Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.

Accredited with A^{+} by NAAC - IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF PHYSICS

TEACHING PLAN

EVEN SEMESTER 2024 -2025

DEPARTMENT OF PHYSICS

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.

PG 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

PG 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, social and ethical responsibilities leading to sustainable development.	PEO3

PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO	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 and projects 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 and solving 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

Strong -S (3), Medium – M (2), Low – L (1)

PO-PSO mapping

POs	PSO1	PSO2	PSO3	PSO4	PSO5
PO 1	**S**	**S**	**M**	**S**	**M**
PO 2	**S**	**S**	**S**	**S**	**M**
PO 3	**S**	**S**	**S**	**M**	**S**
PO 4	**M**	**M**	**M**	**M**	**S**
PO 5	**S**	**S**	**M**	**M**	**S**
PO 6	**M**	**M**	**M**	**M**	**M**
PO 7	**S**	**S**	**M**	**M**	**S**

Eligibility Norms for Admission

A pass in the B.Sc Physics as major with the minimum of 50% in major and major related courses or equivalent examination as per the norms of Manonmaniam Sundaranar University, Tirunelveli. For SC / ST candidates a pass in B.Sc. Physics is sufficient.

Duration of the Programme: 2 years

Medium of Instruction: English

Passing minimum

A minimum of 50% in the external examination and an aggregate of 50% is required. There is no minimum pass mark for the continuous internal assessment.

Components

Courses	No of Courses	Total Marks
Core Courses	10x100	1000
Core Practical	4x100	400
Project	1x100	100
Elective courses	4x100	400
Total marks	**19x100**	**1900**

Course Structure
Distribution of Hours and Credits

(i) Curricular Courses:

Course	Sem.I	Sem.II	Sem.III	Sem.IV	Total	
					Hours	Credits
Core– Theory Core Practical	7 (5) + 6 (5) + 6 (4) 6 (3)	6 (5)+ 6 (5)+ 6 (4)	6 (5) + 6 (5) + 6 (5) 6 (4)	6 (5) + 6 (5) + 6 (3)	85	63
Elective Course	5 (3)	4 (3) 4 (3)	3(3)		16	12
Core Project				8 (7)	8	7
Skill Enhancement Course		4 (2)	3 (2)	4 (2)	11	6
Internship/ Industrial Activity			(2)		-	2
Extension Activity				(1)	-	1
Total	**30 (20)**	**30 (22)**	**30 (26)**	**30 (23)**	**120**	**91**

(ii) Co-curricular Courses

Course	SEMESTER				Total
	I	II	III	IV	Credits
Life Skill Training –I	-	(1)	-	-	1
Life Skill Training –II	-	-	-	(1)	1
Field Project	(1)		-		1
Specific Value-Added Courses	(1)		(1)		2
Generic Value-Added Courses		(1)		(1)	2
MOOC		(1)		(1)	2
Community Engagement Activity (UBA)		(1)			1

Total Number of Hours = 120
Total Number of Credits = 91 + 10

Non- academic courses are mandatory and conducted outside the regular working hours.

Course Structure

SEMESTER I

Course Code	Title of the Course	Credits	Hours
PP231CC1	Core Course I: Mathematical Physics	5	7
PP231CC2	Core Course II: Classical Mechanics and Relativity	5	6
PP231CC3	Core Course III: Linear and Digital ICs and Applications	4	6
PP231CP1	Core Lab Course I – Advanced Physics Lab I	3	6
PP231EC1	Elective Course I: a) Energy Physics	3	5
PP231EC2	Elective Course I: b) Crystal Growth and Thin Films		
PP231EC3	Elective Course I: c) Material Science		
Total		**20**	**30**

SEMESTER II

Course Code	Title of the Course	Credits	Hours
PP232CC1	Core Course IV: Statistical Mechanics	5	6
PP232CC2	Core Course V: Quantum Mechanics – I	5	6
PP232CP1	Core Lab Course II – Advanced Physics Lab II	4	6
PP232EC1	Elective Course II: a) Advanced Optics	3	4
PP232EC2	Elective Course II: b) Non-Linear Dynamics		
PP232EC3	Elective Course II: c) Quantum Field Theory		
PP232EC4	Elective Course III: a) Medical Physics	3	4
PP232EC5	Elective Course III: b) Advanced Spectroscopy		
PP232EC6	Elective Course III: c) Characterization of Materials		
PP232SE1	Skill Enhancement Course I - NME I Solar Energy Utilization	2	4
Total		**22**	**30**

SEMESTER III

Course Code	Title of the Course	Credits	Hours
PP233CC1	Core Course VI: Quantum Mechanics – II	5	6
PP233CC2	Core Course VII: Electro Magnet Theory	5	6
PP233CC3	Core Course VIII: Nuclear and Particle Physics	5	6
PP233CP3	Core Lab Course III : Numerical Methods and Computer Programming C++	4	6
PP233EC1	Elective Course IV: a) Physics of Nano Science and Technology	3	3
PP233EC2	Elective Course IV: b) Communication Electronics		
PP233EC3	Elective Course IV: c) Advanced Mathematical Physics		
PP233SE1	Skill Enhancement Course II - NME II Sewage and Waste Water Treatment and Reuse	2	3
PP233IS1	Internship/ Industrial Activity	2	-
Total		**26**	**30**

SEMESTER IV

Course Code	Title of the Course	Credits	Hours
PP234CC1	Core Course IX: Spectroscopy	5	6
PP234CC2	Core Course X: Numerical Methods and Computer Programming	5	6
PP234CP4	Core Lab Course IV: Microprocessor and Microcontroller	3	6
PP234PW1	Core Project	7	8
PP234SE1	Skill Enhancement Course III – Solid Waste Management	2	4
PP234EA1	Extension Activity	1	-
Total		**23**	**30**

Co-curricular Courses

Semester	Code	Title of the Course	Credit
I & II	PG23LST1	Life Skill Training	1
II & IV	-	MOOC	1+1
II	PG232CE1	Community Engagement Course (CEC)	1
III & IV	PG23LST2	Life Skill Training	1
I	PP231FP1	Field Project	1
I & III	PP231V01 / PP233V01	Specific Value-added Course	1+1
II & IV	PG232V01- PG232V12/ PG234V01- PG234V12	Generic Value-added Course	1+1
		Total	**10**

Specific Value added Course

S. No.	Course code	Title of the course	Total hours
I	PP231V01	Computer Maintenance	30

Examination Pattern

i) Core Course / Elective Course

Internal: External–25:75

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Components	Marks
Internal test (2) (40 marks)	10
Quiz (2) (20 marks)	5
Seminar (10 marks)	5
Assignment: (Model Making, Exhibition, Role Play, Group Discussion, Problem Solving, Class Test, Open Book Test (Minimum three items per course) (30 marks)	5
Total	**25**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4 x 1 (No choice)	4	Part A 10 x 1 (No choice)	10
Part B 3 x 4(Internal choice)	12	Part B 5 x 6 (Internal choice)	30
Part C 3 x 8 (Internal choice)	24	Part C 5 x 12 (Internal choice)	60
Total	**40**	**Total**	100

ii) Lab Course:

Ratio of Internal and External= 25:75

Total: 100 marks

Internal Components and Distribution of Marks

Internal Components	**Marks**
Performance of the Experiments	10
Regularity in attending practical and submission of records	5
Record	5
Model exam	5
Total	**25**

Question pattern

External Exam	**Marks**
Major Practical	75
Minor Practical / Spotters /Record	
Total	**75**

iii) Skill Enhancement Course

Ratio of Internal and External = 2**5: 75**

Internal Components and Distribution of Marks

Components	**Marks**
Internal test (2)	10
Quiz (2)	5
Assignment: (Model Making, Exhibition, Role Play, Album, Group Activity (Mime, Skit, Song) (Minimum three items per course)	10
Total	**25**

Question Pattern

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 2 x 2(No Choice)	4	Part A 5 x 2(No Choice)	10
Part B 3 x 4 (Open choice **Three** out of **Five**)	12	Part B 5 x 5 (Open choice any **Five** out **of Eight**)	25
Part C 1 x 9 (Open choice O**ne** out of **Three**)	9	Part C 5 x 8 (Open choice any **Five** out **of Eight**)	40
Total	**25**	**Total**	**75**

iv) Internship/ Industrial Activity

Components	**Marks**
Industry Contribution	50
Report & Viva-voce	50

Co-Curricular Courses:

(i) Life Skill Training

Internal Component

Components		Marks
Life Skill Training -I	Album (20 pages)	30
	Group Song, Mime, Skit (Group of 5students)	20
	Total	**50**
Life Skill Training -II	Case Study (30 pages)	50
	Total	**50**

External Component

Written Test	Five out of Seven (5 x 10)	50
	Total	**50**

(ii) Field Project:

Components	**Marks**
Field Work	50
Report & Viva-voce	50

(iii) Specific Value-Added Courses & Generic Value-Added Courses:

Components	**Marks**
Internal	25
External	75

(iv) Community Engagement Activity-UBA

Internal Component	
Component	**Marks**
Attendance (Field Work)	30
Participation	20
Total	**50**

External Component

Component	**Marks**
Group Project Report/ Case Study (10-15 pages in print)	50
Total	**50**

SEMESTER – I

CORE COURSE I: MATHEMATICAL PHYSICS

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

Pre-requisite:

Students should know the basic knowledge in matrices, vectors, differentiation, integration, and differential equations.

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

On the successful completion of the course, student will be able to:		
CO1	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**
CO2	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**
CO3	analyze characteristics of matrices and its different types, and the process of diagonalization.	**K4**
CO4	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**
CO5	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**

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

Units	Contents	No. of Hours
I	**Linear Vector Space** Basic concepts – Definitions- examples of vector space – Linear independence - Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure –linear operators – Dual space- ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator –Eigen values and Eigen functions – Direct sum and invariant subspace – orthogonal transformations and rotation.	**21**
II	**Complex analysis** Review of Complex Numbers -de Moivre's theorem-Functions of a Complex Variable- Differentiability -Analytic functions - Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem. Probability – Introduction – Addition rule of probability – Multiplication law of probability – Problems – Introduction to statistics – Mean, median, mode and standard deviations.	**21**
III	**Matrices** Types of Matrices and their properties, Rank of a Matrix -Conjugate of a matrix - Adjoint of a matrix - Inverse of a matrix - Hermitian and Unitary Matrices -Trace of a matrix- Transformation of matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley–Hamilton theorem –Diagonalization.	**21**
IV	**Fourier Transforms and Laplace Transforms** Definitions -Fourier transform and its inverse - Transform of Gaussian function and Dirac delta function -Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium - Wave equation: Vibration of an infinite string and of a semi - infinite string. Laplace transform and its inverse - Transforms of derivatives and integrals – Differentiation and integration of transforms - Dirac delta functions- Application - Laplace equation: Potential problem in a semi - infinite strip.	**21**
V	**Differential Equations** Second order differential equation- Sturm-Liouville's theory - Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function - Rodrigue formula – Orthogonality properties - Dirac delta function- One dimensional Green's function and Reciprocity theorem -Sturm-Liouville's type equation in one dimension & their Green's function	**21**
TOTAL		**105**

Self -Study	Isomorphism of vector space, Harmonic Functions, Rank of a Matrix Vibration of an infinite string, One dimensional Green's function

Text Books:

1. George Arfken, Hans J Weber, 2012, Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press.
2. Chattopadhyay, P.K, 2013,Mathematical Physics (2nd edition), New Age, New Delhi
3. Gupta, B.D, 2009, Mathematical Physics (4th edition), Vikas Publishing House, New Delhi.
4. Dass, H. K, Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi.

Reference Books:

1. Zill, D. G, and Cullen,M.R, 2006, Advanced Engineering Mathematics, 3rd Ed. Narosa, New Delhi.
2. Satya Prakash. (2005). Mathematical Physics. (4th ed.) New Delhi:S. Chand & Company Pvt. Ltd.

Web Resources:

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	1	2	1	3	3	1	3	1
CO2	3	2	1	1	1	2	1	3	2	1	2	1
CO3	2	2	1	1	1	2	1	3	2	1	2	1
CO4	3	2	1	1	1	2	1	3	3	1	3	1
CO5	3	2	1	1	1	2	1	3	3	1	3	1
TOTAL	14	10	5	5	5	10	5	15	13	5	13	5
AVERAGE	2.8	2	1	1	1	2	1	3	2.6	1	2.6	1

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

CORE COURSE II: CLASSICAL MECHANICS AND RELATIVITY

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

Pre requisites:

Fundamentals of mechanics, Foundation in mathematical methods.

