M.Sc., PHYSICS

Syllabus

Program Code: PPH

2023 - Onwards

MANNAR THIRUMALAI NAICKER COLLEGE

(AUTONOMOUS)

Re-accredited with "A" Grade by NAAC

PASUMALAI, MADURAI – 625 004

GUIDLINESS FOR OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM

(FOR PG PROGRAM FROM 2023 -2024 ONWARDS)

ELIGIBILITY CONDITION FOR ADMISSION

For admission to Post Graduate Programmers (P.G) a candidate should have passed the 3years degree course (under 10 + 2 + 3 pattern) recognized by the university as equivalent there to.

DURATION

Two years. Each year consists of 2 semesters. The duration of a semester is 90 working days.

ATTENDANCE

75% of the classes in each semester shortage of attendance can be condoned as per existing university rules.

EVALUATION PROCEDURE:

A mark Statement with CGPA = $\frac{\sum(MarksXcredits)}{\sum(Credits)}$

Where the summations are over all paper appeared up to the current semester.

Examinations: 3 hours duration.

Total marks 100 for all papers

External Internal ratio 75:25 with 2 Internal tests.

Subjects of Study

The courses offered under the PG programs belong to the following categories:

1. Core Subjects
2. Electives
3. Non Major Electives (NME)
4. Skill Enhancement course

CBCS COURSE STRUCTURE - PG COURSES

M.A. (Tamil) - M.A. (English) – M.Com. – M.Com (CA) – M.S.W. M.Sc. (Mathematics) - M.Sc. (CS) - M.Sc. (CS&IT)

Semester–I	**Credit**	**Semester-II**	**Credit**	**Semester-III**	**Credit**	**Semester–IV**	**Credit**
1.1. Core-I	4	2.1. Core-IV	4	3.1. Core-VII	4	4.1. Core-X	4
1.2 Core-II	4	2.2 Core-V	4	3.2 Core-VII	4	4.2 Core-XI	4
1.3 Core – III	4	2.3 Core – VI	4	3.3 Core – IX	4	4.3 Core – XII	4
1.4 Elective (Generic / Discipline Centric)- I	3	2.4 Elective (Generic / Discipline Centric) – III	3	3.4 Elective (Generic / Discipline Centric) – V	3	4.4 Elective (Generic / Discipline Centric) – VI	3
1.5 Elective (Generic / Discipline Centric)-II	3	2.5 Elective (Generic / Discipline Centric)-IV	3	3.5 Core Industry Module	3	4.5 Project with Viva-Voce	3
1.6Ability Enhancement Course- Soft Skill -1	2	2.6 Ability Enhancement Course - Soft Skill -2	2	3.6 Ability Enhancement Course- Soft Skill -3	2	4.6 Ability Enhancement Course- Soft Skill -4	2
Skill Enhancement Course SEC 1	2	2.7 Skill Enhancement Course SEC 2	2	3.7 Skill Enhancement Course – Term Paper and Seminar Presentation SEC 3	2	4.7 Skill Enhancement Course - Professional Competency Skill	2
				3.8 Internship/ Industrial Activity	2	4.8 Extension Activity	1
	22		**22**		**24**		**23**
						Total Credit Points	**91**

QUESTION PAPER PATTERN FOR THE CONTINUOUS INTERNAL ASSESSMENT

Note: Duration – 1 hour 30 minutes

The components for continuous internal assessment are:

Part –A

Four multiple choice questions (answer all)	4 x01= 04 Marks

Part –B

Two questions (‘either …. or ‘type)	2 x 05=10 Marks

Part –C

Two questions (‘either …. or ‘type)	2 x 08=16 Marks

Total	40 Marks

The components for continuous internal assessment are:

(40 Marks of two continuous internal assessments will be converted to 15 marks)

Two tests and their average	--15 marks
Seminar /Group discussion	--5 marks
Assignment	--5 marks

Total	25 Marks

OUTCOME BASED EDUCATION

1. Course is defined as a theory, practical or theory cum practical subject studied in a semester. For e.g. Computer Applications Management

2. Course Outcome (CO) Course outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Outcomes may be specified for each course based on its weightage.

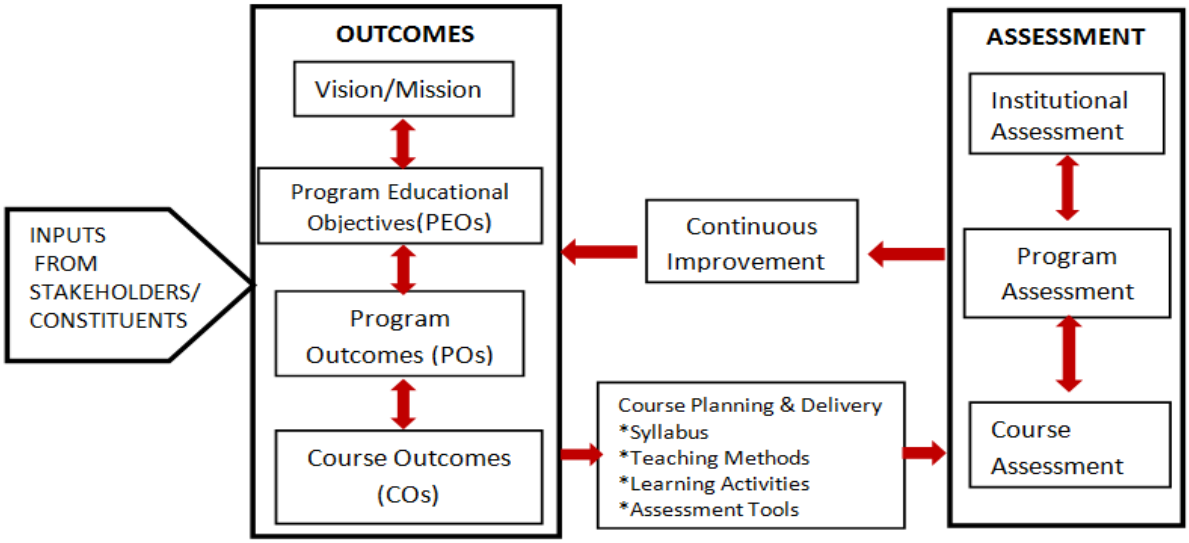
3. Program is defined as the specialization or discipline of a Degree. It is the interconnected arrangement of courses, co-curricular and extracurricular activities to accomplish predetermined objectives leading to the awarding of a degree.

4. Program Outcomes (POs) Program outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be Guidelines for Outcome Based Education System 4 aligned closely with Graduate Attributes.

5. Program Educational Objectives (PEOs) of a program are the statements that describe the expected achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after graduation.

6. Program Specific Outcomes (PSO) are what the students should be able to do at the time of graduation with reference to a specific discipline. Usually there are two to four PSOs for a Program.

7. Graduate Attributes (GA): The graduation attributes, are exemplars of the attributes expected of a graduate from a Program



INSTITUTIONAL VISION

To Mould the learners into accomplished individuals by providing them with a stimulus for social change through character, confidence and competence.

INSTITUTIONAL MISSION

1. Enlightening the learners on the ethical and environmental issues.

2. Extending holistic training to shape the learners in to committed and competent citizens.

3. Equipping them with soft skills for facing the competitive world.

4. Enriching their employability through career oriented courses.

5. Ensuring accessibility and opportunity to make education affordable to the underprivileged.

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced mathematical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Mathematics based problem solving skills are included as mandatory components in the ‘Training for Competitive Examinations’ course at the final semester, a first of its kind.

- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest - Artificial Intelligence.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS),
MADURAI – 625 004
M. SC PHYSICS CURRICULUM
(For the student admitted during the academic year 2023-2024 onwards)

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
FIRST SEMESTER						
Part – III	**Core Courses**					
23PPHCC11	MATHEMATICAL PHYSICS	6	5	25	75	100
23PPHCC12	CLASSICAL MECHANICS	6	5	25	75	100
23PPHCP11	PRACTICAL - I	6	4	25	75	100
Part – III	**Elective Courses**					
23PPHEC11	PHYSICS OF NANO SCIENCE AND TECHNOLOGY	6	3	25	75	100
23PPHEC12	LINEAR AND DIGITAL ICS AND APPLICATIONS	6	3	25	75	100
	Total	30	20	125	375	500
SECOND SEMESTER						
Part – III	**Core Courses**					
23PPHCC21	STATISTICAL MECHANICS	6	5	25	75	100
23PPHCC22	QUANTUM MECHANICS – I	6	5	25	75	100
23PPHCP21	PRACTICAL – II	6	4	25	75	100
Part – III	**Elective Courses**					
23PPHEC21	ADVANCED OPTICS	5	3	25	75	100
23PPHEC22	MEDICAL PHYSICS	5	3	25	75	100
Part – IV	**Skill Enhancement course**					
23PPHSC21	SEWAGE AND WASTE WATER TREATMENT AND REUSE	2	2	25	75	100
	Total	30	22	150	450	600


FIRST SEMESTER

Course Name	MATHEMATICAL PHYSICS			
Course Code	23PPHCC11	**L**	**P**	**C**
Category	CORE	6	-	5

COURSE OBJECTIVES:

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

UNIT - I LINEARVECTOR SPACE 17

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.

