	**K3**
4.	devise the interfacing of microprocessor 8085 with I/O devices (A/D& D/A, Stepper motor).	**K4**
5.	evaluate and develop experiments with assembly language programming on 8085 microprocessor and 8051 microcontroller (Addition, Subtraction, Multiplication and Division).	**K5 & K6**

K1 - Remember**; K2 -** Understand**; K3 –** Apply**; K4 -** Analyze**; K5 -** Evaluate

Units	Contents	No. of Hours	Cognitive Level	Pedagogy	Assessment/ Evaluation
1	Counters using microprocessor	3	K3	Experiential Learning	Assessment through their Output
2	Wave form generation using microprocessor	3	K4	Experiential Learning	Assessment through their Output
3	Display of any character (Rolling display)	3	K2	Experiential Learning	Assessment through their

					Output
4	Code conversion using microprocessor	3	K2	Experiential Learning, Differentiated Instruction	Assessment through their Output
5	A to D converters using microprocessor	3	K4	Experiential Learning	Assessment through their Output
6	D to Aconverters using microprocessor	3	K4	Experiential Learning	Assessment through their Output
7	Number of zeros, positive, negative numbers and square of a number using 8085 microprocessor	3	K3	Experiential Learning	Assessment through their Output
8	Interfacing–Stepper motor using microprocessor	3	K4	Experiential Learning	Assessment through their Output
9	Microcontroller–Logic operations,1's and 2's compliment	3	K5	Experiential Learning, Differentiated Instruction	Assessment through their Output
10	Microcontroller–Addition, Subtraction	3	K5	Experiential Learning, Differentiated Instruction	Assessment through their Output
11	Microcontroller–Multiplication and Division	3	K5	Experiential Learning, Differentiated Instruction	Assessment through their Output
12	Assembly language program for block move operations	3	K4	Experiential Learning	Assessment through their Output
13	Assembly language program for logical operations	3	K4	Experiential Learning, Differentiated Instruction	Assessment through their Output
14	Assembly language program for Addition and Subtraction	3	K5	Experiential Learning, Differentiated Instruction	Assessment through their Output
15	Assembly language program for Multiplication and Division	3	K5	Experiential Learning, Differentiated Instruction	Assessment through their Output
16	Arranging an array of data in Ascending orders	3	K5	Experiential Learning, Differentiated Instruction	Assessment through their Output

17	Arranging an array of data in descendingorders	3	K5	Experiential Learning, Differentiated Instruction	Assessment through their Output
18	Finding the largest for any number of an array using Micro processor	3	K4	Experiential Learning, Differentiated Instruction	Assessment through their Output
19	Finding the smallest for any number of an array using Micro processor	3	K4	Experiential Learning, Differentiated Instruction	Assessment through their Output
20	Finding the search for any number of an array using Micro processor	3	K4	Experiential Learning	Assessment through their Output
Charts/ Slides/ Models/ Bookplates/ Instruments					
	Offering problem solving tasks at varying levels of complexity, Collaborative Problem Solving sessions, Applying concepts in personalized contexts **Model Exam**	30	K2,K3, K4,K5	Observation	Verifying the output

Course Focusing on Employability/ Entrepreneurship/ Skill Development:
Employability,Entrepreneurship and Skill Development
Activities for Employability, Entrepreneurship and Skill Development**:**
Hands on experience of all practical's individually and applying the concepts while doing their projects.
Course Focusing on Cross Cutting Issues: **Professional ethics**
Activities related to Cross Cutting Issues:

1. **Emphasis on Accuracy and Honesty in Data Handling.**
2. **Responsibility in Laboratory Practices**
3. **Adherence to Standards and Protocols**

Dr. V. Shally
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Head of the Department

Dr. C. Nirmala Louis & Dr. R. Krishna Priya

Staff In charge

Department : Physics
Class : II M.Sc Physics
Title of the Course : ELECTIVE COURSE IV: b): MICROPROCESSOR AND MICROCONTROLLER
Semester : III
Course Code : PP233EC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP233EC2	4	-	-	-	3	4	60	25	75	100

Learning Objectives:

1. To offer insight into the architecture and operation of microprocessor 8085A and to the techniques for interfacing I/O devices and memory with the microprocessor.
2. To introduce programming and applications for the 8085A, along with exploring the architecture and instruction sets of the 8051 microcontroller.