Learning 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**

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

Units	Contents	No. of Hours
I	**Principles of Classical Mechanics:** Mechanics of a single particle – mechanics of a system of particles – conservation laws for a system of particles – constraints – holonomic &non-holonomic constraints – generalized coordinates – configuration space – transformation equations – principle of virtual work.	**18**
II	**Lagrangian Formulation:** D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.	**18**
III	**Hamiltonian Formulation:** Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) motion of particle in a central force field.	**18**
IV	**Small Oscillations:** Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.	**18**
V	**Relativity**: Inertial and non-inertial frames – Lorentz transformation equations –	**18**

	length contraction and time dilation – relativistic addition of velocities – Einstein's mass-energy relation – Minkowski's space – four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations.	
	TOTAL	**90**

Self-study	Principle of virtual work, Simple pendulum One dimensional simple harmonic oscillator, Linear triatomic molecule Einstein's mass-energy relation

Text Books:

1. H. Goldstein (2002), Classical Mechanics, 3rd Edition, Pearson Edu.
2. J. C. Upadhyaya (2014), Classical Mechanics, New Delhi: Himalaya Publishing. Co.
3. R. Resnick (1968), Introduction to Special Theory of Relativity, New Delhi: Wiley Eastern
4. R. G. Takwala and P.S. Puranik (1980), Introduction to Classical Mechanics, New Delhi: Tata – McGraw Hill
5. N. C. Rana and P.S. Joag (2001), Classical Mechanics, New Delhi: Tata – McGraw Hill

Reference Books:

1. K. R. Symon (1971), *Mechanics*, London: Addison Wesley.
2. S. N. Biswas (1999), *Classical Mechanics*, Kolkata: Books & Allied Ltd,
3. S.L. Gupta, V. Kumar and H.V. Sharma (1998), *Classical Mechanics*, Meerut: Pragati Prakashan Publications
4. Tom W.B. Kibble Frank and H. Berkshire (2004), *Classical Mechanics*, London: Imperial College press
5. Donald T. Greenwood (1997), *Classical Dynamics*, New Delhi: Dover Publication, New York.

Web Resources:

1. http://poincare.matf.bg.ac.rs/~zarkom/Book_Mechanics_Goldstein_Classical_Mechanics_optimized.pdf
2. https://pdfcoffee.com/classical-mechanics-j-c-upadhyay-2014-editionpdf-pdf-free.html
3. https://nptel.ac.in/courses/122/106/122106027/
4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/
5. https://www.britannica.com/science/relativistic-mechanics

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2.6	2.4	2.6	3	3	3	3	3
CO2	3	3	3	3	2.6	2.4	2.6	2	3	3	3	3
CO3	3	3	3	3	2.6	2.4	2.6	3	3	3	3	3
CO4	3	3	3	3	2.6	2.4	2.6	3	3	3	3	3
CO5	3	3	3	3	2.6	2.4	2.6	3	2	3	3	3
TOTAL	15	15	15	15	13	12	13	14	14	15	15	15
AVERAGE	3	3	3	3	2.6	2.4	2.6	2.8	2.8	3	3	3

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

CORE COURSE III: LINEAR AND DIGITAL ICS AND APPLICATIONS

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

Pre-requisite: Knowledge of semiconductor devices, basic concepts of digital and analog electronics

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:		
CO1	remember the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems	**K1 & K2**
CO2	develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits.	**K2 & K3**
CO3	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**
CO4	analyze about various techniques to develop A/D and D/A converters.	**K4 & K5**
CO5	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

Units	Contents	No. of Hours
I	**Integrated Circuits and Operational Amplifier:** Introduction; Classification of IC's, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit and Op-Amp; Characteristics.	**18**
II	**Applications of OP-AMP**: **Linear applications of OP-AMP:** Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters. **Non-linear applications of OP-AMP:** Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators.	**18**
III	**Active filters, Timer and Phase locked loops:** **Active filters:** Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters. **Timer and Phase locked loops:** Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage-controlled oscillator (IC 566),	**18**

	low pass filter, monolithic PLL and applications of PLL	
IV	**Voltage regulator: D to A and A to D converters:** **Voltage regulator:** Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator. **D to A and A to D converters:** Introduction, basic DAC techniques -weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.	**18**
V	**CMOS logic, combinational circuits using TTL 74XX ICs and Sequential circuits using TTL 74XX ICs:** **Combinational circuits using TTL 74XX ICs:** Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, IC 74154), BCD to 7-segment decoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), Demultiplexer (IC 74154). Sequential circuits using TTL 74XX ICs: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter (IC 7493).	**18**
TOTAL		**90**

Self-study	Basic information of Op-Amp 741, Square waveform generators Schmitt trigger, Counter type ADC, Universal Shift Register

Text Books:

1. Roy Choudhury, D., Shail Jain, B.2012. Linear Integrated Circuit, (Fourth Edition). New Age International Pvt. Ltd., New Delhi, India.
2. Sergio Franco,. 1997, Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi, India.
3. Vijayendran,V. 2008. Introduction to Integrated electronics (Digital & Analog), S. Viswanathan Printers & Publishers Private Ltd, New Delhi, India.

Reference Books:

1. Floyd,.Jain, A.2009. Digital Fundamentals, 8th edition, Pearson Education, New Delhi, India.
2. Ramakant, A.,Gayakwad. 2012. OP-AMP and Linear Integrated Circuits, ForthEdition).Prentice Hall / Pearson Education, New Delhi, India.

Web Resources:

1. https://nptel.ac.in/course.html/digital circuits/
2. https://nptel.ac.in/course.html/electronics/operational amplifier/
3. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/
4. https://www.electrical4u.com/applications-of-op-amp/
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	2	3	2	3
CO2	3	2	3	3	3	2	2	2	3	2	2
CO3	3	2	2	3	3	2	2	2	3	3	2
CO4	3	2	3	3	2	2	2	2	3	2	3
CO5	2	2	3	3	2	2	2	3	2	2	2
TOTAL	14	10	14	15	12	11	10	11	14	11	12
AVERAGE	2.8	2	2.8	3	2.4	2.2	2	2.2	2.8	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

ELECTIVE COURSE I: a) ENERGY PHYSICS

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

Prerequisites:

Knowledge of conventional energy resources

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, students will able to:		
CO1	to 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

Unit	Contents	No. of Hours
I	**INTRODUCTION TO ENERGY SOURCES** Conventional and non-conventional energy sources and their availability–prospects of Renewable energy sources– Energy from other sources–chemical energy–Nuclear energy– Energy storage and distribution.	15
II	**ENERGY FROM THE OCEANS** Energy utilization–Energy from tides–Basic principle of tidal power–utilization of tidal energy – Principle of ocean thermal energy conversion systems.	15

III	**WIND ENERGY SOURCES** Basic principles of wind energy conversion–power in the wind– forces in the Blades– Wind energy conversion–Advantages and disadvantages of wind energy conversion systems (WECS) - Energy storage–Applications of wind energy.	**15**
IV	**ENERGY FROM BIOMASS** Biomass conversion Technologies– wet and dry process– Photosynthesis -Biogas Generation: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion–factors affecting bio digestion and generation of gas- bio gas from waste fuel– properties of biogas-utilization of biogas.	**15**
V	**SOLAR ENERGY SOURCES** Solar radiation and its measurements–solar cells: Solar cells for direct conversion of solar energy to electric powers–solar cell parameter–solar cell electrical characteristics– Efficiency–solar water Heater –solar distillation– solar cooking–solar greenhouse – Solar pond and its applications.	**15**
TOTAL		**75**

Self Study	Nuclear energy, Energy conversion systems Applications of wind energy, Generation of gas- bio gas from waste fuel, Solar cooking

Text Books:

1. G.D. Rai, 1996, Non – convention sources of, 4th edition, Khanna publishers, New Delhi.
2. M.P. Agarwal, Solar Energy, S. Chand and Co., New Delhi (1983).
3. Solar energy, principles of thermal collection and storage by S. P. Sukhatme, 2nd edition, Tata McGraw-Hill Publishing Co. Lt., New Delhi (1997).

Reference Books:

1. Renewable energy resources, John Twidell and Tonyweir, Taylor and Francis group, London and New York.
2. Introduction to Non-Conventional Energy Resources -Raja et. al., Sci. Tech Publications.
3. S. Rao and Dr. ParuLekar, Energy technology.

Web Resources:

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	1	2	1	3	3	2	3	2
CO2	3	3	3	3	1	2	1	3	3	2	2	2
CO3	3	3	3	3	1	2	1	3	3	2	2	2
CO4	3	3	3	3	1	2	1	3	3	2	3	2
CO5	3	3	3	3	1	2	1	3	3	2	3	2
TOTAL	15	15	15	15	5	10	5	15	15	10	13	10
AVERAGE	3	3	3	3	1	2	1	3	3	2	2.6	2

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

ELECTIVE COURSE I: b) CRYSTAL GROWTH AND THIN FILMS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP231EC2	5	-	-	-	3	5	75	25	75	100

Pre-requisite:

Students should know the Fundamentals of Crystal Physics

Learning Objectives:

1. To acquire the knowledge on Nucleation and Kinetics of crystal growth and to study various methods of Crystal growth techniques
2. To understand the thin film deposition methods and to apply the techniques of Thin Film Formation and thickness Measurement

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	acquire the Basic Concepts, Nucleation and Kinetics of crystal growth	**K1**
CO2	understand the Crystallization Principles and Growth techniques	**K2, K4**
CO3	study various methods of Crystal growth techniques	**K3**
CO4	understand the Thin film deposition methods	**K2**
CO5	apply the techniques of Thin Film Formation and thickness Measurement	**K3, K4**

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

Units	Contents	No. of Hours
I	**UNIT I: CRYSTAL GROWTH KINETICS**: Basic Concepts, Nucleation and Kinetics of growth Ambient phase equilibrium - super saturation - equilibrium of finite phases equation of Thomson - Gibbs - Types of Nucleation - Formation of critical Nucleus - Classical theory of Nucleation - Homo and heterogeneous formation of 3D nuclei - rate of Nucleation - Growth from vapour phase solutions, solutions and melts - epitaxial growth - Growth mechanism and classification - Kinetics of growth of epitaxial films	**15**
II	**UNIT II: CRYSTALLIZATION PRINCIPLES:**Crystallization Principles and Growth techniques Classes of Crystal system - Crystal symmetry - Solvents and solutions - Solubility diagram - Super solubility - expression for super saturation - Metastable zone and introduction period - Miers TC diagram - Solution growth - Low and high temperatures solution growth - Slow cooling and solvent evaporation methods - Constant temperature bath as a Crystallizer.	**15**

III	**UNIT III: GEL, MELT AND VAPOUR GROWTH:** Gel, Melt and Vapour growth techniques Principle of Gel techniques - Various types of Gel - Structure and importance of Gel - Methods of Gel growth and advantages - Melt techniques - Czochralski growth - Floating zone - Bridgeman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapour phase growth - Physical vapour deposition - Chemical vapour deposition - Stoichiometry.	**15**
IV	**UNIT IV: THIN FILM DEPOSITION METHODS:** Thin film deposition methods of thin film preparation, Thermal evaporation, Electron beam evaporation, pulsed LASER deposition, Cathodic sputtering, RF Magnetron sputtering, MBE, chemical vapour deposition methods, Sol Gel spin coating, Spray pyrolysis, Chemical bath deposition.	**15**
V	**UNIT V: THIN FILM FORMATION**: Thin Film Formation and thickness Measurement Nucleation, Film growth and structure - Various stages in Thin Film formation, Thermodynamics of Nucleation, Nucleation theories, Capillarity model and Atomistic model and their comparison. Structure of Thin Film, Roll of substrate, Roll of film thickness, Film thickness measurement - Interferometry, Ellipsometry, Micro balance, Quartz Crystal Oscillator techniques.	**15**
	TOTAL	**75**

Self - Study	Basic concepts of crystal growth, Crystallization Principles and Growth techniques, Classes of Crystal system

Text Books:

1. Markov. V, 2004, Crystal growth for beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy (2nd edition).
2. Heinz K. Henish, 1973, “Crystal Growth in Gels”, Cambridge University Press. USA.

Reference Books:

1. J.C. Brice, 1986, Crystal Growth Process (John Wiley, New York, 1986)
2. Goswami, 2008, Thin Film Fundamentals, New Age, New Delhi.
3. Buckley, H.E, 1951, Crystal Growth, John Wiley and Sons, New York
4. Pamplin, B.R, 1980, Crystal Growth, Pergman Press, London.

Web Resources:

1. https://www.youtube.com/playlist?list=PLbMVogVj5nJRjLrXp3kMtrIO8kZl1D1Jp
2. https://www.youtube.com/playlist?list=PLFW6lRTa1g83HGEihgwcy7KeTLUuBu3WF
3. https://www.youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m
4. https://www.youtube.com/playlist?list=PLXHedI-xbyr8xIl_KQFs_R_oky3Yd1Emw
5. https://www.electrical4u.com/thermal-conductivity-of-metals/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	2	2	2	3	3	3	3	3	3
CO3	3	3	2	2	2	2	3	3	3	3	3	2
CO4	3	3	2	2	2	2	2	3	2	2	2	2
CO5	3	3	3	2	2	3	3	3	3	3	3	3
TOTAL	15	15	12	11	11	12	14	15	14	14	14	13
AVERAGE	3	3	2.4	2.2	2.2	2.4	2.8	3	2.8	2.8	2.8	2.6

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

ELECTIVE COURSE I: c) MATERIAL SCIENCE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP231EC3	5	-	-	-	3	5	75	25	75	100

Prerequisites:

Basic knowledge on different types of materials**.**

Learning Objectives:

1. To gain knowledge on optoelectronic materials.
2. To learn about ceramic processing and advanced ceramics.
3. To understand the processing and applications of polymeric materials.
4. To gain knowledge on the fabrication of composite materials.
5. To learn about shape memory alloys, metallic glasses and nanomaterials.