UNIT - II COMPLEXANALYSIS 19

Review of Complex Numbers -de Moivre's theorem-Functions of a Complex Variable- Differentiability - Analytic functions- Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem and its Application: Potential theory - (1) Electrostatic fields and complex potentials - Parallel plates, coaxial cylinders and an annular region (2) Heat problems - Parallel plates and coaxial cylinders.

UNIT - III MATRICES 17

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.

UNIT - IV	FOURIERTRANSFORMS &LAPLACETRANSFORMS	19

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.

UNIT - V	DIFFERENTIAL EQUATIONS	18

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.

Total Lecture Hours	**90**

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- E. Kreyszig, 1983, Advanced Engineering Mathematics, Wiley Eastern, New Delhi,
- D. G. Zill and M. R. Cullen, 2006, Advanced Engineering Mathematics, 3rd Ed. Narosa, New Delhi.
- S. Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw - Hill, New York 3. E. Butkov, 1968, Mathematical Physics Addison - Wesley, Reading, Massachusetts.
- P. R. Halmos, 1965, Finite Dimensional Vector Spaces, 2nd Edition, Affiliated East West, New Delhi
- C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6 th Edition, International Edition, McGraw-Hill, New York

WEB RESOURCES:

- **www.khanacademy.org**
- **https://youtu.be/LZnRlOA1_2I**
- **http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath**
- **https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qa**

- https://archive.nptel.ac.in/courses/115/106/115106086/

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change	**60**	No Changes Made		New Course			
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**								

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students 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 to K5**
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.	**K1 to K5**
CO3	Analyze characteristics of matrices and its different types, and the process of diagonalization.	**K1 to K5**
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	**K1 to 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	**K1 to K5**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	3

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	3	3	3	3	2	3	2
CO 2	2	3	3	3	3	3	3	2	2	2
CO 3	3	3	3	2	2	3	3	2	3	2

CO 4	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**2**
CO 5	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**3**
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	Mathematical Physics	HRS	PEDAGOGY
I	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	**17**	**Chalk &Talk, PPT, Seminar**
II	Review of Complex Numbers -de Moivre's theorem-Functions of a Complex Variable- Differentiability -Analytic functions- Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem and its Application: Potential theory - (1) Electrostatic fields and complex potentials - Parallel plates, coaxial cylinders and an annular region (2) Heat problems - Parallel plates and coaxial cylinders	**19**	**Chalk &Talk, PPT**
III	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.	**17**	**Chalk &Talk, Assignment**
IV	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	**19**	**Chalk &Talk, Group discussion**

	functions - Application - Laplace equation: Potential problem in a semi - infinite strip.		
V	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.	**18**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	**Cos**	**K Level**	**Section A**		**Section B Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 to K5**	2	K1, K2	2 (K2, K2)	2 (K2, K2)
	CO2	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K3, K3)
CI AII	**CO3**	**K1 to K5**	2	K1, K2	2 (K2, K2)	2 (K3, K3)
	CO4	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.57	
	K2	2	10	16	28	50	
	K3		10	16	26	46.43	53.57
	K4						
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.57	
	K2	2	10		12	21.43	
	K3		10	16	26	46.43	25
	K4			16	16	28.57	71.43
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K2, K2)
2	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
3	CO3	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K3, K3)
4	CO4	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
5	CO5	K1 to K5	2	K1, K2	2 (K4, K4)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	**Section A (Multiple Choice Questions)**	**Section B (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**5**			**5**	**3.57**	**-**
K2	**5**	**20**	**16**	**41**	**29.29**	
K3		**20**	**32**	**52**	**37.14**	**32.86**
K4		**10**	**16**	**26**	**18.57**	**70**
K5			**16**	**16**	**11.43**	**88.57**
Marks	**10**	**50**	**80**	**140**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions			**PART – A**	**(10 x 1 = 10 Marks)**	
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions **PART – B**				**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K4**	
		OR		
15. b)	**Unit - V**	**CO5**	**K4**	

Answer **ALL** the questions **PART – C(5 x 8 = 40 Marks)**				
16. a)	**Unit - I**	**CO1**	**K2**	
		OR		
16. b)	**Unit - I**	**CO1**	**K2**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	

Course Name	CLASSICAL MECHANICS			
Course Code	23PPHCC12	**L**	**P**	**C**
Category	CORE	6	-	5

COURSE OBJECTIVES:

- To understand fundamentals of classical mechanics.
- To understand Lagrangian formulation of mechanics and apply it to solve equation of motion.
- To understand Hamiltonian formulation of mechanics and apply it to solve equation of motion.
- To discuss the theory of small oscillations of a system.
- To learn the relativistic formulation of mechanics of a system.

UNIT - I PRINCIPLES OFCLASSICAL MECHANICS 17

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.

UNIT - II LAGRANGIAN FORMULATION 17

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

UNIT - III HAMILTONIAN FORMULATION 19

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.

UNIT - IV SMALL OSCILLATIONS 17

Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.

UNIT - V CANONICAL TRANSFORMATIONS 20

The equations of canonical transformation-Examples of canonical transformations-The harmonic oscillator-The simplistic approach to canonical transformations-Poisson brackets and other canonical invariants-Equation of motion, infinitesimal canonical transformations, and conservation theorems in the Poisson Bracket formulation- The angular momentum Poisson bracket relations, symmetry groups in mechanical systems-Liouville's theorem.

Total Lecture Hours 90

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- K. R. Symon, 1971, Mechanics, Addison Wesley, London.
- S. N. Biswas, 1999, Classical Mechanics, Books & Allied, Kolkata.
- Gupta and Kumar, Classical Mechanics, KedarNath.
- T.W.B. Kibble, Classical Mechanics, ELBS.
- Greenwood, Classical Dynamics, PHI, New Delhi.

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY			SKILL ORIENTED	✓	ENTREPRENEURSHIP				
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓		
Changes Made in the Course	Percentage of Change	**60**		No Changes Made		New Course				

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Understand the fundamentals of classical mechanics.	K1 to K5
CO2	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	K1 to K5
CO3	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	K1 to K5
CO4	Analyze the small oscillations in systems and determine their normal modes of oscillations.	K1 to K5
CO5	Understand and apply the principles of relativistic kinematics to the mechanical systems.	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	2	2	2	3	2	2
CO2	2	3	3	3	2	2	2	3	2	2
CO3	2	3	3	3	2	2	2	3	2	2
CO4	2	3	3	3	2	2	2	3	2	2
CO5	2	3	3	3	2	2	2	3	2	2

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	3	3	3	3	2	3	2
CO 2	2	3	3	3	3	3	3	2	2	2
CO 3	3	3	3	2	2	3	3	2	3	2
CO 4	3	3	3	3	2	3	3	2	2	2
CO 5	3	2	3	3	2	3	3	2	2	2
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	CLASSICAL MECHANICS	HRS	PEDAGOGY

I	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.	**17**	**Chalk &Talk, PPT, Seminar**
II	D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.	**17**	**Chalk &Talk, PPT**
III	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.	**19**	**Chalk &Talk, Assignment**
IV	Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.	**17**	**Chalk & Talk, Assignment**
V	The equations of canonical transformation-Examples of canonical transformations-The harmonic oscillator-The simplistic approach to canonical transformations-Poisson brackets and other canonical invariants-Equation of motion, infinitesimal canonical transformations, and conservation theorems in the Poisson Bracket formulation- The angular momentum Poisson bracket relations, symmetry groups in mechanical systems-Liouville's theorem.	**20**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of. Questions	K - Level		
CI AI	**CO1**	**K1 to K5**	2	K1, K2	2 (K2, K2)	2 (K2, K2)
	CO2	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K3, K3)
CI AII	**CO3**	**K1 to K5**	2	K1, K2	2 (K2, K2)	2 (K3, K3)
	CO4	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.57	
	K2	2	10	16	28	50	
	K3		10	16	26	46.43	53.57
	K4						
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.57	
	K2	2	10		12	21.43	
	K3		10	16	26	46.43	25
	K4			16	16	28.57	71.43
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K2, K2)
2	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
3	CO3	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
4	CO4	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K5, K5)
5	CO5	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K3, K3)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	**Section A (Multiple Choice Questions)**	**Section B (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**5**			**5**	**3.57**	
K2	**5**	**20**	**16**	**41**	**29.29**	
K3		**30**	**32**	**62**	**44.28**	**32.86**
K4			**16**	**16**	**11.43**	**77.14**
K5			**16**	**16**	**11.43**	**88.57**
Marks	**10**	**50**	**80**	**140**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions **PART – B**				**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K2**	
		OR		
15. b)	**Unit - V**	**CO5**	**K2**	