Course Outcomes

COs	Upon completion of this course, students will be able to:	CL
CO-1	illustrate the architecture and functionality of the 8085 microprocessor.	K1
CO-2	infer the architecture and functionality of the 8051 Microcontroller.	K2
CO-3	apply the addressing modes and data transfer scheme for 8085 microprocessor and 8051 microcontroller.	K3

CO-4	categorise instructions to develop programs for measuring various electrical and physical quantities.	**K4**
CO-5	evaluate the interfacing of microprocessors and microcontrollers and develop external devices across various applications.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours*: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**8085 ARCHITECTURE, PROGRAMMING AND PERIPHERALS**								
	1	Intel 8085 microprocessor - Pin configuration- Architecture	2	1	K1 (R)	Lecturing, Inquiry based Learning	**Participative-** Think-pair-share, Formulating Questions, Discussing the plans	Interactive PPT	Evaluation through short test, Formative Quiz I using Google Forms, MCQ, True/False, Conceptual Questions, CIA I

	2	Instruction set- Data transfer operations- Arithmetic operations - Logical operations - Branching and machine control operations	2	1	K1 (R)	Lecturing, Collaborative Learning, Blended Learning, Experiential Learning	**Participative-** Think-pair-share, Group Discussions, Online discussions, **Problem Solving**- Team Based Learning, Online problem sets **Experimental**- Lab work	Interactive PPT, Lecture Slides	Evaluation through short test, Formative Quiz I using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA I
	3	Memory and I/O interfacing- Data transfer schemes	3	1	K1 (R)	Lecturing, Collaborative Learning, Flipped Classroom	**Participative-** Think-pair-share, Group Discussions, In-class discussions, **Problem Solving**- Team Based Learning, Online problem sets	YouTube Videos, Lecture Slides	Evaluation through short test, Formative Quiz I using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA I

	4	Programmable peripheral interface – - Control group and control word– Programmable DMA controller.	2		K1 (R)	Lecturing, Collaborative Learning, Peer Teaching	**Participative-** Think-pair-share, Group Discussions, **Experimental-** Creating Teaching Aids **Problem Solving**-Team Based Learning, Jigsaw method	YouTube Videos, Lecture Slides	Evaluation through short test, Formative Quiz I using Google Forms, MCQ, True/False, Conceptual Questions, CIA I
II	**8085 INTERFACING APPLICATIONS**								
	1	8085 interrupts – Seven segment display interface	2	1	K3 (Ap)	Lecturing (Traditional)	**Participative-** In-class discussions, Q&A with instructor	PPT presentations, lecture videos	Written tests, viva voce
	2	Interfacing of Digital to Analog converter and Analog to Digital converter	2		K3 (Ap)	Active Learning	**Problem Solving** - Pause-and-solve: pose conceptual problems mid-lecture	interactive quizzes	Short problem-solving exercises, quizzes
	3	Stepper motor interface	1	1	K3 (Ap)	Collaborative Learning	**Experimental-** Group discussions, peer feedback, shared decision-making	Amrita Vishwa Vidyapeetham's Virtual Labs	Group project report, peer assessment
	4	Measurement of electrical quantities –	2	1	K3 (Ap)	Problem-Based Learning (PBL)	**Participative-** Information gap activities,	YouTube Tutorials on ammeter/vo	Problem-solving worksheets,

		Voltage and current Measurement					problem-solving tasks	ltmeter design and applications	demonstration of solutions
	5	Measurement of physical quantities – Temperature measurement and control – strain measurement.	2		K3 (Ap)	Project-Based Learning (PBL)	**Experimental** - Team project, designing a working model (e.g., 8085 DAC interface)	LabVIEW (temperatur e and strain virtual instrumentat ion)	Project reports, prototype demonstration
III	**8051 MICROCONTROLLER HARDWARE**								
	1	Introduction – Features of 8051 – 8051	1	1	K2 (U)	Inquiry-Based Learning	**Experimental** - Formulating questions, designing small experiments	Online tutorials, datasheets of ICs	Presentations, design reports
	2	Microcontroller Hardware: Pin-out 8051, Central Processing Unit, internal RAM, Internal ROM,	3		K2 (U)	Lecturing, Inquiry based Learning	**Participative-** Think-pair-share, Formulating Questions, Discussing the plans	Real-world interfacing case reports	Case analysis report, group presentation
	3	Register set of 8051 – Memory organization of 8051 – Input/ Output pins, Ports and Circuits –	3	2	K2 (U)	Blended Learning	**Participative-** Mix of online tutorials + in-person hardware labs	Online courses (e.g., NPTEL, Coursera), virtual labs	Online quizzes + in-lab performance
	4	External data memory and program memory: External program	2		K2 (U)	Flipped Classroom	**Problem Solving** - Pre-class video	Video lectures, online forums	MCQ tests, application-based short answers