Course Outcomes

On the successful completion of the course, students will able to:		
CO1	acquire knowledge on optoelectronic materials	**K1**
CO2	be able to prepare ceramic materials	**K3**
CO3	be able to understand the processing and applications of polymeric materials	**K2& K3**
CO4	be aware of the fabrication of composite materials	**K5**
CO5	be knowledgeable of shape memory alloys, metallic glasses and nanomaterials	**K1**

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

Units	Contents	No. of Hours
I	**OPTOELECTRONIC MATERIALS**: Importance of optical materials – properties: Band gap and lattice matching – optical absorption and emission – charge injection, quasi-Fermi levels and recombination – optical absorption, loss and gain. Optical processes in quantum structures: Inter-band and intra-band transitions Organic semiconductors. Light propagation in materials – Electro-optic effect and modulation, electro-absorption modulation – exciton quenching.	**15**
II	**CERAMIC MATERIALS:** Ceramic processing: powder processing, milling and sintering – structural ceramics: zirconia, almina, silicon carbide, tungsten carbide – electronic ceramics – refractories – glass and glass ceramics.	**15**
III	**POLYMERIC MATERIALS**: Polymers and copolymers – molecular weight measurement – synthesis: chain growth polymerization – polymerization techniques – glass transition temperature and its measurement – viscoelasticity – polymer processing techniques – applications: conducting polymers, biopolymers and high temperature polymers.	**15**

IV	**COMPOSITE MATERIALS**: Particle reinforced composites – fiber reinforced composites – mechanical behavior – fabrication methods of polymer matrix composites and metal matrix composites – carbon/carbon composites: fabrication and applications.	**15**
V	**NEW MATERIALS**: Shape memory alloys: mechanisms of one-way and two-way shape memory effect, reverse transformation, thermo-elasticity and pseudo-elasticity, examples and applications -bulk metallic glass: criteria for glass formation and stability, examples and mechanical behavior - nanomaterials: classification, size effect on structural and functional properties, processing and properties of Nano crystalline materials, single walled and multi walled carbon nanotubes	**15**
TOTAL		**75**

Self Study	Inter-band and intra-band transitions, Electronic ceramics Viscoelasticity, Fiber reinforced composites, Nanomaterials: classification

Text Books:

1. Jasprit Singh, 2007, Electronic and optoelectronic properties of semiconductor structures. Cambridge University Press, Cambridge.
2. Raghavan, V, 2003, Materials Science and Engineering,(4th Edition), Prentice- Hall India, New Delhi. (For units 2,3,4 and 5)
3. Arumugam, M, 2002, Materials Science, (3rd revised Edition), Anuratha Agencies.

Reference Books:

1. Narula, G.K., Narula, K.S., and Gupta, V.K., 1988. Materials Science. Tata McGraw-Hill.
2. Mallick, P. K., 2008, Fiber-Reinforced Composites, CRC Press.

Web Resources :

1. https://onlinecourses.nptel.ac.in/noc20_mm02/preview
2. https://nptel.ac.in/courses/112104229
3. https://archive.nptel.ac.in/courses/113/105/113105081
4. https://nptel.ac.in/courses/113/105/113105025/
5. https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_(Materials_Science)/Electronic_Properties/Lattice_Vibrations

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	1	2	1	3	3	2	3	2
CO2	3	3	3	3	1	2	1	3	3	2	2	2
CO3	3	3	3	3	1	2	1	3	3	2	2	2
CO4	3	3	3	3	1	2	1	3	3	2	3	2
CO5	3	3	3	3	1	2	1	3	3	2	3	2
TOTAL	15	15	15	15	5	10	5	15	15	10	13	10
AVERAGE	3	3	3	3	1	2	1	3	3	2	2.6	2

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

CORE LAB COURSE I: ADVANCED PHYSICS LAB I

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

Prerequisites:

Knowledge and hands on experience of basic general and electronics experiments of Physics.

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:		
CO1	understand the strength of material using Young's modulus.	**K2**
CO2	acquire knowledge of thermal behaviour of the matetials.	**K1**
CO3	understand theoretical principles of magnetism through the experiments.	**K2**
CO4	acquire knowledge about the applications of laser	**K1**
CO5	improve the analytical and observation ability in Physics experiments	**K4**
CO6	analyze various parameters related to operational amplifiers.	**K4**
CO7	understand the concepts involved in arithmatic and logical circuits using IC's	**K2**
CO8	acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits	**K3**
CO9	analyze the applications of counters and registers	**K4**

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

Contents

(Any Twelve Experiments)

1. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes - Cornu's Method
2. Determination of Compressibility of a liquid using Ultrasonics
3. Measurement of Conductivity - Four probe method.
4. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
5. Measurement of Susceptibility of liquid - Quincke's method
6. Determine the slit width of a Fraunhofer single, double slit grating.
7. Construction of Schmidt trigger circuit using IC 741

8. Construction of sine wave Triangular wave generator using IC 741
9. Study of Binary to Gray and Gray to Binary code conversion.
10. Study of R-S, clocked R-S and D-Flip flop using NAND gates
11. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
12. Study of Modulus Counter
13. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
14. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
15. Measurement of Coefficient of linear expansion- Air wedge Method
16. Measurement of Band gap energy- Thermistor
17. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
18. Study of J-K, D and T flip flops using IC 7476/7473
19. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
20. Study of Arithmetic logic unit using IC 74181.
21. Construction of Encoder and Decoder circuits using ICs.

Text Books:

1. Singh, S.P, 2019, Advanced Practical Physics, Pragati Prakasan, India.
2. Anavas, K,2008, Electronic lab manual, Vol I, Rajath Publishing Kochi.
3. Kuriachan T.D and Syam Mohan,2010, Electronic lab manual Vol II, Ayodhya Publishing, India.

Reference Books:

1. Ramakanth A Gaykwad,Op-Amp and linear integrated circuit, Eastern Economy Edition.
2. Sirohi, R.S,1985, A course on experiment with He-Ne Laser, John Wiley & Sons Pvt. Ltd, Asia.
3. Chattopadhayay, D and Rakshit, C.R,1990, An advanced course in Practical Physics, New Central Book Agency Pvt. Ltd, Calcutta.

SEMESTER I
SPECIFIC VALUE ADDED COURSE

COMPUTER MAINTENANCE

Course Code	Credits	Total Hours	Total Marks
PP231V01	**1**	**30**	**100**

Learning Objectives

(i). Students will be able to analyse problems associated with PC components and provide solutions to troubleshoot and isolate the problems.

(ii). Students will be able to identify early detection of issues

(iii) Students will be able to prevent Viruses and Malware and Speed up their Computer

COs	Upon completion of this course, students will be able to:	
CO- 1	understand the basic components of a computer	**K1**
CO- 2	install different types of operating systems	**K2**
CO- 3	to assemble and disassemble a personal computer	**K3**
CO- 4	to troubleshoot the problems	**K3**

Unit I: Computer Hardware

Introduction to Computer Hardware - Parts of Computer - Motherboard: Block Diagram- Types -Identification of Ports, Chip, Slot, Connector - Computer Assembling & Dissembling - How to Upgrade Computer.

Unit II: Computer Software

Introduction to windows, Identification of windows - Windows Installation (win 7, 8, & 10) without data loss - Driver Installation (offline / online) - Software Installation - Hard Disk Partition - Windows Backup & Restore

Unit III: Soldering and Desoldering

Removing component from motherboard - Fixing component from motherboard - Changing Port & Slot from motherboard - Removing& fixing all ICs from motherboard

Unit IV: Fault Finding and Repairing in External Hardware

Keyboard Problem - Mouse Problem- Battery Problem - Overheating Problem - Hard Disk Problem - USB Problem - LAN Problem - Monitor Problem - Display White Problem - Blue Screen Problem - Shorting Problem

Unit V: Fault Finding and Repairing ComputerInternal

Windows Problem - Software Problem - Network Problem - Virus Problem – Antivirus - RAM Problem - Slow Working Problem - Hang Problem – Restart Problem - Control Panel Setting- Data recovery -Password Breaking

Benefit and Outcome

Students would become capable to process and monitors the system's capability to deliver services, records problems for analysis, takes corrective, adaptive, perfective, and preventive actions, and confirms restored capability.

Reference Books

1.Upgrading and Repairing PCs 22nd Edition, First Edition (2017), Scott Muelle, McGraw Hill Education

2.Simple Practical Hacks to Optimize, Speed Up and Make Computer Faster (2019), Hack, Khanna Publishers

3.A Simple Guide to Computer Maintenance and Troubleshooting First Edition (2019),AdaneNegaTarekegn, AlemuKumilachewTegegne, McG

SEMESTER – I

LIFE SKILL TRAINING – I ETHICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PG23LST1	1				1	1	15	-	50	100

Prerequisites: Value education-its purpose and significance in the present world

Learning Objectives

1. To familiarize students with values of the individual, society, culture, one's own health and life philosophy,

2. To impart knowledge of professional ethical standards, codes of ethics, obligations, safety, rights, and other worldwide challenges.

Course Outcomes	On completion of this course the student will be able to	
CO1	understand deeper insight of the meaning of their existence.	K1
CO2	recognize the philosophy of life and individual qualities	K2
CO3	acquire the skills required for a successful personal and professional life.	K3
CO4	develop as socially responsible citizens.	K4
CO5	create a peaceful, communal community and embrace unity.	**K3**

Unit	Contents	No. of Hours
I	**Goal Setting:** Definition - Brainstorming Session – Setting Goals – Few components of setting goals.	**3**
II	**Group Dynamics:** Definition - Nature of Groups – Types of Groups – Determinants of group behavior	**3**
III	**Conflict Resolution:** Definition – What is a conflict resolutio – Why should conflicts be resolved? - Lessons for life	**3**
IV	**Decision Making:** Definition – 3C's of decision making – Seven Steps to effective decision making – Barriers in effective decision making	**3**
V	**Anger Management:** Effects of anger – Tips to reduce anger – Anger warning signs – Identify your triggers – Ways to cool down your anger.	**3**
TOTAL		**15**

Self-Study Portion: Salient values for life, Human Rights, Social Evils and how to tackle them, Holistic living, Duties and responsibilities.

Textbooks

Life Skill Training – I Ethics, Holy Cross College (Autonomous), Nagercoil

Reference Books

1. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.
2. Mathew, Sam (2010). Self Help Life Book. Opus Press Publisher.
3. Swati Mehrotra. (2016). Inspiring Souls Moral Values and Life Skills (1st ed.) [English]. Acevision Publisher Pvt. Ltd.
4. Irai Anbu, v. (2010, August). Random Thoughts (1st ed.) [English]. THG Publishing Private Limited, 2019.
5. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.

Web Resources

1. https://positivepsychology.com/goal-setting-exercises/
2. https://www.gov.nl.ca/iet/files/CCB_GroupDynamicsGuide.pdf
3. https://en.wikipedia.org/wiki/Conflict_resolution
4. https://asana.com/resources/decision-making-process
5. https://www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/anger-management/art-20045434

Teaching Plan

Department : Physics
Class : II M.Sc. Physics
Title of the Course: Statistical Mechanics
Semester : II
Course Code: PP232CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP232CC1	6	-	-	-	5	6	90	25	75	100

Learning Objectives:

1. To identify the relationship between statistic and thermodynamic quantities.
2. To comprehend the concept of partition function, canonical, grand canonical ensembles, ideal, real gases and fluctuations.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
CO1	examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition	**K1 & K2**
CO2	interpret the macroscopic properties such as pressure, volume, temperature, specific heat, elastic module etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc. describe the peculiar behaviour of the entropy by mixing two gases. relate the connection between statistics and thermodynamic quantities	**K2& K3**
CO3	distinguish canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function	**K3 & K4**
CO4	analyze and apply the different statistical concepts to assess the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish the three types of statistics.	**K4& K5**
CO5	evaluate and generalise the thermodynamical behaviour of gases under fluctuation and also using Ising model	**K5& K6**

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

Modules

Total contact hours: 90 (Including lectures, assignment and tests)

Unit	Module	Topics	Teaching hours	Cognitive Level	Pedagogy	Assessment/ Evaluation
I	**Phase Transitions**					
	1	Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications	5	K2 (U)	PPT using GAMMA AI, Descriptive lecture and Group Discussion	Evaluation through: SLIDO Problem solving Descriptive answers Short questions Formative assessment (I CIA)
	2	Third law of Thermodynamics: Nernst Heat Theorem. Order parameters - Landau's theory of phase transition	4	K3 (Ap)	Illustration, Descriptive lecture, Problem Solving	
	3	Critical indices - Scale transformations and dimensional analysis:	3	K2 (U)	Illustration, Lecture using Chalk and Talk	
	4	Scaling Hypothesis - Universality of Critical Behaviour- Law of Corresponding states	3	K3 (Ap)	Illustration, Descriptive lecture, Problem Solving	
II	**Statistical Mechanics and Thermodynamics**					