Answer **ALL** the questions **PART – C(5 x 8 = 40 Marks)**				
16. a)	**Unit - I**	**CO1**	**K2**	
		OR		
16. b)	**Unit - I**	**CO1**	**K2**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K4**	
		OR		
18. b)	**Unit - III**	**CO3**	**K4**	
19. a)	**Unit - IV**	**CO4**	**K5**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K5**	
20. a)	**Unit - V**	**CO5**	**K3**	
		OR		
20. b)	**Unit - V**	**CO5**	**K3**	

Course Name	PRACTICAL - I			
Course Code	23PPHCP11	**L**	**P**	**C**
Category	CORE	-	6	4

COURSE OBJECTIVES:

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

Course Details

(Any Twelve Experiments)

1. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes - Cornu's Method
2. Determination of Viscosity of the given liquid – Meyer's disc
3. Measurement of Coefficient of linear expansion- Air wedge Method
4. B-H loop using Anchor ring.
5. Determination of Thickness of the enamel coating on a wire by diffraction
6. Determination of Rydberg's Constant - Hydrogen Spectrum
7. FP Etalon
8. Determination of Thickness of air film. - Solar spectrum – Hartmann's formula. Edser and Butler fringes.
9. Measurement of Band gap energy- Thermistor
10. Determination of Planck Constant – LED Method
11. Determination of Specific charge of an electron – Thomson's method.
12. Determination of Compressibility of a liquid using Ultrasonics
13. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer
14. GM counter – Characteristics, inverse square law and absorption coefficient.
15. Measurement of Conductivity - Four probe method.
16. Arc spectrum – Iron.
17. Molecular spectra – AlO band.
18. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.

19. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
20. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
21. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square, Receiver end transmitter behavior, Radiation Pattern - Microwave test bench
22. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient
23. Construction of relaxation oscillator using UJT
24. FET CS amplifier- Frequency response, input impedance, output impedance
25. Study of important electrical characteristics of IC741.
26. V- I Characteristics of different colours of LED.
27. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
28. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
29. Constructions of Schmidt trigger circuit using IC 741 for a given hysteresis- application as squarer.
30. Construction of square wave Triangular wave generator using IC 741
31. Construction of a quadrature wave using IC 324
32. Construction of pulse generator using the IC 741 – application as frequency divider
33. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
34. Study of Binary to Gray and Gray to Binary code conversion.
35. Study of R-S, clocked R-S and D-Flip flop using NAND gates
36. Study of J-K, D and T flip flops using IC 7476/7473
37. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
38. Study of Arithmetic logic unit using IC 74181.
39. Construction of Encoder and Decoder circuits using ICs.

BOOKS FOR STUDY:

- Practical Physics, Gupta and Kumar, PragatiPrakasan.
- Kit Developed for doing experiments in Physics- Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences.
- Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
- Electronic lab manual Vol I, K ANavas, Rajath Publishing.
- Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition.

BOOKS FOR REFERENCES:

- Advanced Practical Physics, S.P Singh, PragatiPrakasan.
- An advanced course in Practical Physics, D. Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd
- Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
- A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.
- Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing.

WEB RESOURCES:

- **https://unacademy.com/content/upsc/study-material/physics/shapes-of-interference-fringes-in-youngs-double-slit-experiment/**
- **https://www.teachspin.com/diode-laser-spectroscopy**
- **https://vikramlearning.com/jntuh/notes/electronic-circuits-and-pulse-circuits-lab/ujt-relaxation-oscillator/280**
- **https://www.geeksforgeeks.org/4-bit-binary-adder-subtractor/**
- **https://he-coep.vlabs.ac.in/exp/decoders-encodersmultiplexer-demultiplexer/theory.html**

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED			ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL			GLOBAL		✓
Changes Made in the Course	Percentage of Change		**90**	No Changes Made			New Course			
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**										

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Understand the strength of material using Young's modulus.	K1 to K5
CO2	Acquire knowledge about arc spectrum and applications of laser	K1 to K5
CO3	Conduct experiments on applications of UJT and arithmetic and logical circuits using IC's	K1 to K5
CO4	Analyze various parameters related to operational amplifiers.	K1 to K5
CO5	Improve the analytical and observation ability in Physics Experiments	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	3	2	2	2	1	2	3
CO2	2	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	2	2	3	2	2	2	1	2	3
CO2	2	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

Experiments	PRACTICAL - I	HRS	PEDAGOGY
1 to 4	Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes - Cornu's Method. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.	30	Chalk & Talk, PPT

	Measurement of Conductivity - Four probe method. Construction of relaxation oscillator using UJT.		
5 to 8	Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp. Construction of square wave Triangular wave generator using IC 741. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type).	**30**	**Chalk & Talk, PPT**
9 to 12	Study of Binary to Gray and Gray to Binary code conversion. Study of R-S, clocked R-S and D-Flip flop using NAND gates. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction. Construction of Encoder and Decoder circuits using ICs.	**30**	**Chalk & Talk, PPT**

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total
25	75	100

Record Note and Attendance -10 mark
Model examination - 15 mark

Total CIA - 25 mark

Model examination should be conducted for 30 mark and it has to be converted to 15 mark

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	**Cos**	**K Level**	**No. of. Questions**	**K - Level**
CIA-I	**CO1 – CO5**	**K1 – K5**	**1 Question for Each Student**	**K1 – K5**
Question Pattern CIA - I		**No. of Questions to be asked**	**1 Question for Each Student**	
		No. of Questions to be answered	**1**	
		Marks for each question	**30**	
		Total Marks for each section	**30**	

Distribution of Marks with COs &K Level for Correction of CIA I					
	COs	**K - Level**	**Distribution of the work of the experiment**	**K - Level**	**MARKS**
CIA I	**CO1**	**K1 to K5**	Aim and apparatus	**K1**	**2.0**
	CO2	**K1 to K5**	Formula and Tabular Column	**K3**	**5.0**
	CO3	**K1 to K5**	Understanding and Observation	**K5**	**10.0**
	CO4	**K1 to K5**	Calculation and Graph	**K4**	**10.0**
	CO5	**K1 to K5**	Interpretation of result	**K2**	**3.0**
	Total Marks				**30**

Distribution of Marks with K Level CIA I					
	K Level	**Distribution of the work of the experiment**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	K1	Aim and apparatus	2	6.67	-
	K3	Formula and Tabular Column	5	16.67	
	K5	Understanding and Observation	10	33.33	**23.34**
	K4	Calculation and Graph	10	33.33	**56.67**
	K2	Interpretation of result	3	10.00	**90.00**
	Marks		**30**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

K5 – Evaluating, interpreting and concluding the results with accurate measurements**.**

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)			
COs	**K - Level**	**No. of Questions**	**K – Level**
CO1- CO5	**K1 – K5**	**1** Question for Each Student	**K1 – K5**
No. of Questions to be Asked		**1** Question for Each Student	
No. of Questions to be answered		**1**	
Marks for each question		**75**	
Total Marks for each section		**75**	

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)			
COs	**K - Level**	**No. of Questions**	**K – Level**
CO1- CO5	**K1 – K5**	**1** Question for Each Student	**K1 – K5**
No. of Questions to be Asked		**1** Question for Each Student	
No. of Questions to be answered		**1**	
Marks for each question		**75**	
Total Marks for each section		**75**	

Distribution of Marks with K Level				
K Level	**Parameters for K-Level**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**Aim and apparatus**	**10**	**13.33**	**13**
K3	**Formula and Tabular Column**	**15**	**20**	**20**
K5	**Understanding and Observation**	**30**	**40**	**40**
K4	**Calculation and Graph**	**15**	**20**	**20**
K2	**Interpretation of result**	**5**	**6.67**	**7**
Marks		**75**	**100**	**100**

Course Name	PHYSICS OF NANOSCIENCE AND TECHNOLOGY			
Course Code	23PPHEC11	**L**	**P**	**C**
Category	ELECTIVE	6	-	3

COURSE OBJECTIVES:

- Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.
- To provide the basic knowledge about nanoscience and technology.
- To learn the structures and properties of nanomaterials.
- To acquire the knowledge about synthesis methods and characterization techniques and its applications.

UNIT – I FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY 17

Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology -– Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.