		memory, External data memory.					lectures, in-class problem solving		
	Reference Books: 1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D, Mckinlay, 2008. The 8051Microcontroller and Embedded Systems, 1, (2nd Edition), Pearson Education, London.								
IV	**8051 ASSEMBLY LANGUAGE PROGRAMMING**								
	1	Addressing modes – Data transfer instructions: Instructions to Access external data memory, external ROM / program memory	3	1	K4 (An)	Lecturing, Collaborative Learning, Blended Learning, Experiential Learning	**Participative-** Think-pair-share, Group Discussions, Online discussions, **Problem Solving**- Team Based Learning, Online problem sets **Experimental**- Lab work	Interactive PPT	Evaluation through short test, Formative Quiz II using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
	2	PUSH and POP instructions, Data exchange instructions	2	1	K4 (An)	Lecturing, Collaborative Learning, Peer Teaching	**Participative-** Think-pair-share, Group Discussions, **Experimental**- Creating Teaching Aids **Problem Solving**-Team Based Learning, Jigsaw method	Interactive PPT, Lecture Slides	Evaluation through short test, Formative Quiz II using Google Forms, MCQ, True/False, Conceptual Questions, CIA II

	3	Logical instructions – Arithmetic instructions	2	1	K4 (An)	Lecturing, Collaborative Learning, Flipped Classroom	**Participative-** Think-pair-share, Group Discussions, In-class discussions, **Problem Solving**- Team Based Learning, Online problem sets	YouTube Videos, Lecture Slides	Evaluation through short test, Formative Quiz II using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
	4	Decimal arithmetic - Jump and CALL instructions: Jump, Call and subroutines.	2		K4 (An)	Lecturing, Collaborative Learning, Blended Learning, Experiential Learning	**Participative-** Think-pair-share, Group Discussions, Online discussions, **Problem Solving**- Team Based Learning, Online problem sets **Experimental-** Lab work	YouTube Videos, Lecture Slides	Evaluation through short test, Formative Quiz II using Google Forms, MCQ, True/False, Conceptual Questions, CIA II
		Reference Books: 1. Ram B, 2016. Fundamentals of Microprocessors & Microcontrollers, 1, (2nd Edition), Dhanpat Rai publications, New Delhi. 2. Nagoor Kani. A. 2017. Microprocessors & Microcontrollers, 1, (2nd Edition), McGraw Hill Education.							
V	**INTERRUPT AND INTERFACING TO EXTERNAL WORLD**								

	1	8051 Interrupts – Enabling and disabling an interrupt	2	1	K2 (U)	Lecturing, Active Learning, Peer Teaching	**Participative-** Think-pair-share, Group Discussions, **Experimental-** Classroom experiments, Models, Creating Teaching Aids **Problem Solving**-Team Based Learning, Jigsaw method	YouTube Videos, Lecture Slides	Evaluation through short test, Formative Quiz II using Google Forms, MCQ, True/False, Conceptual Questions, CIA II
	2	Interrupt priority: Nested interrupts – Software triggering – LED Seven segment display interface	2		K2 (U)	Lecturing, Active Learning, Flipped Classroom	**Participative-** Think-pair-share, Group Discussions, In-class discussions, Brain Storming, **Problem Solving**- Team Based Learning, Online problem sets	Interactive PPT	Evaluation through short test, Formative Quiz II using Google Forms, MCQ, True/False, Conceptual Questions, CIA II

	3	Interfacing of D/A converter and A/D converter - Stepper motor interface.	2	1	K5 (E)	Lecturing, Collaborative Learning, Peer Teaching, Reflective Pedagogical Approach	**Participative-** Think-pair-share, Group Discussions, **Experimental-** Creating Teaching Aids, Experimenting with different reflective techniques, **Problem Solving**-Team Based Learning, Jigsaw method	Interactive PPT	
	4	Measurement of electrical quantities – Voltage and current– Measurement of physical quantities – Temperature and strain.	3	1	K5 (E)	Lecturing, Collaborative Learning, Flipped Classroom	**Participative-** Think-pair-share, Group Discussions, In-class discussions, **Problem Solving**- Team Based Learning, Online problem sets	Interactive PPT	
	Reference Books 1. Nagoor Kani. A. 2017. Microprocessors & Microcontrollers, 1, (2nd Edition), McGraw Hill Education.								