	1	Foundations of statistical mechanics - Specification of states of a system: Microscopic and Macroscopic States - Phase space – Liouville's theorem-	4	K2 (U)	PPT using GAMMA AI, Illustration, Descriptive Lecture	Evaluation through: MENTIMETER Short questions Descriptive answers Problem solving Formative assessment (I&II CIA)
	2	Microcanonical ensemble: Isolated systems- Microcanonical distribution - Principle of Equal a Priori Probabilities - Entropy	4	K3 (Ap)	Lecture, Seminar	
	3	Connection between statistics and thermodynamics - Entropy of an ideal gas using the micro canonical ensemble -	4	K3 (Ap)	Descriptive lecture , Problem Solving	
	4	Entropy of mixing and Gibb's paradox.	3	K4 (A)	Descriptive lecture, seminar	

III	**Canonical and Grand Canonical Ensembles**					
	1	Canonical and grand canonical ensembles: Systems at fixed temperature- Systems with fixed chemical potential	4	K2 (U)	Illustration, Descriptive lecture	Evaluation through: quiz, Problem Solving, short questions
	2	Trajectories and density of states: Canonical and Grand Canonical distribution - Equipartition theorem	4	K3 (Ap)	Lecture using Chalk and Talk, Seminar	
	3	Quantum Canonical Partition function - Calculation of statistical quantities – Free energy of an ideal gas-	4	K3 (Ap)	Descriptive lecture , Problem Solving	

	4	Thermodynamic functions- Energy and density fluctuations.	3	K4 (A)	Group Discussion, Lecture, seminar	Descriptive answers Formative assessment (I CIA)
IV	**Classical and Quantum Statistics**					
	1	Statistical density matrix – Equilibrium Statistical ensemble - Statistics of indistinguishable particles – The ideal gases in the microcanonical ensemble	5	K3 (Ap)	PPT using SLIDESPILOT Illustration, Descriptive lecture.	Evaluation through quiz, Descriptive answers
	2	Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy: Weakly degenerate – strongly degenerate –	5	K4 (A)	Lecture, Group discussion , Demonstration, Problem Solving	Short questions Assignment, Formative assessment (II CIA)
	3	Bose Einstein statistics – Black-body radiation: The Photon Gas- Planck radiation formula - Ideal Bose gas – Bose Einstein condensation.	5	K4 (A)	Lecture, Seminar using STEVE.AI	
V	**Real Gas, Ising Model and Fluctuations**					

	1	Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model -	4	K3 (Ap)	PPT Illustration, Descriptive lecture	Evaluation through: quiz, short questions
	2	Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one dimension.	4	K4 (A)	Descriptive lecture , Problem Solving	Descriptive answers
	3	Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena -	4	K4 (A)	Descriptive lecture, Seminar, Assignment	Problem solving
	4	Brownian motion - Langevin's theory – Fluctuation dissipation theorem - The Fokker-Planck equation	3	K4 (A)	Illustration, Descriptive lecture	Formative assessment (II CIA)

PO- Program outcome; LO – Learning outcome; Cognitive Level U – Understand; Ap- Apply; A- Analyze; C-Create

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 : **Fluctuations and transport phenomena: Online Assignment**

Seminar Topic: **Ideal Fermi gas – Degeneracy: Weakly degenerate**

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. Microscopic parameters of a system those which are independent of size of the system is called _____. **(K2-U, CO1)**

a) Intensive b) Extensive c) Additive d) Multiplicative.

2. The ensemble distribution according to Gibb's microcanonical distribution function is called a _____.**(K3- Ap, CO2)**

a) canonical ensemble b) Microcanonical ensemble c) Partition function d) Grand canonical ensemble

3. Chemical potential of boson is _____ **(K3 – Ap, CO2)**

4. State Virial theorem. **(K2- U, CO1)**

5. In P-T diagram, the state in which three phases co-exist will be represented on the phase boundary line by a point called _____. **(K2- U, CO5)**

Part B (6 marks)

1. Interpret microstates and macrostates. **(K2- U, CO1)**

2. How is grand canonical and canonical partition functions related? **(K4 – Ap, CO2)**

3. A Fermi Dirac gas has two particles in the i^{th} state whose degeneracy is three. Find out the number of independent ways of selecting the particles in the state. **(K6-C, CO3)**

4. Explain Joule Thompson process. **(K4-A, CO4)**

5. Depict the phase diagram for pure system. **(K2-U, CO-5)**

Part C (12 marks)

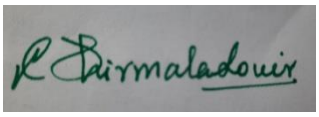
1. Describe the basic postulates of Thermodynamics. **(K2 – U, CO1)**

2. Apply the concept of Gibb's Paradox and deduce the equation of state. **(K3 – Ap, CO2)**

3. Derive the number density of photons and discuss Bose condensation. **(K4- A, CO4)**

4. Show that the diffusion process is irreversible for Brownian particles. **(K3 – Ap, CO2)**

5. Derive the exact solution for one dimensional Ising model. **(K4 – A, CO4)**



Head of the Department **Course Instructor**

Dr. C. Nirmala Louis Dr. M. Priya Dharshini & Dr. S. Virgin Jeba

Teaching Plan

Department : Physics
Class : I M.Sc. Physics
Title of the Course : CORE COURSE V: QUANTUM MECHANICS - I
Semester : II
Course Code : PP232CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP232CC2	6	-	-	-	5	6	90	25	75	100

Learning Objectives

1. To develop the physical principles and the mathematical background important to quantum mechanical descriptions.
2. To discuss the Approximation methods like perturbation theory, Variational and WKB methods for solving the Schrödinger equation.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
CO1	understand the basic postulates of quantum mechanics which serve to formalize the rules of quantum mechanics.	K1(R) & K2 (U)
CO2	interpret and relate the Schrodinger equation to solve one dimensional problems and three dimensional problems.	K2(U)& K3 (Ap)
CO3	apply and analyze various representations, space time symmetries and formulations of time evolution.	K3 (Ap) & K4 (An)
CO4	construct and prioritize the approximation methods for various quantum mechanical problems.	K4((An)& K5(E)
CO5	apply and formulate non-commutative algebra for angular and spin angular momentum and assess spectral line splitting.	K5(E) & K6(C)

Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	1.	**BASIC FORMALISM** Interpretation of the wave function –—— Postulates of Quantum	4	K1(R)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping,	Evaluation through: short test Class Test Quiz through Quizziz Formative assessment through Hot Potatoes
	2.	Time dependent Schrodinger equation –Time independent Schrodinger equation Stationary states – Ehrenfest's theorem	4	K1(R)	Peer tutoring, Lecture using videos, Problem solving, Demonstration, PPT, Review	
	3.	Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator	5	K2(U)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping,	
	4.	Mechanics – Simultaneous measurability of observables – General Uncertainty relation.	5	K2(U)	Peer tutoring, Lecture using videos, Problem solving, Demonstration, PPT, Review	
II	1.	Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier	4	K2(U)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping	Evaluation through: short test Class Test Multiple choice questions Quiz through Nearpod
	2.	Alpha emission – Bloch waves in a periodic potential – Kronig-penny square – well periodic potential	4	K2(U)	Peer tutoring, Lecture using videos, Problem solving, Derivation, PPT, Review	
	3.	Linear harmonic oscillator: Operator method – Particle	5	K3(Ap)	Lecture using Chalk and talk ,Introductory	

		moving in a spherically symmetric potential			session, Group Discussion, Mind mapping,	Formative assessment through Mentimetre
	4.	System of two interacting particles – Hydrogen atom – Rigid rotator.	5	K3(Ap)	Peer tutoring, Lecture using videos, Problem solving, Demonstration, PPT, Review	
III	1.	**GENERAL FORMALISM** Dirac's notation- Equations of motions – Schrodinger representation –	4	K2(U)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping,	Evaluation through: short test Class Test
	2.	Heisenberg representation – Interaction representation – Coordinaterepresentation –	5	K3(Ap)	Peer tutoring, Lecture using videos, Problem solving, Demonstration, PPT, Review	Match the following through Hot Potatoes
	3.	Momentum representation: Probabilty Density– Operator for Position Coordinate- Operator for Momentum	4	K4(An)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping,	
	4.	Equation of Motion- Symmetries and conservation laws- Unitary transformation – Parity and time reversal.	5	K4(An)	Peer tutoring, Lecture using videos, Problem solving, Demonstration, PPT, Review	Formative assessment through Quizziz
IV	1.	Time independent perturbation theory : Basic Concepts- Non-degenerate energy levels: First and second order correction to the	5	K4(An)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping	Evaluation through: short Class Test

		Energy and Wave function				
	2	Degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state – Variation method	4	K4(An)	Peer tutoring, Lecture using videos, Problem solving, Derivation, PPT	Multiple choice questions Quiz through Slido
	3.	Helium atom – WKB approximation: The WKB method – Connection formulae (no derivation)	5	K5(E)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping,	Formative assessment through Nearpod
	4.	WKB quantization – Application to simple harmonic oscillator.	4	K5(E)	Peer tutoring, Lecture using videos, Problem solving, Derivation, PPT, Review	
V	1.	Eigenvalue spectrum of general angular momentum – Ladder operators and their algebra – Angular momentum matrices	4	K5(E)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Derivation	Evaluation through: short Class Test Multiple choice questions Quiz
	2.	Matrix representation – Spin angular momentum: spin-(1/2) systems-Addition of angular momenta	4	K5(E)	Peer tutoring, Lecture using videos, Problem solving, PPT,	Formative assessment through Hot Potatoes
	3.	Clebsh- Gordan Coefficients – Symmetry and anti – symmetry of wave functions	5	K6(C)	Lecture using Chalk and talk ,Derivation, Group Discussion, Mind mapping,	
	4.	Construction of wave-functions and Pauli's exclusion principle.	5	K6(C)	Peer tutoring, Lecture using videos, Problem solving, PPT	

Course Focussing on Employability/ Entrepreneurship/ Skill Development :
Entrepreneurship

Activities (Em/ En/SD): Problem solving on one and two dimensional system

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

Activities related to Cross Cutting Issues : -

Assignment : Clebsh- Gordan Coefficients

Seminar Topic: Hydrogen atom problem

Sample questions

Part A

1.A …….. state is a bound one if the corresponding wave function vanishes at infinity.**(K1-R, CO-1)**

2. The alpha particles strikes the barrier wall at the rate of---------- times per second. **(K2-U, CO-3)**

a) 10^{21} b) 10^{8} c)10^{-21} d) 10^{-8}

3. If |a> and |b> are orthogonal then <a|b> ..... **(K3-Ap, CO-3)**
4. Eigen value of momentum is_____**(K4-An, CO-2)**

5. The spin angular momentum of the electron is..... (**K3-Ap, CO-5)**

Part B

1. Derive time dependent schodinger equation in one diamension.**(K2-U, CO-1)**

2. Determine the time period of alpha emission. **(K2-U, CO-2).**

3. Derive Heisenberg equation of motion that replaces Schrodinger equation of motion.**(K3-Ap, CO- 3)**

4. Obtain the ground state energy of helium using WKB Approximation.**(K4-An, CO-4)**
5.Explain in detail about spin vector for the spin half system. **(K3-Ap, CO-5)**

Part C

1. State and derive Ehrenfests theorem **(K2-U, CO-1)**

2. Derive an expression for Kronig-Penny square well potential. **(K3-Ap, CO-2)**

3. Derive an expression for equation of motion in the momentum representation. **(K3-Ap, CO-3)**

4. DefineStark effect. Explain the effect of electric field on the ground state of Hydrogen. **(K5-E, CO-4)**

5. Describe the Clebsh Gordan coefficients with suitable example **.(K6-C,CO-5)**

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Head of the Department

Dr. M. Abila Jeba Queen & Dr. S. Sonia
Course Instructors

Teaching Plan

Department : Physics
Class : I M.Sc Physics
Title of the Course : Elective Course II: a) Advanced Optics
Semester : II
Course Code : PP232EC1

Course Code	L	T	P	S	Credits	Inst.Hours	Total Hours	Marks		
								CIA	External	Total
PP232EC1	4	-	-	-	3	4	60	25	75	100

LearningObjectives:

1. To impart an extensive understanding of the optical phenomenon of various optical strategies like laser, fiber optics, non-linear optics and electro magneto optics.
2. To study the working of different types of Lasers and optical fibers.