UNIT - II PROPERTIES OF NANOMATERIALS 19

Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior: Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).

UNIT - III SYNTHESIS AND FABRICATION 17

Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography –Nanomanipulator.

UNIT - IV CHARACTERIZATION TECHNIQUES 18

Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.

UNIT - V APPLICATIONS OF NANOMATERIALS 19

Sensors: Nanosensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters –Photocatalytic application: Air purification, water purification -Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries - supercapacitors-photovoltaics.

Total Lecture Hours 90

BOOKS FOR STUDY:

- A textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw-Hill Publishing Co. (2012).
- Principles of Nanoscience and Nanotechnology, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010).
- Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay and A.N. Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012).
- Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, (2002).
- Nanotechnology and Nanoelectronics, D.P. Kothari,V. Velmurugan and Rajit Ram Singh, Narosa Publishing House Pvt. Ltd, New Delhi. (2018).

BOOKS FOR REFERENCES:

- E. Kreyszig, 1983, Advanced Engineering Mathematics, Wiley Eastern, New Delhi,
- D. G. Zill and M. R. Cullen, 2006, Advanced Engineering Mathematics, 3rd Ed. Narosa, New Delhi.
- S. Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw - Hill, New York 3. E. Butkov, 1968, Mathematical Physics Addison - Wesley, Reading, Massachusetts.
- P. R. Halmos, 1965, Finite Dimensional Vector Spaces, 2nd Edition, Affiliated East West, New Delhi.
- C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6 th Edition, International Edition, McGraw-Hill, New York

WEB RESOURCES:

- **www.khanacademy.org**
- **https://youtu.be/LZnRlOA1_2I**
- **http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath**
- **https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qa**
- **https://archive.nptel.ac.in/courses/115/106/115106086/**

Nature of Course	EMPLOYABILITY			SKILL ORIENTED			ENTREPRENEURSHIP		✓			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL			GLOBAL	✓			
Changes Made in the Course	Percentage of Change		**60**	No Changes Made			New Course					
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**												

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Understand the basic of Nano science and explore the different types of nanomaterial's and should comprehend the surface effects of the nanomaterial's.	K1 to K5
CO2	Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterial's.	K1 to K5
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterial's.	K1 to K5
CO4	Analyze the various characterizations of Nano-products through diffraction, spectroscopic, microscopic and other techniques.	K1 to K5
CO5	Apply the concepts of Nano science and technology in the field of sensors, robotics, purification of air and water and in the energy devices.	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	1	1	3	3	3	3
CO2	3	3	3	2	1	1	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3
CO4	3	3	3	2	1	1	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	2	1	1	3	3	3	3
CO 2	3	3	3	2	1	1	3	3	3	3
CO 3	3	3	2	2	1	1	3	3	3	3
CO 4	3	3	3	2	1	1	3	3	3	3
CO 5	3	3	2	2	1	1	3	3	3	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	PHYSICS OF NANOSCIENCE AND TECHNOLOGY	HRS	PEDAGOGY
I	Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology -– Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.	17	Chalk &Talk, PPT, Seminar

II	Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior: Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).	**19**	**Chalk &Talk, PPT**
III	Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography – Nanomanipulator.	**17**	**Chalk &Talk, Assignment**
IV	Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.	**18**	**Chalk & Talk, Assignment**
V	Sensors: Nanosensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters – Photocatalytic application: Air purification, water purification -Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries - supercapacitors - photovoltaics.	**19**	**Chalk & Talk, Seminar**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of. Questions	K - Level		
CI AI	CO1	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K3, K3)
	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
CI AII	CO3	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K3, K3)
	CO4	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.57	-
	K2	2	10		12	21.43	
	K3		10	16	26	46.43	25
	K4			16	16	28.57	71.43
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.57	-
	K2	2	10		12	21.43	
	K3		10	16	26	46.43	25
	K4			16	16	28.57	71.43
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K – LEVEL
			No. of Questions	K – Level		
1	CO1	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K3, K3)
2	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
3	CO3	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K3, K3)
4	CO4	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
5	CO5	K1 to K5	2	K1, K2	2 (K4, K4)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	**Section A (Multiple Choice Questions)**	**Section B (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**5**			**5**	**3.57**	**-**
K2	**5**	**20**		**25**	**17.86**	**-**
K3		**20**	**32**	**52**	**37.14**	**21.43**
K4		**10**	**32**	**42**	**30**	**58.57**
K5			**16**	**16**	**11.43**	**88.57**
Marks	**10**	**50**	**80**	**140**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions **PART – B**				**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K4**	
		OR		
15. b)	**Unit - V**	**CO5**	**K4**	

Answer **ALL** the questions **PART – C(5 x 8 = 40 Marks)**				
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	

Course Name	LINEAR AND DIGITAL ICS AND APPLICATIONS			
Course Code	23PPHEC12	**L**	**P**	**C**
Category	ELECTIVE	6	-	3

COURSE OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of PLL.
- To introduce the concepts of waveform generation and introduce one special function ICs.
- Exposure to digital IC‘s

UNIT - I INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER 16

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

UNIT - II APPLICATIONS OF OP-AMP 18

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.

UNIT - III ACTIVE FILTERS &TIMER AND PHASE LOCKED LOOPS 19

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), low pass filter, monolithic PLL and applications of PLL

UNIT - IV VOLTAGE REGULATOR & D to A AND A to D CONVERTERS 17

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.

UNIT - V	CMOS LOGIC,COMBINATIONAL CIRCUITS USING TTL 74XX ICs & SEQUENTIAL CIRCUITS USING TTL 74XX ICs	20

CMOS LOGIC: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic. COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, 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).

Total Lecture Hours **90**

BOOKS FOR STUDY:

- D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt. Ltd., New Delhi, India
- Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.
- B.L. Theraja and A.K. Theraja, 2004, A Textbook of Electrical technology, S. Chand & Co.
- V.K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
- V. Vijayendran, 2008, Introduction to Integrated electronics (Digital & Analog), S. Viswanathan Printers & Publishers Private Ltd, Reprint. V.

BOOKS FOR REFERENCES:

- Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
- Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.
- Malvino and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw Hill, New Delhi
- Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
- Integrated Electronics, Millman&Halkias, Tata McGraw Hill, 17th Reprint (2000).

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change	**60**	No Changes Made		New Course			
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**								

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems	**K1 to K5**
CO2	Develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits.	**K1 to K5**
CO3	Gain knowledge about PLL, and develop the skills to design the simple circuits using IC 555 timer and can solve problems related to it.	**K1 to K5**
CO4	Learn about various techniques to develop A/D and D/A converters.	**K1 to K5**
CO5	Acquire the knowledge about the CMOS logic, combinational and sequential circuits	**K1 to K5**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	2	3	3	3	2
CO2	3	3	3	3	1	3	3	3	2	1
CO3	3	3	3	3	1	3	3	3	2	1
CO4	3	3	3	3	1	3	3	3	2	1
CO5	3	3	3	2	1	1	2	3	2	1

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	3	2	2	3	3	3	2
CO 2	3	3	3	3	1	3	3	3	2	1
CO 3	3	3	3	3	1	3	3	3	2	1
CO 4	3	3	3	3	1	3	3	3	2	1
CO 5	3	3	3	2	1	1	2	3	2	1
WEIGTAGE										
WEIGHTED PERCENTAGE OF										

COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	LINEAR AND DIGITAL ICs AND APPLICATIONS	HRS	PEDAGOGY
I	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.	16	Chalk &Talk, PPT, Seminar
II	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	Chalk &Talk, PPT
III	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), low pass filter, monolithic PLL and applications of PLL	19	Chalk &Talk, Assignment
IV	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.	17	Chalk & Talk, Assignment
V	CMOS LOGIC: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic. COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, 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).	20	Seminar, PPT, Chalk &Talk

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	**Cos**	**K Level**	**Section A**		**Section B Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 to K5**	2	K1, K2	2 (K2, K2)	2 (K2, K2)
	CO2	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K3, K3)
CI AII	**CO3**	**K1 to K5**	2	K1, K2	2 (K2, K2)	2 (K3, K3)
	CO4	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**			**2**	**3.57**	
	K2	**2**	**10**	**16**	**28**	**50**	
	K3		**10**	**16**	**26**	**46.43**	**53.57**
	K4						
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	**2**			**2**	**3.57**	
	K2	**2**	**10**		**12**	**21.43**	
	K3		**10**	**16**	**26**	**46.43**	**25**
	K4			**16**	**16**	**28.57**	**71.43**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K2, K2)
2	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
3	CO3	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
4	CO4	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K4, K4)
5	CO5	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.57	-
K2	5	20	16	41	29.29	-
K3		30	32	62	44.28	32.86
K4			16	16	11.43	77.14
K5			16	16	11.43	88.57
Marks	10	50	80	140	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions **PART – B**				**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K2**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K2**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions **PART – C(5 x 8 = 40 Marks)**				
16. a)	**Unit - I**	**CO1**	**K2**	
		OR		
16. b)	**Unit - I**	**CO1**	**K2**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	


SECOND SEMESTER

Course Name	STATISTICAL MECHANICS			
Course Code	23PPHCC21	**L**	**P**	**C**
Category	CORE	6	-	5

COURSE OBJECTIVES:

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

UNIT - I PHASE TRANSITIONS 18

Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics. Order parameters – Landau's theory of phase transition - Critical indices - Scale transformations and dimensional analysis.