***Total Teaching hours include 15 hours allotted for Formative and Summative Assessments**

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development**

Activities (Em / En /SD): **Problem Solving**

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Assignment: **Memory and I/O Interfacing, Data Transfer Schemes -Problem Solving**

Seminar Topics: **8051 Interrupts, Enabling and disabling an interrupt**

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. What is the function of stack pointer in 8085 microprocessor? (K1-R, CO-1)
2. The step angle of a stepper motor is defined as: (K5 - Ev, CO-5)
   A) The maximum speed of rotation B) The angle moved per input pulse
   C) The voltage applied across the motor D) The resistance of the winding
3. State True or False. A Microcontroller is a programmable digital processor with necessary peripherals. (K2-U, CO-2)
4. Name any two 16-bit registers in 8051 microcontroller? (K4-An, CO-4)
5. Which one of the following is a software interrupt? (K2-U, CO-1)
a) TRAP b) INTR c) RST 5.5 d) RST 5

Part B (6 marks)

1. Draw the timing diagram for memory read operation (K1-R, CO-1)
2. Analyze the process of interfacing ADC0800 with 8085 microprocessor. (K4-An, CO-5)
3. Describe the features of 8051 microcontroller. (K2-U, CO-2)
4. Discuss in detail about the PUSH and POP instructions of microcontroller 8051. (K4-An, CO-4)
5. Describe the interrupts of 8085 microcontroller. (K4-An, CO-5)

Part C (12 marks)

1. Explain with schematic diagram, the architecture of 8085 microprocessor (K1-R, CO-1)
2. Describe the principle of seven segment display and its interfacing with 8085 microprocessor. (K5 - Ev, CO-5)

3. With a neat sketch explain the functions of each pin of 8051 microcontroller. (K2-U, CO-2)
4. Enumerate the different addressing modes of 8051 and explain them in detail with one example for each. (K4-An, CO-4)
5. Explain the functioning of a stepper motor and its interfacing with an 8051 microcontroller. (K5 - Ev, CO-5)

Head of the Department
Dr. V. Shally

Course Instructor
Dr. R. Krishna Priya & Dr. P. Aji Udhaya

Department : Physics
Class : II M.Sc. Physics
Title of the Course : Skill Enhancement Course II: Sewage and Waste Water Treatment And Reuse

Subject code : PP233SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP233SE1	3	–	–	–	2	3	45	25	75	100

Objectives

1. To gain basic knowledge in sewage and waste water Treatment procedures
2. To gain industry exposure and be equipped to take up job.

Course Outcomes

Upon completion of this course, students will be able to: CL		
1.	identify solid waste management methods	**K2**
2.	interpret factors affecting disinfection	**K4**
3.	use advanced waste water treatment for removal of suspended solids in the nearby areas	**K4**
4.	connect to related job by gaining industry exposure	**K3**
5.	defend solid waste in and around the locality and develop entrepreneurial skills.	**K6**

Teaching plan

Total Contact hours: 45 (Including lectures, assignments and tests)

Unit	Module	Topics	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment / Evaluation
I		**RECOVERY & REUSE OF WATER**							
	1	Methods of recovery: Flocculation –	3	1	K2(U)	Lecture with diagrams and flowcharts Case-based	Think-Pair-Share Interactive quiz	YouTube videos on water treatment	Short answer questions MCQs Group

		Sedimentation-sedimentation with coagulation Filtration - sand filters - pressure filters - horizontal filters				discussion Demonstration of water treatment process Problem-solving sessions	Group poster presentation	NPTEL lectures SWAYAM course materials Animated PPTs	assignment Class discussion participation
	2	vector control measures in industries	2	1	K3(Ap)	Real-world case study analysis Discussion-based teaching Audio-visual aids Scenario-based learning	Simulation games Problem-based learning (PBL) Group investigation	Industrial hygiene manuals MOOC lectures (SWAYAM) Documentaries on industrial health safety CPCB guidelines	Case study presentation Class test
	3	chemical and biological methods of vector eradication	3	1	K4(An)	Chalk & talk with charts Lab-based experiential learning Comparison method Multimedia-supported lecture	Concept mapping Jigsaw method Science debate (Chemical vs Biological)	Animated videos showing vector life cycles WHO publications e-books on vector-borne diseases National Centre for Vector Borne Diseases Control	MCQs and true/false test Oral presentation