CourseOutcomes

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

Modules

Total contact hours: 90 (Including lectures, assignment and tests)

Unit	Module	Topic	Teaching Hours	Cognitive Level	Pedagogy	Assessment/Evaluation
I	**POLARIZATIONAND DOUBLE REFRACTION**					
	1	Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu's law – Production of	3	K1(R)	Lecture Discussion with PPT Illustration	

		polarized light – Wire grid				Evaluation through: Online quiz (Kahoot) Formative assessment I
	2	polarizer and the polaroid Polarization by reflection – Polarization by double refraction – Polarization by scattering	3	K1(R)	Lecture discussion	
	3	The phenomenon of double refraction – Normal and oblique incidence – Interference of polarized light	3	K1(R)	PPT Illustration (nearpod)	
	4	Quarter and half wave plates – Analysis of polarized light – Optical activity	3	K1(R)	Lecture discussion	
II	**LASERS**					
	1	Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action	3	K1(R)	PPT and group Discussion	Evaluation through: Online quiz (Slido), Short questions Descriptive answers Formative assessment I
	2	Types of lasers and its applications – Solid state lasers – Ruby laser	3	K2(U)	Lecture Discussion with PPT Illustration	
	3	Nd:YAG laser – gas lasers – He-Ne laser – CO2 laser	3	K2(U)	PPT Illustration	
	4	Chemical lasers – HCl laser – Semiconductor laser	3	K2(U)	Lecture Discussion with PPT Illustration	
III	**FIBER OPTICS**					

	1	Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – multimode optical fibers	3	K2(U)	Lecture discussion	Evaluation Evaluation through: Online quiz, Short questions Descriptive answers Formative assessment I/II
	2	Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion	3	K2(U)	Lecture Discussion with PPT Illustration	
	3	Ray dispersion in multimode step index fibers – Parabolic- index fibers – Fiber-optic	3	K3(Ap)	Lecture discussion	
	4	sensors: precision displacement sensor – Precision vibration sensor	3	K4(An)	PPT and group Discussion	
IV	**NON-LINEAROPTICS**					
	1	Basic principles – Harmonic generation	3	K1(R)	Lecture Discussion with PPT Illustration	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment II
	2	Second harmonic generation – Phase matching	3	K2(U)	Lecture discussion	
	3	Third harmonic generation – Optical mixing	3	K3(Ap)	PPT Illustration	
	4	Parametric generation of	3	K4(An)	Lecture Discussi	

		light – Self-focusing of light			on with PPT Illustration	
V	**MAGNETO OPTICS AND ELECTRO OPTICS**					
	1	Magneto-optical effects – Zeeman effect – Inverse Zeeman effect – Faraday effect	3	K2(U)	Short Learning Object (Zoom)	Evaluation through: Online quiz, Short questions Descriptive answers Formative assessment II
	2	Voigt effect – Cotton-mouton effect – Kerr magneto- optic effect – Electro-optical effects	3	K3(Ap)	Lecture Discussion with PPT Illustration	
	3	Stark effect – Inverse stark effect – Electric double refraction	3	K4(An)	Lecture discussion	
	4	Kerr electro-optic effect – Pockels electro-optic effect	3	K5(E)	PPT Illustration	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

CourseFocussingonEmployability/Entrepreneurship/SkillDevelopment: **Employability**
Activities(Em/En/SD):**Practical**

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

Activities related to Cross Cutting Issues: Nil
Assignment : (Mention Topic and Type): Single and multi-mode fibers- Google Classroom

Seminar Topic: (if applicable): Polarization by double refraction, Total Internal reflection, Zeeman effect.

Part A (1 mark)

1. Malu's law is associated with **(K1- R, CO-1)**
   A) Reflection
   B) Refraction
   C) Polarization
   D) Interference
2. Which laser type uses a solid-state medium? **(K2- U, CO-2)**
   A) He-Ne laser
   B) CO2 laser
   C) Ruby laser
   D) Semiconductor laser
3. Numerical Aperture (NA) in fiber optics is a measure of the fiber's ability to _____ light. **(K3- Ap, CO-3)**
4. Harmonic generation involves the production of frequency components that are integermultiples of the original frequency.
   TRUE/FALSE**(K4- An, CO-4)**
4. Which effect involves the splitting of spectral lines in the presence of a magnetic field?**(K5- E, CO-5)**
   A) Voigt effect
   B) Faraday effect
   C) Zeeman effect
   D) Cotton-Mouton effect

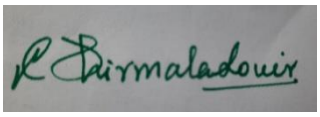
Part B (6 marks)

1. What are the different classifications of polarization, and how do they relate to the transverse character of light waves?**(K1- R, CO-1)**
2. Outline the basic principles of lasers, including the concepts of spontaneous and stimulated emissions. Explain the role of a resonator in lasing action.**(K2- U, CO-2)**
3. Illustrate the characteristics of optical fibers, emphasizing the types of glass fibers and the concept of a coherent bundle.**(K3- Ap, CO-3)**
4. Analyze the concept optical mixing and its applications in the field of non-linear optics. **(K4- An, CO-4)**
5. Interpret the concept inverse Zeeman effect and how it contrasts with the regular Zeeman effect. **(K5- E, CO-5)**

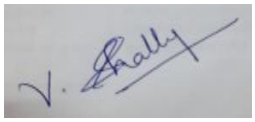
Part C (12 marks)

1. Describe the methods of production of polarized light. Discuss the use of wire grid polarizers and polaroids in achieving polarization.**(K1- R, CO-1)**
2. Explore chemical lasers and semiconductor lasers. Provide an overview of their principles and applications.**(K2- U, CO-2)**
3. Illustrate the significance of numerical aperture in optical fibers and discuss the factors contributing to attenuation in these fibers. **(K3- Ap, CO-3)**

4. Analyze the process of second harmonic generation and its significance in non-linear optics**. (K4- An, CO-4)**
5. Interpret Kerr magneto-optic effect and how it influences the polarization of light in a magnetic field. **(K5- E, CO-5)**



Head of the Department



Ms. V. Shally & Ms. A. Lesly Fathima
Course Instructor

Teaching Plan

Department : Physics

Class : I M.Sc. Physics
Semester : II
Name of the Course : Medical Physics

Subject code : PP232EC4

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP232EC4	4	-	-	-	3	4	60	25	75	100

Learning Objectives

1. To understand the major applications of Physics to Medicine.
2. To study the aid of different medical devices such as X-ray machines, gamma camera, accelerator and nuclear magnetic resonance.

Course Outcomes

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO-1	Learn the fundamentals, production and applications of X-rays.	PSO - 4	U
CO-2	Understand the basics of blood pressure measurements. Learn about sphygmomanometer, EGC, ENG and basic principles of MRI.	PSO - 4	Ap
CO-3	apply knowledge on Radiation Physics	PSO - 4	U
CO-4	analyse Radiological imaging and filters	PSO - 4	An
CO-5	assess the principles of radiation protection	PSO- 4	An

Modules

Credit: 5 **Total Hours: 60**

Unit	Section	Topics	Lecture hours	Cognitive level	Pedagogy	Assesment/ Evaluation
I		X-RAYS AND TRANSDUCERS				
	1	Electromagnetic Spectrum – Production of X-Rays – X-Ray Spectrum –	3	K1(R)	Illustration and PPT using gamma	Evaluation through: quiz nearpod

		Bremsstrahlung				
	2	Characteristic X-Ray – X-Ray Tubes – Coolidge Tube – X-Ray Tube Design – Thermistors	3	K1(R)	Illustration, PPT	Formative assessment Evaluation through short test using nearpod
	3	photo electric transducers – Photo voltaic cells – photo emissive cells	3	K1(R)	Lecture Discussion using gamma	
	4	Photoconductive cells– piezoelectric transducer.	3	K1(R)	Illustration and AI tool	
II		**BLOOD PRESSURE MEASUREMENTS**				
	1	Introduction – Sphygmomanometer – Measurement of heart rate	3	K2(U)	Illustration using OLAB	Evaluation through: quiz using hotpotatoes Class test using nearpod
	2	basic principles of electrocardiogram (ECG)	3	K2(U)	Lecture Discussion using PPT	
	3	Basic principles of electro-neurography (ENG)	3	K3(Ap)	Lecture ,Illustration using AI tool	
	4	Basic principles of magnetic resonance imaging (MRI).	3	K3(Ap)	Lecture Discussion using gamma	
III		**RADIATION PHYSICS**				
	1	Radiation Units – Exposure – Absorbed Dose – Rad to Gray	3	K1(R)	Lecture and Discussion using slido	Evaluation through: quiz using quizzes Formative assessment Evaluation through short test Multiple choice questions
	2	Kera Relative Biological Effectiveness – Effective Dose – Sievert (Sv)functions - objects as function arguments	3	K2(U)	Illustration	Lecture Illustration , Writing simple programmes
	3	Inverse Square Law –	2	K3(Ap)	Lecture	Lecture

		Interaction of radiation with Matter – Linear Attenuation Coefficient			Discussion using gamma	Illustration , Writing simple programmes
	4	Radiation Detectors – Thimble Chamber – Condenser Chambers – Geiger Counter – Scintillation Counter	4	K3(Ap)	Lecture ,Illustration using AI tool	Lecture Illustration , Writing simple programmes
IV		**MEDICAL IMAGING PHYSICS**				
	1	Radiological Imaging – Radiography – Filters – Grids	3	K1(R)	Lecture Illustration ,	Evaluation through: quiz, using quizzes,slido Problem solving Theoretical derivation Formative assessment
	2	Cassette – X-Ray Film – Film processing – Fluoroscopy	3	K3(Ap)	Illustration	
	3	Computed Tomography Scanner – Principal Function	3	K2(U)	Lecture Discussion using gamma	
	4	Display – Mammography – Ultrasound Imaging	3	K2(U)	Lecture ,Illustration using AI tool	
V		**RADIATION PROTECTION**				
	1	Principles of Radiation Protection	3	K2(U)	Lecture Illustration ,	Evaluation through: quiz, Mentimeter Problem solving Formative Assessment
	2	Protective Materials	3	K4(An)	Illustration	
	3	Radiation Effects – Somatic – Genetic Stochastic and Deterministic Effect	3	K3(Ap)	Lecture Discussion using gamma	
	4	– Personal Monitoring Devices, TLD Film Badge – Pocket Dosimeter	3	K3(Ap)	Lecture ,Illustration using slido	

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

Activities (Em / En /SD): **Problem solving and analysing using the images**

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

Assignment: (Mention Topic and Type): Solve problems, Analyse X-RAYS

Seminar Topic: (if applicable):-

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. The frequency of gamma rays is--------.**(K1-U, CO-1)**
2. In the electromagnetic spectrum ----- has the high penetrating power**(K2-R, CO-2)**
3. The protective material used for radiation protection **is -----(Ap, CO3)**
4. Analyze the energy in terms of wavelength and frequency**(K4-An,CO3)**
5. Evaluate the amount of energy released by 10R of radiation(**K5-E, CO4)**

Part B (4 marks)

1. Briefly explain the electromagnetic spectrum. **(K1-U, CO-1)**
2. Explain the basic principles of a electrocardiogram.**(K1-U, CO-1)**
3. Analyse the biological effect of radiations. **(K4-An,CO3)**
4. Explain the construction and working of a Computed Tomography Scanner **(K1-U, CO-3)**
5. Explain the Thyroid Uptake System in medical imaging**(K3-Ap, CO-4)**

Part C (8 marks)

1. With neat sketch explain the construction and working of Geiger **K1-U, CO-1)**
2. With neat sketch explain the construction and working of counter Mammography.**(K2-R, CO-2)**
3. Determine the amount of radiation using Thimble chamber. **(K3-Ap, CO-3)**
4. Analyse Somatic, Genetic Stochastic, and Deterministic Effect of radiations**(K4-An, CO-4)**
5. Explain the various radiation protective materials**(K1-, CO-1)**

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Dr.C.Nirmala Louis
Head of the Department

Dr.S.J.Jenepha Mary & Dr. P. Aji Udhaya

Course Instructors

Teaching Plan

Department : Physics

Class : I M.Sc Physics

Title of the Course: SKILL ENHANCEMENT COURSE I – NME-I
Solar Energy Utilization

Semester : II

Course Code : PP232SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP232SE1	4	-	-	-	2	4	60	25	75	100

Learning Objectives:

1. To impart fundamental aspects of solar energy utilization.
2. To develop an industrialist mindset by utilizing renewable source of energy.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
CO1	gained knowledge in fundamental aspects of solar energy utilization	**K1 & K2**
CO2	equipped to take up related job by gaining industry exposure	**K1 & K2**
CO3	develop entrepreneurial skills	**K2 & K3**
CO4	skilled to approach the needy society with different types of solar cells	**K3 & K5**
CO5	gained industrialist mindset by utilizing renewable source of energy	**K5 & K6**

Modules

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
I	**HEAT TRANSFER AND RADIATION ANALYSIS:**					
	1	Conduction: Conduction in extended surface – Radiation and Convection – Forced convection and wind loss	**4**	K1(R)	Lecture discussion with illustration	Evaluation through: Online quiz, Class test, Formative assessment I
	2	Solar radiation at the Earth's surface – Basic Earth sun angles	**4**	K2(U)	PPT, Lecture discussion with illustration, and group discussion	
	3	Determination of solar time – Solar energy measuring instruments and its classifications.	**4**	K2(U)	Lecture discussion with illustration	
II	**SOLAR COLLECTORS:**					
	1	Introduction – Physical Principle of the conversion of solar radiation into heat	**4**	K2(U)	Lecture discussion with illustration	Evaluation through: Online quiz, Short questions, Descriptive answers, Formative assessment I
	2	Description of flat plate collectors- General characteristics of flat plate collectors	**4**	K1(R)	Discussion And Illustration with PPT	
	3	Selection of materials of flat plate collectors	**4**	K2(U)	Lecture Illustration, group discussion	
III	**SOLAR HEATERS:**					
	1	Introduction – Types of solar water heaters – Collectors and storage tanks	**4**	K2(U)	PPT, Lecture discussion with illustration	Evaluation through: Online quiz, Short questions, Descriptive