UNIT - II STATISTICAL MECHANICS AND THERMODYNAMICS 18

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

UNIT - III CANONICAL AND GRAND CANONICAL ENSEMBLES 16

Trajectories and density of states - Liouville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations.

UNIT - IV CLASSICAL AND QUANTUM STATISTICS 18

Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT - V REAL GAS,ISING MODEL AND FLUCTUATIONS 20

Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one dimension. Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin's theory - Fluctuation-dissipation theorem - The Fokker-Planck equation.

Total Lecture Hours 90

BOOKS FOR STUDY:

- S. K. Sinha, 1990, Statistical Mechanics, Tata McGraw Hill, New Delhi.
- B. K. Agarwal and M. Eisner, 1998, Statistical Mechanics, Second Edition New Age International, New Delhi.
- J. K. Bhattacharjee, 1996, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi.
- F. Reif, 1965, Fundamentals of Statistical and Thermal Physics, McGraw -Hill, New York.
- M. K. Zemansky, 1968, Heat and Thermodynamics, 5th edition, McGraw-Hill New York.

BOOKS FOR REFERENCES:

- R. K. Pathria, 1996, Statistical Mechanics, 2nd edition, Butter WorthHeinemann, New Delhi.
- L. D. Landau and E. M. Lifshitz, 1969, Statistical Physics, Pergamon Press, Oxford.
- K. Huang, 2002, Statistical Mechanics, Taylor and Francis, London
- W. Greiner, L. Neise and H. Stoecker, Thermodynamics and Statistical Mechanics, Springer Verlang, New York.
- A. B. Gupta, H. Roy, 2002, Thermal Physics, Books and Allied, Kolkata.

WEB RESOURCES:

- **https://byjus.com/chemistry/third-law-of-thermodynamics/**
- **https://web.stanford.edu/~peastman/statmech/thermodynamics.html**
- **https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics**
- **https://en.wikipedia.org/wiki/Grand_canonical_ensemble**
- **https://en.wikipedia.org/wiki/Ising_model**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change	**70**	No Changes Made		New Course			

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition	K1 to K5
CO2	To analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc. Describe the peculiar behaviour of the entropy by mixing two gases Justify the connection between statistics and thermodynamic quantities	K1 to K5
CO3	Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function	K1 to K5
CO4	To recall and apply the different statistical concepts to analyze the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics.	K1 to K5
CO5	To discuss and examine the thermodynamicalbehaviour of gases under fluctuation and also using Ising model	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	1	2	3	1	1	3
CO2	3	3	3	1	1	2	3	1	1	3
CO3	3	3	3	1	1	2	3	2	1	3
CO4	3	3	3	1	1	2	3	2	1	3
CO5	3	3	3	1	1	2	3	1	1	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	1	1	2	3	1	1	3
CO 2	3	3	3	1	1	2	3	1	1	3
CO 3	3	3	3	1	1	2	3	2	1	3
CO 4	3	3	3	1	1	2	3	2	1	3
CO 5	3	3	3	1	1	2	3	1	1	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:			
UNIT	**STATISTICAL MECHANICS**	**HRS**	**PEDAGOGY**
I	Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics. Order parameters – Landau's theory of phase transition - Critical indices - Scale transformations and dimensional analysis.	**18**	**Chalk &Talk, PPT, Seminar**
II	Foundations of statistical mechanics - Specification of states of a system - Micro canonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an ideal gas using the micro canonical ensemble - Entropy of mixing and Gibb's paradox.	**18**	**Chalk &Talk, PPT**
III	Trajectories and density of states - Liouville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations.	**16**	**Chalk &Talk, Assignment**
IV	Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.	**18**	**Chalk &Talk, Group discussion**
V	Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one dimension. Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin's theory - Fluctuation-dissipation theorem - The Fokker-Planck equation	**20**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	**Cos**	**K Level**	**Section A**		**Section B Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
	CO2	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
CI AII	**CO3**	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
	CO4	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**			**2**	**3.57**	
	K2	**2**			**2**	**3.57**	
	K3		**20**		**20**	**35.71**	**7.14**
	K4			**32**	**32**	**57.14**	**42.86**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	**2**			**2**	**3.57**	
	K2	**2**			**2**	**3.57**	
	K3		**20**		**20**	**35.71**	**7.14**
	K4			**32**	**32**	**57.14**	**42.86**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
2	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
3	CO3	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
4	CO4	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K5, K5)
5	CO5	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.57	-
K2	5	10		15	10.71	3.57
K3		40	16	56	40.00	14.28
K4			48	48	34.29	54.28
K5			16	16	11.43	88.57
Marks	10	50	80	140	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions **PART – B**				**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K3**	
		OR		
11. b)	**Unit - I**	**CO1**	**K3**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K2**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K2**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions **PART – C(5 x 8 = 40 Marks)**				
16. a)	**Unit - I**	**CO1**	**K4**	
		OR		
16. b)	**Unit - I**	**CO1**	**K4**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K4**	
		OR		
18. b)	**Unit - III**	**CO3**	**K4**	
19. a)	**Unit - IV**	**CO4**	**K5**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K5**	
20. a)	**Unit - V**	**CO5**	**K3**	
		OR		
20. b)	**Unit - V**	**CO5**	**K3**	

Course Name	QUANTUM MECHANICS – I			
Course Code	23PPHCC22	**L**	**P**	**C**
Category	CORE	6	-	5

COURSE OBJECTIVES:

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

UNIT - I BASIC FORMALISM **18**

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

UNIT - II DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS **18**

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

UNIT - III GENERAL FORMALISM **17**

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

UNIT - IV APPROXIMATION METHODS **18**

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

UNIT - V ANGULAR MOMENTUM **19**

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

Total Lecture Hours **90**

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- E. Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970.
- V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985.
- L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976.
- S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata, 1999.
- V. Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford , 2011.

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY			SKILL ORIENTED	✓		ENTREPRENEURSHIP					
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓				
Changes Made in the Course	Percentage of Change	**60**		No Changes Made			New Course					
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**												

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics	K1 to K5
CO2	Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems	K1 to K5
CO3	Can discuss the various representations, space time symmetries and formulations of time evolution	K1 to K5
CO4	Can formulate and analyze the approximation methods for various quantum mechanical problems	K1 to K5
CO5	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	S	3	2	2	3
CO3	2	3	3	2	3	2	3	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	2	3	S	3	3	2	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	3	3	2	3	2	2	3
CO 2	3	3	3	3	3	S	3	2	2	3
CO 3	2	3	3	2	3	2	3	2	2	3
CO 4	3	3	3	3	3	2	3	3	2	3
CO 5	3	3	3	2	3	3	3	3	2	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	QUANTUM MECHANICS – I	HRS	PEDAGOGY
I	Interpretation of the wave function – Time dependent Schrodinger equation –Time independent Schrodinger equation – Stationary states – Ehrenfest's theorem – Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator – Postulates of	18	Chalk &Talk, PPT, Seminar

	Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation		
II	Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig-penny square – well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles – Hydrogen atom – Rigid rotator	**18**	**Chalk &Talk, PPT**
III	Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation – Momentum representation – Symmetries and conservation laws – Unitary transformation – Parity and time reversal	**17**	**Chalk &Talk, Assignment**
IV	Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state – Variation method – Helium atom – WKB approximation – Connection formulae (no derivation) – WKB quantization – Application to simple harmonic oscillator.	**18**	**Chalk & Talk, Assignment**
V	Eigenvalue spectrum of general angular momentum – Ladder operators and their algebra – Matrix representation – Spin angular momentum – Addition of angular momenta – CG Coefficients – Symmetry and anti – symmetry of wave functions – Construction of wave-functions and Pauli's exclusion principle.	**19**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	**Cos**	**K Level**	**Section A**		**Section B Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
	CO2	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
CI AII	**CO3**	**K1 to K5**	2	K1, K1	2 (K3, K3)	2 (K4, K4)
	CO4	**K1 to K5**	2	K2, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.57	
	K2	2			2	3.57	
	K3		20		20	35.71	7.14
	K4			32	32	57.14	42.86
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.57	
	K2	2			2	3.57	
	K3		20		20	35.71	7.14
	K4			32	32	57.14	42.86
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
2	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
3	CO3	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
4	CO4	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K5, K5)
5	CO5	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	**Section A (Multiple Choice Questions)**	**Section B (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**5**			**5**	**3.57**	**-**
K2	**5**	**10**		**15**	**10.71**	**3.57**
K3		**40**	**16**	**56**	**40.00**	**14.28**
K4			**48**	**48**	**34.29**	**54.28**
K5			**16**	**16**	**11.43**	**88.57**
Marks	**10**	**50**	**80**	**140**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K3**	
		OR		
11. b)	**Unit - I**	**CO1**	**K3**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K2**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K2**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K4**	
		OR		
16. b)	**Unit - I**	**CO1**	**K4**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K5**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K5**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	PRACTICAL - II			
Course Code	23PPHCP21	**L**	**P**	**C**
Category	CORE	-	6	4