								(NCVBDC) site	
II	**DISINFECTION**								
	1	Introduction to disinfection and sterilization: Disinfecta UV radiation - Chlorinatio n nt	3	1	K2 (U)	Concept-based teaching with diagrams Comparative method (types of disinfection and sterilization) Case-study approach (hospital/industrial use) Demonstration using video or lab samples	Brainstorming session Think-Pair-Share activity Interactive flowchart building Small group discussion	WHO Guidelines on disinfection Animated videos on UV & chlorination (YouTube, MOOC) CDC	Quiz (MCQs & True/False) Matching activity (terms & definitions) Flowchart creation on disinfection process Group presentation
	2	Antisepsis - Sterilant - Aseptic and sterile - Bacteriostat ic and Bactericidal Factors affecting disinfection	4	1	K3 (A p)	Inquiry-based learning Cause-effect analysis Diagrammatic teaching with charts Case analysis of disinfection failure	Problem-based learning (PBL) Jigsaw activity (each group explores one factor) Peer teaching Debate (e.g., "Is temperature the most critical factor?")	Research articles from PubMed/Goo gle Scholar WHO/CDC material on environmenta l impact on disinfection Short educational videos Infographics from textbooks/we bsites	Concept map evaluation Short answer test Scenario-based case study report Poster creation and explanation
III		**CHEMICAL DISINFECTION**							
	1	Introduction - Theory of Chemical Disinfection - Chlorinatio n Other Chemical Methods Chemical	2	1	K2 (U)	Concept-based teaching with diagrams Comparative method (types of disinfection and sterilization) Case-study approach (hospital/industrial use) Demonstration using video or lab samples	Brainstorming session Think-Pair-Share activity Interactive flowchart building Small group discussion	WHO Guidelines on disinfection Animated videos on UV & chlorination (YouTube, MOOC) CDC online disinfection	Quiz (MCQs & True/False) Matching activity (terms & definitions) Flowchart creation on disinfection process

		Disinfection Treatments Requiring - Electricity				Inquiry-based learning Cause-effect analysis Diagrammatic teaching with charts Case analysis of disinfection failure	Problem-based learning (PBL) Jigsaw activity (each group explores one factor) Peer teaching Debate (e.g., “Is temperature the most critical factor?”)	training module SWAYAM/NPTEL courses on microbiology /sanitation impact on disinfection Short educational videos	Group presentation Short answer test Scenario-based case study report
	2	Coagulation / Flocculation Agents as Pretreatment	2	1	K3 (Ap)	Concept-based teaching with diagrams Comparative method (types of disinfection and sterilization) Case-study approach (hospital/industrial use) Demonstration using video or lab samples	Brainstorming session Think-Pair-Share activity Interactive flowchart building Small group discussion	WHO Guidelines on disinfection Animated videos on UV & chlorination (YouTube, MOOC) CDC online disinfection training module SWAYAM/NPTEL courses on microbiology /sanitation	Quiz (MCQs & True/False) Matching activity (terms & definitions) Flowchart creation on disinfection process Group presentation
	3	Disinfection By-Products (DBPs)	2		K4 (An)	Inquiry-based learning Cause-effect analysis Diagrammatic teaching with charts Case analysis of disinfection failure	Problem-based learning (PBL) Peer teaching Debate (e.g., “Is temperature the most critical factor?”)	WHO material on environmental impact on disinfection Short educational videos Infographics from textbooks/websites	Concept map evaluation Short answer test Scenario-based case study report Poster creation and explanation
IV	**PHYSICAL DISINFECTION**								

	1	Introduction - Ultraviolet Radiation- Solar disinfection	2	K1(R)	K3 (Ap)	Visual-based explanation with light spectrum Diagrammatic teaching Case-study based approach (rural/remote use) Concept comparison: UV vs Solar	Think-Pair-Share Case analysis in small groups Student-led explanation of UV mechanism	WHO Guidelines for solar water disinfection (SODIS) Animated videos on UV mechanism (YouTube, NPTEL) CDC & UNICEF reports on solar disinfection	Quiz (MCQs and T/F) Process flowchart creation Peer-assessed group discussion Infographic/ poster
	2	Heat Treatment - Filtration Methods - Distillation	3	K3(Ap)	K4 (An)	Sequential teaching of traditional vs modern techniques Hands-on demo/virtual lab Comparative analysis Use of visual aids and models	Lab simulation activity Group comparison charts Role play (experts from different treatment methods)	Videos on distillation/filtration (Khan Academy, YouTube) SWAYAM e-content Manuals on heat-based water purification e-book chapters from environmental engineering	Practical demo report Comparison table submission Class quiz Oral presentation
	3	Electrochemical Oxidation, Water Disinfection by Microwave Heating.	2	1	K5 (E)	Technology-enhanced teaching Real-world industrial examples Conceptual teaching with electrochemical diagrams Inquiry-based problem solving STEM-integrated teaching Energy and safety-based evaluation	Peer-led seminar Simulation exercise Group innovation challenge Role-play as inventors Critical discussion in peer groups	NPTEL and SWAYAM lectures Research papers from Science Direct Virtual simulation tools WHO reports on emerging disinfection methods	Viva or seminar assessment Project report submission Short answer test MCQs