	2	Combined heating and cooling systems - Solar pond: Introduction	**4**	K3(Ap)	Lecture discussion with illustration	answers, Formative assessment I/II
	3	Principle of operation of solar pond – Types of solar ponds – Application of solar ponds	**4**	K3(Ap)	PPT, Lecture discussion with illustration	
IV	**SOLAR ENERGY CONVERSION:**					
	1	Photovoltaic principle: Semiconductor junction, Basic Photovoltaic system for power generation	**4**	K5(E)	Discussion And Illustration with PPT	Evaluation through: Online quiz, short questions, Descriptive answers, Formative assessment II
	2	Advantages and disadvantages of photovoltaic solar energy conversion	**4**	K3(Ap)	Lecture discussion with illustration	
	3	Types of solar cells – Applications of solar photovoltaic system	**4**	K3(Ap)	Discussion And Illustration with PPT	
V	**NANOMATERIALS IN FUEL CELL APPLICATIONS:**					
	1	Use of nanostructures and nanomaterials in fuel cell technology	**4**	K6(C)	Discussion And Illustration with PPT	Evaluation through: Online quiz, MCQ, True/False, short questions, Descriptive answers, Formative assessment II
	2	High and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts.	**4**	K5(E)	Discussion And Illustration with PPT	
	3	Use of Nanotechnology in hydrogen production and storage.	**4**	K5(E)	Lecture Illustration	

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

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

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

Activities related to Cross Cutting Issues: **Nil**

Assignment: (Mention Topic and Type): **Solar Energy Panel**

Seminar Topic: (if applicable): **Solar Energy Radiation**

Sample questions (minimum one question from each unit)

Part A (1 mark)

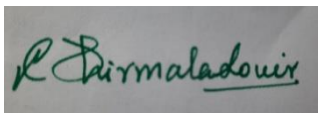
1. The incident solar radiation that comes directly from the apparent solar disc, without reflection from other objects is _____ **(K4- An, CO1)**
2. A _____ is a device designed to absorb incident solar radiation. **(K3 – Ap, CO2)**
   (a) solar heater (b)solar plate (c) solar collector (d) solar receiver
3. The solar pond combines solar energy collection and sensible heat storage. **(True/False) (K5 – E, CO3)**
4. A basic use of solar water heating is ----------. **(K6 – C, CO4)**
5. Schottky junction photo voltaic cell made with the ----------. **(K3 – Ap, CO5)**

Part B (3 marks)

6. Differentiate radiation and conduction. **(K4 – An, CO1)**
7. Summarize the general characteristics of flat plate solar collectors. **(K5 – E, CO2)**
8. Criticize the classification of solar ponds. **(K5- E, CO3)**
9. Design combined solar heating and cooling systems. **(K6- C, CO4)**
10. Illustrate the concept of crystal growth. **(K3 – Ap, CO5)**

Part C (7 marks)

11. Interpret the solar radiation at the earth's surface. **(K3 – Ap, CO1)**
12. Predict the concept of general description of flat plate solar collectors. **(K5 – E, CO2)**
13. Describe the principle of operation of a solar pond. **(K6- C, CO3)**
14. Derive an expression for photo voltaic principles. **(K3 – Ap, CO4)**
15. Explain in detail about the applications of solar photo voltaic system. **(K5- E, CO5)**



Head of the Department

S. Sebastiammal

Dr. Sr. S. Sebastiammal

Course Instructor

Teaching Plan

Department : Physics
Class : II M.Sc. Physics
Title of the Course : Core X: Nuclear and Particle Physics
Semester : IV
Course Code : PP234CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP234CC1	6	-	-	-	5	6	90	25	75	100

Learning Objectives

1. Introduces students to the different models of the nucleus in a chronological order
2. Imparts an in-depth knowledge on the nuclear force, experiments to study it and the types of nuclear reactions and their principles
3. Provides students with details of nuclear decay with relevant theories
4. Exposes students to the Standard Model of Elementary Particles and Higgs boson

Course Outcomes

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO-1	gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion.	**PSO-1**	**K1,K5**
CO-2	demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter	**PSO-2**	**K2,K3**
CO-3	use the different nuclear models to explain different nuclear phenomena and the concept of resonances through Briet-Weigner single level formula	**PSO-2**	**K3**
CO-4	analyze data from nuclear scattering experiments to identify different properties of the nuclear force.	**PSO-3**	**K3,K4**
CO-5	summarize and identify allowed and forbidden nuclear reactions based on conservation laws of the elementary particles	**PSO-4**	**K5**

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

Modules

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

Unit	Module	Topics	Teaching Hours	Cognitive Level	Pedagogy	Assessment/ Evaluation
I	**NUCLEAR MODELS**					
	1	Liquid drop model – Analogy between nucleus and liquid drop - Weizacker mass formula	4	K1 (R)	Lecture –cum-Group Discussion, Problem Solving	Evaluation through: Online quiz, short questions Descriptive answers MCQ, True/False, Concept explanations, Formative assessment I
	2	Isobaric mass parabola - Bohr Wheeler theory of fission – Shell model – Spin-orbit coupling	4	K5 (E)	Lecture, Group Discussion and Problem Solving	
	3	Magic numbers – Angular momenta and parity of ground states – Magnetic moment – Schmidt model	5	K5 (E)	Lecture, Group Discussion and Problem Solving	
	4	Electric Quadrapole moment - Bohr and Mottelson collective model – Rotational and vibrational bands.	5	K1 (R)	Group Discussion and Problem solving	
II	**NUCLEAR FORCES**					
	1	Fundamental Forces-Nucleon – Nucleon interaction – Tensor forces	4	K2 (U)	Lecture –cum-Group Discussion	Evaluation through: Online quiz, short questions Descriptive answers MCQ, True/False, Concept explanations, Formative assessment I
	2	Characteristics of nuclear forces – Ground state of deuteron	2	K2 (U)	Lecture, Group Discussion and Problem Solving	
	3	Exchange Forces - Meson theory of nuclear forces – Nucleon-nucleon scattering	4	K3 (Ap)	Lecture, Group Discussion and Problem Solving	
	4	Neutron-proton scattering at low energy- Effective range theory of neutron-proton scattering	4	K2 (U)	Lecture, Group Discussion and Problem Solving	
	5	Spin dependence of nuclear forces - charge independence and charge symmetry of nuclear	4	K3 (Ap)	Lecture, Group Discussion and	

		force– isospin formalism			Problem Solving	
III	**NUCLEAR REACTIONS**					
	1	Kinds of nuclear reactions – Endoergic reactions – Exoergic reactions	4	K2 (U)	Lecture –cum-Group Discussion	Evaluation through: Online quiz, short questions Descriptive answers MCQ, True/False, Concept explanations, Formative assessment II
	2	Reaction kinematics – Q-value – Partial wave analysis of scattering cross section	4	K2 (U)	Lecture, Group Discussion and Problem Solving	
	3	Reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem	5	K3 (Ap)	Lecture, Group Discussion and Problem Solving	
	4	Nuclear resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – four factor formula.	5	K3 (Ap)	Lecture, Group Discussion and Problem Solving	
IV	**NUCLEAR DECAY**					
	1	Beta decay – Continuous Beta spectrum – Fermi theory of beta decay - Comparative Half-life	4	K3 (Ap)	Lecture –cum-Group Discussion	Evaluation through: Online quiz, short questions Descriptive answers MCQ, True/False, Concept explanations, Formative assessment II
	2	Fermi Kurie Plot – mass of neutrino – allowed and forbidden decay — neutrino physics	5	K4 (An)	Lecture, Group Discussion and Problem Solving	
	3	Helicity - Parity violation - Gamma decay – multipole radiations – Angular Correlation	4	K3 (Ap)	Lecture, Group Discussion and Problem Solving	
	4	Internal conversion – nuclear isomerism – angular momentum and parity selection rules	5	K4 (An)	Lecture, Group Discussion and Problem Solving	
V	**ELEMENTARY PARTICLES**					
	1	Classification of Elementary Particles – Leptons - Mesons-Baryons-Types of Interaction and conservation laws	5	K2 (U)	Lecture –cum-Group Discussion	Evaluation through: Online quiz, short questions Descriptive
	2	Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge	5	K5 (E)	Lecture, Group Discussion and	

		and Quarks			Problem Solving	answers MCQ, True/False, Concept explanations
	3	SU (2) and SU (3) groups - Gell Mann matrices– Gell Mann Okuba Mass Formula	4	K3 (Ap)	Lecture, Group Discussion and Problem Solving	
	4	Quark Model. Standard model of particle physics – Higgs boson.	4	K5 (E)	Group Discussion and Problem solving	

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

Activities (Em/ En/SD): **Industrial Visit- Planetarium, Koodankulum**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment

Sustainability/ Gender Equity): **-**

Activities related to Cross Cutting Issues: -

Assignment: (Mention Topic and Type):**Problem Solving in Elementary Particles**

Seminar Topic: (if applicable): **Gell Mann Okuba Mass Formula**

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. The magic numbers are 2,8,20,28,50,82,126. Say true or false **(K1- R, CO-1)**
2. The existence of quadrupole moment of deuteron reveals the existence of **(K2-U, CO-2**
   (a) Central forces (b) Non-Central forces
   (a) Gravitational forces (d) Electromagnetic forces
3. For an elastic nuclear collision the Q value is **(K5-E, CO-5)**

   a) $Q>0$ b) $Q<0$ c)$Q=0$ d) *infinite*

4. Name the process which emits α or β particle, when the nucleus is left in excited state and if excess energy is given to an atomic electron then the electron is emitted. (**K4-An, CO-4)**
   (a) electron volt (b) β particle
   (c) internal conversion (d) αparticle
5. Quarks in hadrons and mesons are held together by real strong interaction, whose propagator is the gluons. Say true/ False. **(K5-E, CO-5)**

Part B (4 marks)

1. Discuss the analogies between atomic nucleus and a small drop of liquid. **(K5- E, CO-1)**
2. Explain tensor forces in the case of a deuteron. How is it used to explain the magnetic moment of deuteron? **(K2-U, CO-2)**
3. Derive Breit Wigner dispersion formula for nuclear reactions. **(K2- U, CO-3)**
4. Explain the general features of alpha decay. **(K4- An, CO-4)**

5. Comment on the statement" A neutron is neutral but it possess a negative magnetic moment". **(K5-E, CO-5)**

Part C (8 marks)

1. On the basis of liquid drop model give a simple derivation of Weizascker semi-empirical mass formula giving arguments for each term. What are the important conclusions drawn from this formula? **(K5- E, CO-1)**
2. What are exchange forces? Explain how the study of deuteron problem indicates the spin dependence of nuclear forces. **(K3-Ap, CO-2)**
3. Derive an expression for Q-value of a reaction. How is it related to threshold energy of a particle. **(K3- Ap, CO-3)**
4. Give the Fermi theory of β-decay. Explain the transitions in β-emission with the selection rules.**(K4- An, CO-4)**
5. Explain why the following decay processes are not conserved? **(K5-E, CO-5)**

$$p + n \rightarrow \Lambda^0 + \Sigma^+$$

$$\Sigma^+ \rightarrow \Lambda^0 + k^+$$

$$\Lambda^0 \rightarrow k^+ + k^-$$

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Head of the Department **Course Instructor**

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

Teaching Plan

Department : Physics
Class : II M.Sc Physics
Title of the Course : CORE COURSE XI: SPECTROSCOPY
Semester : IV
Course Code : PP234CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP234CC2	6	-	-	-	5	6	90	25	75	100

Objectives

1. To comprehend the theory behind different spectroscopic methods.
2. To know the working principles along with an overview of construction of different types of spectrometers involved.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recognize fundamentals of rotational spectroscopy, view molecules as elastic rotors and interpret their behavior.	**K1**
2.	understand the working principles of spectroscopic instruments and theoretical background of IR spectroscopy.	**K2**
3.	apply the resonance spectroscopic techniques for quantitative and qualitative estimation of a substance.	**K3**
4.	analyze the different types of spectrum.	**K4**
5.	evaluate structures and composition of molecules and use their knowledge of Raman Spectroscopy as an important analytical tool.	**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	Cognitive Level	Pedagogy	Assessment/ Evaluation
I	**MICROWAVE SPECTROSCOPY**					
	1	Classification of molecules – Interaction of Radiation -Rotational spectra of rigid diatomic molecules	4	K1 (R)	Lecture – cum- Group Discussion , Problem Solving	Evaluation through: Online quiz, short questions Descriptive answers MCQ, True/False, Concept explanations, Formative assessment I
	2	Effect of isotopic substitution - Intensity of Rotational Lines- Non rigid Rotator	4	K5 (E)	Lecture, Group Discussion and Problem Solving	
	3	Polyatomic molecules – linear – Symmetric- asymmetric top molecules- Stark effect	5	K5 (E)	Lecture, Group Discussion and Problem Solving	
	4	Quadrupole hyperfine interaction– Microwave spectrometer - Information Derived from Rotational Spectra.	5	K1 (R)	Group Discussion and Problem solving	
II	**INFRA-RED SPECTROSCOPY**					
	1	Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator	4	K2 (U)	Lecture – cum- Group Discussion	Evaluation through: Online quiz, short questions Descriptive
	2	Overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch	2	K2 (U)	Lecture, Group Discussion and Problem	