COURSE OBJECTIVES:

- To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
- To calculate the thermodynamic quantities and physical properties of materials.
- To analyze the optical and electrical properties of materials.
- To observe the applications of FET and UJT.
- To study the different applications of operational amplifier circuits.
- To learn about Combinational Logic Circuits and Sequential Logic Circuits

Course Details

(Any Twelve Experiments)

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Determination of Stefan's constant of radiation from a hot body
3. Measurement of Coefficient of linear expansion- Air wedge Method
4. Measurement of Susceptibility of liquid - Quincke's method
5. B-H curve using CRO
6. Measurement of Magnetic Susceptibility - Guoy's method
7. LG Plate
8. Arc spectrum: Copper
9. Determination of Solar constant
10. Determination of e/m - Millikan's method
11. Miscibility measurements using ultrasonic diffraction method
12. Determination of Thickness of thin film. - Michelson Interferometer
13. GM counter – Feather's analysis: Range of Beta rays
14. Iodine absorption spectra
15. Molecular spectra – CN bands
16. Determination of Refractive index of liquids using diode Laser/ He – Ne Laser
17. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
18. Measurement of Dielectricity - Microwave test bench
19. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility

20. Interpretation of vibrational spectra of a given material.
21. Determination of I-V Characteristics and efficiency of solar cell.
22. IC 7490 as scalar and seven segment display using IC7447
23. Solving simultaneous equations – IC 741 / IC LM324
24. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
25. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
26. Construction of second order butter worth multiple feedback narrow band pass filter
27. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
28. Construction of square wave generator using IC 555 – Study of VCO
29. Construction of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer
30. Construction of pulse generator using the IC 555 – Application as frequency divider
31. BCD to Excess- 3 and Excess 3 to BCD code conversion
32. Study of binary up / down counters - IC 7476 / IC7473
33. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474
34. Study of synchronous parallel 4-bit binary up/down counter using IC 74193
35. Study of asynchronous parallel 4-bit binary up/down counter using IC 7493
36. Study of Modulus Counter
37. Construction of Multiplexer and Demultiplexer using ICs.

BOOKS FOR STUDY:

- Practical Physics, Gupta and Kumar, PragatiPrakasan
- Kit Developed for doing experiments in Physics- Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences
- Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
- Electronic lab manual Vol I, K ANavas, Rajath Publishing
- Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition.

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

- https://www.niser.ac.in/sps/sites/default/files/basic_page/Young's%20modulus%20by%20Cornu's%20method.pdf
- https://www.mdpi.com/2075-1702/9/12/336
- https://www.electronics-tutorials.ws/filter/second-order-filters.html
- https://acschandwadcollege.com/up-images/downloads/FY_Asynchronous-Up-Down-counter.pdf
- https://www.engineersgarage.com/building-multiplexer-and-demultiplexer-using-sn-7400-series-ics-de-part-16/

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change	**90**	No Changes Made		New Course			
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**								

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Understand the strength of material using Young's modulus and Poisson's ratio by Elliptical fringes	**K1 to K5**
CO2	Acquire knowledge on Coefficient of linear expansion	**K1 to K5**
CO3	Understand theoretical principles of carrier concentration and carrier mobility of semiconducting material	**K1 to K5**
CO4	Solving simultaneous equations using OPAMP and ICs	**K1 to K5**
CO5	Improve the analytical and observation ability in Physics Experiments	**K1 to K5**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	S	S	2	2	2	3	3
CO2	2	2	S	S	S	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	2	2	3	3	2	2	2	3	3
CO2	2	2	3	3	3	2	2	3	3	3

CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

Experiments	PRACTICAL - II	HRS	PEDAGOGY
1 to 4	Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method. Measurement of Coefficient of linear expansion- Air wedge Method. Determination of Refractive index of liquids using diode Laser/ He – Ne Laser. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility.	**30**	**Demonstration & Video**
5 to 8	IC 7490 as scalar and seven segment display using IC7447. Solving simultaneous equations – IC 741 / IC LM324. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.	**30**	**Chalk & Talk, PPT**
9 to 12	Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193 Construction of square wave generator using IC 555 – Study of VCO Study of binary up / down counters - IC 7476 / IC7473 Construction of Multiplexer and Demultiplexer using ICs.	**30**	**Chalk & Talk, PPT**

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total
25	**75**	**100**

Record Note and Attendance -10 mark
Model examination - 15 mark
Total CIA - 25 mark

Model examination should be conducted for 30 mark and it has to be converted to 15 mark

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	**Cos**	**K Level**	**No. of. Questions**	**K - Level**
CIA-I	**CO1 – CO5**	**K1 – K5**	**1** Question for Each Student	**K1 – K5**
Question Pattern CIA - I		**No. of Questions to be asked**	**1** Question for Each Student	
		No. of Questions to be answered	**1**	
		Marks for each question	**30**	
		Total Marks for each section	**30**	

Distribution of Marks with COs &K Level for Correction of CIA I					
	COs	**K - Level**	**Distribution of the work of the experiment**	**K - Level**	**MARKS**
CIA I	**CO1**	**K1 to K5**	Aim and apparatus	**K1**	**2.0**
	CO2	**K1 to K5**	Formula and Tabular Column	**K3**	**5.0**
	CO3	**K1 to K5**	Understanding and Observation	**K5**	**10.0**
	CO4	**K1 to K5**	Calculation and Graph	**K4**	**10.0**
	CO5	**K1 to K5**	Interpretation of result	**K2**	**3.0**
	Total Marks				**30**

Distribution of Marks with K Level CIA I					
	K Level	**Distribution of the work of the experiment**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	K1	Aim and apparatus	2	6.67	-
	K3	Formula and Tabular Column	5	16.67	
	K5	Understanding and Observation	10	33.33	**23.34**
	K4	Calculation and Graph	10	33.33	**56.67**
	K2	Interpretation of result	3	10.00	**90.00**
	Marks		**30**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

K5 – Evaluating, interpreting and concluding the results with accurate measurements**.**

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)			
COs	**K - Level**	**No. of Questions**	**K – Level**
CO1- CO5	**K1 – K5**	**1** Question for Each Student	**K1 – K5**
No. of Questions to be Asked		**1** Question for Each Student	
No. of Questions to be answered		**1**	
Marks for each question		**75**	
Total Marks for each section		**75**	

Distribution of Marks with COs &K Level for Correction of the Summative Exam				
COs	**K - Level**	**Distribution of the work of the experiment**	**K - Level**	**MARKS**
CO1	**K1 to K5**	**Aim and apparatus**	**K1**	**10**
CO2	**K1 to K5**	**Formula and Tabular Column**	**K3**	**15**
CO3	**K1 to K5**	**Understanding and Observation**	**K5**	**30**
CO4	**K1 to K5**	**Calculation and Graph**	**K4**	**15**
CO5	**K1 to K5**	**Interpretation of result**	**K2**	**5**
Total Marks				**75**

Distribution of Marks with K Level				
K Level	**Parameters for K-Level**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**Aim and apparatus**	**10**	**13.33**	**13**
K3	**Formula and Tabular Column**	**15**	**20**	**20**
K5	**Understanding and Observation**	**30**	**40**	**40**
K4	**Calculation and Graph**	**15**	**20**	**20**
K2	**Interpretation of result**	**5**	**6.67**	**7**
Marks		**75**	**100**	**100**

Course Name	ADVANCED OPTICS			
Course Code	23PPHEC21	**L**	**P**	**C**
Category	Elective	5	-	3

COURSE OBJECTIVES:

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

UNIT - I POLARIZATION AND DOUBLE REFRACTION 20

Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu's law – Production of polarized light – Wire grid polarizer and the polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction – Normal and oblique incidence – Interference of polarized light: Quarter and half wave plates – Analysis of polarized light – Optical activity