V	**ADVANCED WASTE WATER TREATMENT**								
	1	Removal of suspended solids, Removal of dissolved solids Nitrogen removal- Phosphorus removal	3	1	K3 (Ap)	Visual explanation using sedimentation and filtration diagrams Chalk and talk + multimedia support Case-based discussion (STP/ETP) Real-world process videos Process-oriented teaching (nitrification, denitrification, chemical precipitation) Environmental impact	Group activity: compare treatment methods Think-Pair-Share Lab observation of water clarity testing Inquiry-based learning (case of nutrient pollution)	EPA & CPCB guidelines on solid removal NPTEL videos on primary and secondary treatment WHO e-learning modules SWAYAM environmental engineering content	MCQs and fill-in-the-blanks Group presentation Process diagram labelling Lab activity report Case study analysis Group discussion evaluation
	2	Advanced biological systems, Chemical oxidation	2	1	K6 (C)	Multimedia-supported lectures Inquiry-driven explanation of	Peer teaching (on different systems) Group model making Jigsaw method (each group studies one advanced system)	3D animation videos SWAYAM and NPTEL courses EPA/CPCB technical guidelines Research articles from ScienceDirect	Rubric-based evaluation of models Diagram identification quiz Peer feedback sheet

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill**
Activities (Em / En /SD): **SD**
Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity):
- Environment Sustainability activities related to Cross Cutting Issues:- **Environment Sustainability**
Assignment: (Mention Topic and Type): Solve problems, Analyse the Chemical Disinfection
Seminar Topic: Hazards faced

Sample questions (minimum one question from each unit)

Part A (2 marks)

1. What are the chemicals commonly used as flocculants?**(K2-U, CO-1)**
2. What are the forms of chlorine most commonly used in water treatment? **(K2-U, CO-1)**
3. Is the the effectiveness of sedimentation independent of the flow rate of water through the tank? **(K1-R, CO-1)**
4. In the electromagnetic spectrum which spectrum of sunlight is primarily responsible for the disinfection process? **(K2-U, CO-2)**
5. What is converted by Nitrosomonas bacteria to nitrite in the nitrification process?**(K3-Ap, CO3)**

Part B (4 marks)

1. Explain the theory on coagulation and flocculation. **(K2-U, CO-2)**
2. Analyse the advantages and disadvantages of using autoclaves for sterilization.**(K4-An, CO-4)**
3. Analyse the potential ecological impacts of introducing biological control agents into an ecosystem**(K4-An,CO3)**
4. Explain the regulatory standards for sterility in the pharmaceutical and medical device industries **(K2-U, CO-2)**
5. Design an experiment to investigate the impact of varying chlorine doses on the formation of different DBPs.**(K6-C,CO-5)**

Part C (9 marks)

1. The Maximum daily demand at a water purification plant has been estimated as 12 million litres per day. Design the dimensions of a suitable sedimentation tank (fitted with mechanical sludge removal arrangements) for the raw supplies, assuming a detention period of 6 hours and the velocity of flow as 20 cm per minute. (**K6-C, CO-5)**
2. How do coagulation and flocculation work together to remove suspended solids from water(**K2-U, CO-2)**
3. Explain the oxidation state of an element change during a chemical oxidation reaction(**K2-U, CO-2)**
4. Analyse the effect of temperature and pH on the efficiency of chemical oxidation reactions**(K4-An,CO3)**
5. How can nitrogen removal processes be optimized for small-scale or decentralized wastewater treatment systems(**K5-E,CO4)**

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Department of Physics
Holy Cross College (Autonomous)
Nagercoil - 629 004
Kanyakumari District, Tamilnadu, India

Head of the Department

Course Instructors