					Solving	answers
	3	Fundamental modes of vibration of H_2O and CO_2 Introduction to application of vibrational spectra	4	K3 (Ap)	Lecture, Group Discussion and Problem Solving	MCQ, True/False, Concept explanations, Formative assessment I
	4	IR Spectrophotometer Instrumentation (Double Beam Spectrometer)	4	K2 (U)	Lecture, Group Discussion and Problem Solving	
	5	Fourier Transform Infrared Spectroscopy - Interpretation of vibrational spectra	4	K3 (Ap)	Lecture, Group Discussion and Problem Solving	
III	**RAMAN SPECTROSCOPY**					
	1	Theory of Raman Scattering - classical theory – molecular polarizability - quantum theory	4	K2 (U)	Lecture – cum- Group Discussion	Evaluation through: Online quiz, short questions Descriptive answers MCQ, True/False, Concept explanations, Formative assessment II
	2	Rotational Raman spectra- Symmetric top molecules – stokes and anti-stokes line- SR branch	4	K2 (U)	Lecture, Group Discussion and Problem Solving	
	3	Raman activity of H_2O and CO_2 - determination of N_2O structure - Instrumentation technique	5	K3 (Ap)	Lecture, Group Discussion and Problem Solving	
	4	Structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy- SERS	5	K3 (Ap)	Lecture, Group Discussion and Problem	

					Solving	
IV	**RESONANCE SPECTROSCOPY**					
	1	Introduction-Nuclear spin and Magnetic Moment-Nuclear Magnetic Resonance	4	K3 (Ap)	Lecture – cum- Group Discussion	Evaluation through: Online quiz, short questions Descriptive answers MCQ, True/False, Concept explanations, Formative assessment II
	2	Theory of NMR Spectroscopy-Precession of particles in a field-Relaxation processes in NMR	5	K4 (An)	Lecture, Group Discussion and Problem Solving	
	3	Experimental methods of NMR Spectroscopy-Interpretation of NMR Spectra	4	K3 (Ap)	Lecture, Group Discussion and Problem Solving	
	4	Types of environmental effects-chemical shift and spin-spin splitting-shielding and de-shielding	5	K4 (An)	Lecture, Group Discussion and Problem Solving	
V	**UV SPECTROSCOPY**					
	1	The Nature of Electronic Excitations- origin of UV band structure- Principles of absorption spectroscopy	5	K2 (U)	Lecture – cum- Group Discussion	Evaluation through: Online quiz, short questions Descriptive answers MCQ, True/False, Concept explanations
	2	Instrumentation- Laws of absorption – Lambert Bouguer law – Lambert Beer law- Chromophore	5	K5 (E)	Lecture, Group Discussion and Problem Solving	
	3	Effect of Conjugation- Effect of Conjugation on Alkenes - Woodward–Fieser rules for Dienes	4	K3 (Ap)	Lecture, Group Discussion and	

					Problem Solving	
	4	Electron-releasing and electron withdrawing effects - Visible spectra-Color in Compounds - Simple applications	4	K5 (E)	Group Discussion and Problem solving	

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

Activities (Em/ En/SD): **FIST Lab visit**

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

Activities related to Cross Cutting Issues: -

Assignment: (Mention Topic and Type): **Problem Solving in Spectroscopy**

Seminar Topic: (if applicable): Interpretation of vibrational spectra

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. In rotational spectroscopy, molecules primarily interact with **(K1- R, CO-1)**
    a) Infrared radiation
    b) Microwave radiation
    c) Ultraviolet radiation
    d) Visible light
2. What are overtones in vibrational spectroscopy? **(K2-U, CO-2)**
    a) Fundamental vibrations
    b) Higher harmonics of the fundamental frequency
    c) Rotational transitions
    d) Electronic transitions
3. Carbon dioxide (CO2) is Raman active because **(K5-E, CO-5)**
    a) It has a permanent dipole moment
    b) It shows changes in polarizability during vibration
    c) It is a polar molecule
    d) It has electronic transitions in the visible range

4.What is the spin quantum number for a proton? **(K4- An, CO-4)**

(a) 0 (b) 1/2 (c) 1 (d) 3/2

5. Which type of electronic transition typically requires the least amount of energy? **(K5-E, CO-5)**

a) $\pi \rightarrow \pi^*$ b) $\sigma \rightarrow \sigma^*$ c) $n \rightarrow \pi^*$ d) $n \rightarrow \sigma^*$

Part B (4 Marks)

1.Outline the effect of isotopic substitution on the rotational spectra of the molecules. **(K5- E, CO-1)**

2. Write short note on overtones and combinations. **(K2-U, CO-2)**

3. Explain the rotational Raman spectrum of a symmetric top molecules. **(K2- U, CO-3)**

4. Explain the concept of spin-spin splitting in NMR. **(K4- An, CO-4)**

5. Explain the Lambert-Beer law and how it is applied in spectroscopy. **(K5-E, CO-5)**

Part C (8 Marks)

6. Describe the instrumentation of microwave spectroscopy with the block diagram. What are the information's deriving from rotational spectra? **(K5- E, CO-1)**

7. Explain in detail the Fourier transform infrared spectroscopy. Discuss any two applications. **(K3-Ap, CO-2)**

8. Discuss the classical and quantum theories of Raman effect. **(K3- Ap, CO-3)**

9. Explain the concept of de-shielding and provide examples of factors that cause de-shielding in NMR spectra. **(K4- An, CO-4)**

10. Describe the factors that influence the UV band structure. **(K5-E, CO-5)**

Head of the Department **Course Instructor**

Dr. C. Nirmala Louis **Dr. V. Shally and Dr. Jenepha Mary**

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Teaching Plan

Department :Physics
Class : II M.Sc Physics
Title of the Course : Elective Course V: a) Numerical Methods and Computer Algorithms
Semester :IV
Course Code : PP234EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PP234EC1	4	-	-	-	3	4	60	25	75	100

Learning Objectives

1. To calculate parameters in an equation by fitting that equation to measured data.
2. To apply advanced concepts learned in numerical methods to find approximate solutions of problems.

Course Outcome

COs	Upon completion of this course the students will be able to:	PSO addressed	CL
CO- 1	Recognize different numerical approaches to solve a problem.	**PSO-1**	**K1**
CO- 2	Compare various numerical methods for differentiation and integration.	**PSO-3**	**K2**
CO- 3	Relate various interpolation methods for finite difference concepts.	**PSO-1**	**K3**
CO -4	Devise the numerical solutions of linear system of equations.	**PSO-4**	**K4**
CO- 5	Prioritise computational methods and design C++ programs for day-to-day life applications.	**PSO-2**	**K5 & K6**

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

Modules

Total contact hours: 60 (Including lectures, assignment and tests)

Unit	Module	Topic	Teaching Hours	Cognitive Level	Pedagogy	Assessment/Evaluation
I	**SOLUTIONS OF EQUATIONS**					
	1	Zeros or Roots of an equation - Non-linear algebraic equation and transcendental equations	4	K1(R)	Lecture Discussion with PPT Illustration	Evaluation through: Online quiz (Kahoot) Formative assessment I
	2	Zeros of polynomials – Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods	4	K2(U)	Lecture discussion and Problem solving	
	3	Convergence of solutions in Bisection and Newton-Raphson methods – Limitations of Bisection and Newton-Raphson methods.	4	K2(U)	Problem solving	
II	**LINEAR SYSTEM OF EQUATIONS**					
	1	Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations	4	K2(U)	Problem solving and group Discussion	Evaluation through: Online quiz (Slido), Short questions Descriptive answers Formative assessment I

	2	Gaussian elimination method – Gauss Jordan method – Inverse of a matrix by Gauss elimination method	4	K2(U)	Lecture Discussion with PPT Illustration and Problem solving	
	3	Eigen values and eigenvectors of matrices – Direct method - Power method and Jacobi Method to find the Eigen values and Eigen vectors	4	K2(U)	PPT Illustration and Problem solving	
III	**INTERPOLATION AND CURVE FITTING**					
	1	Interpolation with equally spaced points - Newton forward and backward interpolation – Interpolation with unevenly spaced points	3	K2(U)	Lecture discussion and Problem solving	Evaluation Evaluation through: Online quiz, Short questions Descriptive answers Formative assessment I/II
	2	Lagrange interpolation – Hermite's Interpolation formula	3	K3(Ap)	Lecture Discussion with PPT Illustration and Problem solving	
	3	Curve fitting – Fitting a straight line – Nonlinear Curve Fitting	3	K3(Ap)	Lecture discussion and Problem solving	
	4	Method of least squares – Fitting a polynomial.	3	K3(Ap)	PPT and group Discussion	
IV	**DIFFERENTIATION AND INTEGRATION**					
	1	Numerical differentiation – Numerical	3	K1(R)	Lecture Discussion with PPT Illustration	Evaluation through: Online quiz,

		integration – Trapezoidal rule				Problem solving short questions Descriptive answers Formative assessment II
	2	Simpson's 1/3 rule – Simpson's 3/8 rule – Newton Cotes Integration Formula – Error estimates	3	K2(U)	Lecture discussion	
	3	Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite and Gauss – Chebyshev quadrature	3	K3(An)	PPT Illustration and Problem solving	
	4	Solution of ordinary differential equations – Euler and Runga Kutta methods.	3	K2(U)	Problem solving	
V	**PROGRAMMING WITH C++**					
	1	Subroutines and functions – Programs for the following computational methods: (a) Zeros of polynomials by the bisection method	4	K2(U)	Program writing	Evaluation through: Online quiz, Short questions Descriptive answers Formative assessment II
	2	(b) Zeros of polynomials/non-linear equations by the Newton-Raphson method, (c) Newton's forward and backward interpolation, Lagrange Interpolation	4	K3(Ap)	Solve the problem and Program writing	
	3	(d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method	4	K6(C)	Solve the problem and Program writing	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

CourseFocussingonEmployability/Entrepreneurship/SkillDevelopment:**Skill Development**

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

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

ActivitiesrelatedtoCross CuttingIssues:Nil

Assignment: (Mention Topic and Type): **Problem solving on Differentiation and Integration**

Seminar Topic (if applicable):**Problem solving on Interpolation**

Part- A (1 mark)

1. What are transcendental equations? **(K1-R, CO 1)**
2. Mention the limitations of the solution of simultaneous equations by Matrix inversion method? **(K2-U, CO 2)**
3. What is the process of construction of y(x) to fit a table of data points? **(K2-U, CO 2)**
4. List the advantages of Trapezoidal rule. **(K2-U, CO 2)**
5. Define subroutine. **(K2-U, CO 2)**

Part- B (6 marks)

1. Deduce the real root of x^3+3x-5 using bisection method. **(K5-E, CO 5)**
2. Analyze and solve the system of equations using Gauss – Jordan method. **(K4-An, CO 4)**
   $2x+y+z=10$
   $3x+2y+3z=18$
   $x+4y+9z=16$.
3. Derive Newton's forward and backward interpolation formula. **(K5-E, CO 5)**
4. Illustrate Simpson's 1/3-Rule and 3/8-Rule. **(K3-Ap, CO 3)**
5. Develop a C++ program to find the solution of first order differential equations by Euler's method. **(K5-C, CO 5)**

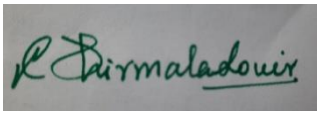
Part- C (12 marks)

1. Use Newton – Raphson method to obtain a root for the equation $x^3+2x^2+10x-20$. Correct to three decimal places. **(K5-E, CO 5)**

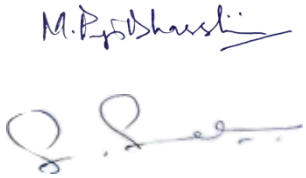
2. Analyze and solve the system of equations using Gauss – elimination method. **(K4-An, CO 4)**

$$10x + y + z = 12$$
$$2x + 10y + z = 13$$
$$x + y + 5z = 7$$

3. Derive Hermite's Interpolation formula. **(K5-E, CO 5)**
4. Write the value of y (0.2) and y (0.4) given that y = 1 when x = 0 and $\frac{dy}{dx} = \frac{y-x}{y+x}$ using Runge-Kutta fourth order method. **(K3-Ap, CO 3)**
5. Formulate a C++ program to illustrate Legrange interpolation. **(K5-C, CO 5)**



Head of the Department



Dr. M.Priya Dharshini & Dr.S.Sonia
Course Instructor

TeachingPlan

Department : Physics
Class : II M.Sc Physics
Title of the Course : Elective Course VI: a) Physics of Nanoscience and Technology
Semester : IV
Course Code : PP234EC4

Hours/Week	Credits	Total Hours	Marks
4	3	60	100

Learning Objectives

1. To provide the basic knowledge about nanoscience and technology and to learn the structures and properties of nanomaterials.
2. To acquire the knowledge about synthesis methods and characterization techniques and its applications.