UNIT - II LASERS 18

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

UNIT - III FIBER OPTICS 18

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

UNIT - IV NON-LINEAR OPTICS 16

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

UNIT - V MAGNETO-OPTICS AND ELECTRO-OPTICS 18

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

Total Lecture Hours 90

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th Edition), McGraw – Hill International Edition.
- Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH.
- Lipson, S. G. Lipson and H. Lipson, 2011, Optical Physics, 4th Edition, Cambridge University Press, New Delhi, 2011.
- Y. B. Band, Light and Matter, Wiley and Sons (2006)
- R. Guenther, Modern Optics, Wiley and Sons (1990)

WEB RESOURCES:

- **https://www.youtube.com/watch?v=WgzynezPiyc**
- **https://www.youtube.com/watch?v=ShQWwobpW60**
- **https://www.ukessays.com/essays/physics/fiber–optics–and–it-applications.php**
- **https://www.youtube.com/watch?v=0kEvr4DKGRI**
- **http://optics.byu.edu/textbook.aspx**

Nature of Course	EMPLOYABILITY			SKILL ORIENTED			ENTREPRENEURSHIP		✓			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓				
Changes Made in the Course	Percentage of Change		**55**	No Changes Made			New Course					
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**												

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Discuss the transverse character of light waves and different polarization phenomenon	K1 to K5
CO2	Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices	K1 to K5
CO3	Demonstrate the basic configuration of a fiber optic – communication system and advantages	K1 to K5
CO4	Identify the properties of nonlinear interactions of light and matter	K1 to K5
CO5	Interpret the group of experiments which depend for their action on an applied magnetics and electric field	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	2	3	3	3	3	3	3
CO 2	3	3	3	2	3	3	3	3	3	3
CO 3	3	3	3	2	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	ADVANCED OPTICS	HRS	PEDAGOGY
I	Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu's law – Production of polarized light – Wire grid polarizer and the polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction – Normal and oblique incidence –	20	Chalk &Talk, PPT, Seminar

	Interference of polarized light: Quarter and half wave plates – Analysis of polarized light – Optical activity		
II	Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action – Types of lasers and its applications – Solid state lasers – Ruby laser – Nd:YAG laser – gas lasers – He-Ne laser – CO_2 laser – Chemical lasers – HCl laser – Semiconductor laser	**18**	**Chalk &Talk, PPT**
III	Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical fibers – Ray dispersion in multimode step index fibers – Parabolic-index fibers – Fiber-optic sensors: precision displacement sensor – Precision vibration sensor	**18**	**Chalk &Talk, Assignment**
IV	Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self-focusing of light	**16**	**Chalk & Talk, Assignment**
V	Magneto-optical effects – Zeeman effect – Inverse Zeeman effect – Faraday effect – Voigt effect – Cotton-mouton effect – Kerr magneto-optic effect – Electro-optical effects – Stark effect – Inverse stark effect – Electric double refraction – Kerr electro-optic effect – Pockels electro-optic effect	**18**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	**Cos**	**K Level**	**Section A**		**Section B Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 to K5**	2	K1, K2	2 (K2, K2)	2 (K2, K2)
	CO2	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K3, K3)
CI AII	**CO3**	**K1 to K5**	2	K1, K2	2 (K2, K2)	2 (K3, K3)
	CO4	**K1 to K5**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.57	
	K2	2	10	16	28	50	
	K3		10	16	26	46.43	53.57
	K4						
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.57	
	K2	2	10		12	21.43	
	K3		10	16	26	46.43	25
	K4			16	16	28.57	71.43
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K2, K2)
2	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
3	CO3	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
4	CO4	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K4, K4)
5	CO5	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	**Section A (Multiple Choice Questions)**	**Section B (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**5**			**5**	**3.57**	**-**
K2	**5**	**20**	**16**	**41**	**29.29**	**3.57**
K3		**30**	**32**	**62**	**44.28**	**32.86**
K4			**16**	**16**	**11.43**	**77.14**
K5			**16**	**16**	**11.43**	**88.57**
Marks	**10**	**50**	**80**	**140**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions **PART – B**				**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K2**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K2**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions **PART – C(5 x 8 = 40 Marks)**				
16. a)	**Unit - I**	**CO1**	**K2**	
		OR		
16. b)	**Unit - I**	**CO1**	**K2**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	

Course Name	MEDICAL PHYSICS			
Course Code	23PPHEC22	**L**	**P**	**C**
Category	ELECTIVE	5	-	3

COURSE OBJECTIVES:

- To understand the major applications of Physics to Medicine
- To study the aid of different medical devices such as X-ray machines, gamma camera, accelerator and nuclear magnetic resonance.
- To outline the principles of Physics of different medical radiation devices and their modern advances, especially in medical radiation therapy and different applications in medical physics.
- To introduce the ideas of Radiography.
- To form a good base for further studies like research.

UNIT - I X-RAYS AND TRANSDUCERS 18

Electromagnetic Spectrum – Production of X-Rays – X-Ray Spectrum –Bremsstrahlung – Characteristic X-Ray – X-Ray Tubes – Coolidge Tube – X-Ray Tube Design – Thermistors – photo electric transducers – Photo voltaic cells – photo emissive cells –Photoconductive cells– piezoelectric transducer

UNIT - II BLOOD PRESSURE MEASUREMENTS 18

Introduction – sphygmomanometer – Measurement of heart rate – basic principles of electrocardiogram (ECG) –Basic principles of electro-neurography (ENG) – Basic principles of magnetic resonance imaging (MRI).

UNIT - III RADIATION PHYSICS 19

Radiation Units – Exposure – Absorbed Dose – Rad to Gray – Kera Relative Biological Effectiveness – Effective Dose – Sievert (Sv) – Inverse Square Law – Interaction of radiation with Matter – Linear Attenuation Coefficient – Radiation Detectors –Thimble Chamber – Condenser Chambers – Geiger Counter – Scintillation Counter.

UNIT - IV MEDICAL IMAGING PHYSICS 18

Radiological Imaging – Radiography – Filters – Grids – Cassette – X-Ray Film – Film processing – Fluoroscopy – Computed Tomography Scanner – Principal Function – Display – Mammography – Ultrasound Imaging – Magnetic Resonance Imaging – Thyroid Uptake System – Gamma Camera (Only Principle, Function and display)

UNIT - V RADIATION PROTECTION 17

Principles of Radiation Protection – Protective Materials – Radiation Effects – Somatic – Genetic Stochastic and Deterministic Effect – Personal Monitoring Devices – TLD Film Badge – Pocket Dosimeter

Total Lecture Hours 90

BOOKS FOR STUDY:

- Dr. K. Thayalan , Basic Radiological Physics, Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi, 2003.
- Curry, Dowdey and Murry, Christensen's Physics of Diagnostic Radiology: -LippincotWilliams and Wilkins, 1990.
- FM Khan, Physics of Radiation Therapy, William and Wilkins, 3rd ed, 2003.
- D. J. Dewhurst, An Introduction to Biomedical Instrumentation, 1st ed, Elsevier Science, 2014.
- R.S. Khandpur, Hand Book of Biomedical Instrumentations, 1st ed, TMG, New Delhi, 2005.

BOOKS FOR REFERENCES:

- Muhammad Maqbool, An Introduction to Medical Physics, 1st ed, Springer International Publishing, 2017.
- Daniel Jirák, FrantišekVítek, Basics of Medical Physics, 1st ed, Charles University, Karolinum Press, 2018
- Anders Brahme, Comprehensive Biomedical Physics, Volume 1, 1st ed, Elsevier Science, 2014.
- K. Venkata Ram, Bio-Medical Electronics and Instrumentation, 1st ed, Galgotia Publications, New Delhi, 2001.
- John R. Cameron and James G. Skofronick, 2009, Medical Physics, John Wiley Interscience Publication, Canada, 2nd edition.