Course Outcome

Cos	Upon completion of this course the students will be able to:	PSO addressed	CL
CO- 1	identify the different types of nanomaterials and surface effects of the nanomaterials.	**PSO-1**	**K1**
CO- 2	understand various physical, mechanical, optical, electrical and magnetic properties nanomaterials.	**PSO-3**	**K2**
CO- 3	utilise the process and mechanism of synthesis and fabrication of nanomaterials.	**PSO-6**	**K3**
CO -4	correlate the various characterizations of Nano-products through diffraction, spectroscopic, microscopic and other techniques.	**PSO-2**	**K4**
CO- 5	grade the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy sectors and design devices.	**PSO-6**	**K5 & K6**

Modules

Total contact hours: 60 (Including lectures, assignment and tests)

Unit	Module	Topic	Teaching Hours	Cognitive Level	Pedagogy	Assessment/Evaluation
I	**FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY**					
	1	Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology	4	K1(R)	Lecture Discussion with PPT Illustration	Evaluation through: Online quiz (Kahoot) Formative assessment I
	2	Classification of Nanomaterials – Metal and Semiconductor Nanomaterials – 2D, 1D, 0D nanostructured materials	4	K2(U)	Lecture discussion	
	3	Quantum dots – Quantum wires – Quantum wells – Surface effects of nanomaterials.	4	K2(U)	PPT Illustration (nearpod)	
II	**PROPERTIES OF NANOMATERIALS**					
	1	Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant	3	K1(R)	PPT and group Discussion	Evaluation through: Online quiz (Slido), Short questions Descriptive answers Formative assessment I
	2	Mechanical behavior: Elastic properties – Optical properties: – Surface Plasmon Resonance – Quantum size effects	3	K2(U)	Lecture Discussion with PPT Illustration	
	3	Electrical properties – Conductivity, Ferroelectrics and dielectrics	3	K2(U)	PPT Illustration	
	4	Magnetic properties – super para magnetism – Diluted magnetic semiconductor	3	K2(U)	Lecture Discussion with PPT Illustration	

		(DMS)				
III	**PROPERTIES OF NANOMATERIALS**					
	1	Physical vapour deposition – Chemical vapour deposition – sol-gel – Wet deposition techniques	4	K2(U)	Lecture discussion	Evaluation Evaluation through: Online quiz, Short questions Descriptive answers Formative assessment I/II
	2	Electrochemical deposition method – Plasma arching – Electrospinning method – ball milling technique	4	K3(Ap)	Lecture Discussion with PPT Illustration	
	3	Pulsed laser deposition – Nanolithography: photolithography	4	K3(Ap)	Lecture discussion	
IV	**CHARACTERIZATION TECHNIQUES**					
	1	Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) – UV-visible spectroscopy – Photoluminescence	4	K2(U)	Lecture Discussion with PPT Illustration	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment II
	2	Scanning electron microscopy (SEM) – Transmission electron microscopy (TEM) – Scanning probe microscopy (SPM)	4	K3(Ap)	Lecture discussion	
	3	Scanning tunneling microscopy (STM) – Atomic Force Microscopy (AFM) – Vibrating sample	4	K4(An)	PPT Illustration	

		Magnetometer				
V	**APPLICATIONS OF NANOMATERIALS**					
	1	Sensors: Nanosensors based on optical and physical properties – Electrochemical sensors	3	K2(U)	Short Learning Object(Zoom)	Evaluation through: Online quiz, Short questions Descriptive answers Formative assessment II
	2	Nano-biosensors. Nano Electronics: Nanorobots – display screens – GMR – Carbon Nanotube Emitters – Photocatalytic application	3	K3(Ap)	Lecture Discussion with PPT Illustration	
	3	Medicine: Imaging of cancer cells – biomarkers and bio imaging – Targeted drug delivery – photodynamic therapy –	3	K5(E)	Lecture discussion	
	4	Energy: fuel cells – rechargeable batteries – supercapacitors – photovoltaics.	3	K6(C)	PPT Illustration	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**
Activities (Em/En/SD): **Project**
Course Focussing onCross Cutting Issues (Professional Ethics/ Human Values/ Environment Sustainability/ Gender Equity): -
Activities related to Cross Cutting Issues: Nil
Assignment: (Mention Topic and Type): Applications of nanoparticles in medicine - Google Classroom
Seminar Topic: (if applicable): Nanorobots

Part A (1 mark)

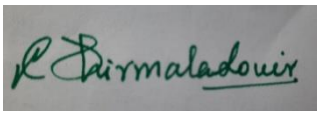
1. Quantum dots possess _____ energy levels. **(K1- R, CO-1)**
   a) discrete b) continuous c) both (a) and (b) d) none of the above
2. Due to the increased surface area to volume ratio in nanomaterials, their _____ is often lower than that of bulk materials, as surface atoms require less energy to break bonds. **(K2- U, CO-2)**
3. Semiconductor nanoparticles are commonly synthesized by arrested precipitation. TRUE/FALSE **(K2- U, CO-3)**
4. Give the Debye Scherrer formula. **(K2- U, CO-4)**
5. MEMS stand for _____. **(K2- U, CO-5)**
   a) Micro-electro mechanical system b) Macro-electro mechanical system
   c) Nano-electro mechanical system d) Mini-electro mechanical system

Part B (3 marks)

1. Enumerate the surface effects of nanomaterials. **(K1- R, CO-1)**
2. Describe the concept super para magnetism in nanomaterials. **(K2-U, CO-2)**
3. Explain the synthesis of nanoparticles by chemical vapour deposition. **(K3- Ap, CO-3)**
4. Construct and explain the principle and experimental setup of X-ray diffraction method. **(K4- An, CO-4)**
5. Classify the different types of GMR. **(K5- E, CO-5)**

Part C (7 marks)

1. Describe in detail about Nanoscale in two dimension materials with suitable example. **(K1- R, CO-1)**
2. Evaluate the elastic and optical properties of nanomaterials. **(K2-U, CO-2)**
3. Interpret the theory of Nanolithography. **(K3- Ap, CO-3)**
4. Explain the principle and working of Scanning electron microscopy (SEM). **(K4- An, CO-4)**
5. Correlate the internal and external control of nanorobots and explain its functioning. **(K5- E, CO-5)**



Head of the Department

Dr.A. Lesly Fathima
Course Instructor

Teaching Plan

Department : Physics
Class : II M.Sc. Physics
Title of the Course : SKILL ENHANCEMENT COURSE III: SOLID WASTE MANAGEMENT
Semester : IV
Course Code : PP234SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Marks		
							CIA	External	Total
PP234SE1	4	-	-	-	2	4	25	75	100

Learning Objectives:

1. To gain basic knowledge in solid waste management procedures.
2. To gain industry exposure and be equipped to take up a job.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	illustrate the different types of solid waste management.	**K1**
2.	infer the concept of Solid Waste Management hierarchy.	**K2**
3.	apply entrepreneurial skills for promoting Waste Treatment Systems.	**K3**
4.	conclude the status of the solid wastes in the nearby areas.	**K4**
5.	defend the management of solid wastes in and around the locality.	**K5**

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	Cognitive level	Pedagogy	Assessment/ Evaluation
I	1.	**SOLID WASTE MANAGEMENT** Introduction - Definition of solid waste - Types – Hazardous Waste:	4	K1(R)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping,	Evaluation through: short test Class Test Quiz through Quizziz
	2.	Resource conservation and Renewal act- - Location Restrictions-	4	K1(R)	Peer tutoring, Lecture	Formative assessment

		Operating Criteria- Clean Air Act			using videos, Demonstration, PPT, Review	through Hot Potatoes
	3.	Amendments of 1990 – Hazardous Waste: Municipal Solid waste and non-municipal solid waste	4	K1(R)	Lecture using Chalk and talk , Group Discussion, Mind mapping,	
II	1.	**SOLID WASTE CHARACTERISTICS** Solid Waste Characteristics: Methods of Characterizing Municipal Solid Waste	4	K2(U)	Peer tutoring, Lecture using videos, Derivation, PPT, Review	Evaluation through: short test Class Test
	2.	Solid Waste Management hierarchy - Directing Material Flows- Preventing and Reducing	4	K2(U)	Lecture using Chalk and talk , Group Discussion, Mind mapping,	Match the following through Hot Potatoes
	3.	Waste- The Great R's: Re-use, Recycle, Recover- Recovering Materials and Energy from Waste	4	K2(U)	Peer tutoring, Lecture using videos, Problem solving, Demonstration, PPT, Review	Formative assessment through Quizziz
III	1.	**TOOLS AND EQUIPMENT** Assessment Tools for	4	K3(Ap)	Lecture using Chalk and	Evaluation through: short test

		Waste Treatment Systems- An Introduction to Life-			talk ,Introductory session, Group Discussion, Mind mapping	Class Test
	2.	Cycle Assessment- Mechanical Sorting Processes and Material Recycling-	4	K3(Ap)	Peer tutoring, Lecture using videos, Demonstration, PPT, Review	Match the following through Hot Potatoes
	3.	Glass Recycling- Recycling of Paper and Cardboard - Transportation - Disposal techniques	4	K3(Ap)	Lecture using Chalk and talk , Group Discussion, Mind mapping,	Formative assessment through Quizziz
IV	1.	**ECONOMIC DEVELOPMENT** Solid Waste Management for economic development – Mixed MSW composting	4	K4(An)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping	Evaluation through: short test Class Test
	2.	Yard waste composting - environmental protection – Water and air resources – Vectors – Industrial health and safety	4	K4(An)	Peer tutoring, Lecture using videos, Demonstration, PPT,	Match the following through Hot Potatoes

					Review	
	3.	Fires – Constrains on use of the compost - Linking Solid Waste Management and climate change	4	K4(An)	Lecture using Chalk and talk , Group Discussion, Mind mapping,	Formative assessment through Quizziz
V	1	**LANDFILLING** The landfill method of solid waste disposal – Classification of landfills – Landfilling methods	4	K5(E)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping	Evaluation through: short test Class Test
	2	Reactions occurring in landfills – Composition of landfill gas –	4	K5(E)	Peer tutoring, Lecture using videos, Demonstration, PPT, Review	Match the following through Hot Potatoes
	3	Management of landfill – Structural characteristics – Settlement of landfills	4	K5(E)	Lecture using Chalk and talk , Group Discussion, Mind mapping,	Formative assessment through Quizziz

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

Activities (Em/ En/SD): Problem solving on one and two dimensional system: **Industrial Visit**

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

Activities related to Cross Cutting Issues : **Case Study**

Assignment : Glass Recycling

Seminar Topic: Land filling

Sample questions

Part A

1. Which of the following acts regulates hazardous waste management in the United States? **(K1-R, CO-1)**
   a) Clean Air Act b) Water Pollution Control Act
   c) Resource Conservation and Recovery Act
   d) National Environmental Policy Act
2. Which hierarchy step in solid waste management prioritizes minimizing waste creation? **(K2-U, CO-2)**
   a) Disposal b) Recovery c) Prevention and reduction d) Transportation

Which process in solid waste management is primarily focused on separating materials for recycling? **(K3-Ap, CO-3)**

a) Landfilling b) Mechanical sorting c) Incineration d) Composting

3. Which type of waste is typically included in municipal solid waste (MSW)? **(K4-An, CO-4)**
   a) Industrial sludge b) Household waste c) Radioactive waste d) Agricultural waste
4. Which of the following is NOT considered a major factor for environmental protection in solid waste management? **(K5-E, CO-5)**
   a) Air quality b) Vector control c) Waste prevention d) Material pricing

Part B

1. Define solid waste and give two examples. **(K1-R, CO-1)**
2. What is the purpose of the Clean Air Act Amendments of 1990 in relation to solid waste management? **(K2-U, CO-2)**
3. Explain the concept of the "Great R's" in solid waste management. **(K3-Ap, CO-3)**
4. What is life-cycle assessment, and how is it used in waste treatment systems? **(K4-An, CO-4)**
5. Describe one economic benefit of effective solid waste management. **(K5-E, CO-5)**

Part C

1. Discuss the different types of solid waste and the key methods for their safe management. **(K1-R, CO-1)**
2. Examine the role of solid waste management in economic development and environmental protection. .**(K2-U, CO-2)**
3. Analyze the landfill method of solid waste disposal and discuss the chemical and biological reactions that occur within landfills. **(K3-Ap, CO-3)**
4. Evaluate the effectiveness of various solid waste treatment tools and equipment in reducing environmental impact. **(K4-An, CO-4)**
5. Discuss how solid waste management practices contribute to climate change mitigation. **(K5-E, CO-5)**

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Head of the Department

Dr. M. Abila Jeba Queen & Dr. P. Aji Udhaya
Course Instructors