WEB RESOURCES:

- **https:nptel.ac.in/courses/108/103/108103157/**
- **https://www.studocu.com/en/course/university-of-technology-sydney/medical-devices-and-diagnostics/225692**
- **https://www.technicalsymposium.com/allecturenotes_biomed.html**
- **https://lecturenotes.in/notes/17929-note-for-biomedical-instrumentation-bi-by-deepraj-adhikary/78**
- **https://www.modulight.com/applications-medical/**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		ENTREPRENEURSHIP	✓		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made		New Course	✓		
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**								

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Learn the fundamentals, production and applications of X-rays.	K1 to K5
CO2	Understand the basics of blood pressure measurements. Learn about sphygmomanometer, EGC, ENG and basic principles of MRI.	K1 to K5
CO3	Apply knowledge on Radiation Physics	K1 to K5
CO4	Analyse Radiological imaging and filters	K1 to K5
CO5	Assess the principles of radiation protection	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	1	2	3	3	1	3
CO2	3	3	3	2	1	2	3	3	1	3
CO3	3	3	3	2	1	2	3	3	1	3
CO4	3	3	3	2	1	2	3	3	1	3
CO5	3	3	3	1	1	2	3	3	1	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	1	1	2	3	3	1	3
CO 2	3	3	3	2	1	2	3	3	1	3
CO 3	3	3	3	2	1	2	3	3	1	3
CO 4	3	3	3	2	1	2	3	3	1	3
CO 5	3	3	3	1	1	2	3	3	1	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	MEDICAL PHYSICS	HRS	PEDAGOGY
I	Electromagnetic Spectrum – Production of X-Rays – X-Ray Spectrum – Bremsstrahlung – Characteristic X-Ray – X-Ray Tubes – Coolidge Tube – X-Ray Tube Design – Thermistors – photo electric transducers – Photo voltaic cells – photo emissive cells –Photoconductive cells– piezoelectric transducer	18	Chalk &Talk, PPT, Seminar

II	Introduction –sphygmomanometer – Measurement of heart rate – basic principles of electrocardiogram (ECG) –Basic principles of electro-neurography (ENG) – Basic principles of magnetic resonance imaging (MRI).	**18**	**Chalk &Talk, PPT**
III	Radiation Units – Exposure – Absorbed Dose – Rad to Gray – Kera Relative Biological Effectiveness –Effective Dose – Sievert (Sv) – Inverse Square Law – Interaction of radiation with Matter – Linear Attenuation Coefficient – Radiation Detectors –Thimble Chamber – Condenser Chambers – Geiger Counter – Scintillation Counter	**19**	**Chalk &Talk, Assignment**
IV	Radiological Imaging – Radiography – Filters – Grids – Cassette – X-Ray Film – Film processing – Fluoroscopy – Computed Tomography Scanner – Principal Function – Display – Mammography – Ultrasound Imaging – Magnetic Resonance Imaging – Thyroid Uptake System – Gamma Camera (Only Principle, Function and display)	**18**	**Chalk & Talk, Assignment**
V	Principles of Radiation Protection – Protective Materials – Radiation Effects – Somatic – Genetic Stochastic and Deterministic Effect – Personal Monitoring Devices – TLD Film Badge – Pocket Dosimeter	**17**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of. Questions	K - Level		
CI AI	CO1	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K2, K2)
	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
CI AII	CO3	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K3, K3)
	CO4	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.57	
	K2	2	10	16	28	50	
	K3		10	16	26	46.43	53.57
	K4						
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.57	
	K2	2	10		12	21.43	
	K3		10	16	26	46.43	25
	K4			16	16	28.57	71.43
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K2, K2)
2	CO2	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
3	CO3	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K3, K3)
4	CO4	K1 to K5	2	K1, K2	2 (K2, K2)	2 (K4, K4)
5	CO5	K1 to K5	2	K1, K2	2 (K3, K3)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	**Section A (Multiple Choice Questions)**	**Section B (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**5**			**5**	**3.57**	
K2	**5**	**20**	**16**	**41**	**29.29**	**3.57**
K3		**30**	**32**	**62**	**44.28**	**32.86**
K4			**16**	**16**	**11.43**	**77.14**
K5			**16**	**16**	**11.43**	**88.57**
Marks	**10**	**50**	**80**	**140**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions			**PART – A**	**(10 x 1 = 10 Marks)**	
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K2**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K2**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K2**	
		OR		
16. b)	**Unit - I**	**CO1**	**K2**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	

Course Name	SEWAGE AND WASTE WATER TREATMENT AND REUSE			
Course Code	23PPHSC21	**L**	**P**	**C**
Category	SKILL ENHANCEMENT COURSE	2	-	2

COURSE OBJECTIVES:

- To gain basic knowledge in sewage and waste water Treatment procedures
- To gain industry exposure and be equipped to take up job.
- To harness entrepreneurial skills.
- To analyze the status of sewage and waste water management in the nearby areas.
- To sensitize the importance of healthy practices in waste water management.

UNIT - I	**RECOVERY & REUSE OF WATER**	**06**

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

UNIT - II	**DISINFECTION**	**06**

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

UNIT - III	**CHEMICAL DISINFECTION**	**06**

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

UNIT - IV	**PHYSICAL DISINFECTION**	**06**

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

UNIT - V	**INDUSTRIAL VISIT**	**06**

Industrial visit – data collection and analysis – presentation.

Total Lecture Hours	**30**

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

- **https://www.google.co.in/books/edition/Drinking_Water_DisinfectionTechniques/HVbNBQAAQBAJ?hl=en**
- **https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-Principles-And-Management-Issues-125648?**
- **https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsAC-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wB**
- **https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsAC-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJ jxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made	✓	New Course	✓		

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Gained knowledge in solid waste management	K1 to K5
CO2	Equipped to take up related job by gaining industry exposure	K1 to K5
CO3	Develop entrepreneurial skills	K1 to K5
CO4	Will be able to analyze and manage the status of the solid wastes in the nearby areas	K1 to K5
CO5	Adequately sensitized in managing solid wastes in and around his/her locality	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	3	3	2	3	2	3	2
CO2	2	3	2	2	3	3	2	3	2	2
CO3	2	2	2	2	2	3	3	3	3	2
CO4	3	2	3	3	2	3	3	3	3	2
CO5	2	2	2	2	3	3	2	2	2	2

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	2	3	3	3	2	3	2	3	2
CO 2	2	3	2	2	3	3	2	3	2	2
CO 3	2	2	2	2	2	3	3	3	3	2
CO 4	3	2	3	3	2	3	3	3	3	2
CO 5	2	2	2	2	3	3	2	2	2	2
WEIGHTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	SEWAGE AND WASTE WATER TREATMENT AND REUSE	HRS	PEDAGOGY
I	Recovery & Reuse of water from Sewage and Waste water: Methods of recovery: Flocculation - Sedimentation - sedimentation with coagulation - Filtration - sand filters - pressure filters - horizontal filters - vector control measures in industries - chemical and biological methods of vector eradication.	06	Chalk &Talk, PPT, Seminar

II	Disinfection: Introduction to disinfection and sterilization: Disinfectant - UV radiation - Chlorination - Antisepsis - Sterilant - Aseptic and sterile -Bacteriostatic and Bactericidal - factors affecting disinfection.	**06**	**Chalk &Talk, PPT, Seminar**
III	Chemical Disinfection: Introduction - Theory of Chemical Disinfection - Chlorination Other Chemical Methods - Chemical Disinfection Treatments Requiring - Electricity - Coagulation/Flocculation Agents as Pretreatment - Disinfection By-Products(DBPs).	**06**	**Chalk &Talk, PPT, Seminar**
IV	Physical Disinfection: Introduction - Ultraviolet Radiation - Solar Disinfection - Heat Treatment - Filtration Methods - Distillation - Electrochemical Oxidation Water Disinfection by Microwave Heating.	**06**	**Chalk &Talk, PPT, Seminar**
V	Industrial visit – data collection and analysis – presentation.	**06**	**Chalk &Talk, PPT, Seminar**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	**Cos**	**K Level**	**Section A**	
			MCQs	
			No. of. Questions	**K - Level**
CI **AI**	**CO1**	**K1 – K2**	**25**	**K1,K2**
	CO2	**K1 – K2**	**25**	**K1,K2**
CI **AII**	**CO3**	**K1 – K2**	**25**	**K1,K2**
	CO4	**K1 – K2**	**25**	**K1,K2**
Question Pattern **CIA I & II**		**No. of Questions to be asked**	**50**	
		No. of Questions to be answered	**50**	
		Marks for each question	**1**	
		Total Marks for each section	**50**	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	**Section A (Multiple Choice Questions)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**30**	**30**	**60**	**100**
	K2	**20**	**20**	**40**	
	K3				
	K4				
	Marks	**50**	**50**	**100**	**100**
CIA II	**K1**	**30**	**30**	**60**	**100**
	K2	**20**	**20**	**40**	
	K3				
	K4				
	Marks	**50**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				

M.Sc., PHYSICS

Syllabus

Program Code: PPH

2023 - Onwards

MANNAR THIRUMALAI NAICKER COLLEGE

(AUTONOMOUS)

Re-accredited with "A" Grade by NAAC

PASUMALAI, MADURAI – 625 004

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS), MADURAI – 625 004

M. SC PHYSICS CURRICULUM

(For the students admitted from the academic year 2023-2024 onwards)

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
FIRST SEMESTER						
Part – III	**Core courses**					
23PPHCC11	MATHEMATICAL PHYSICS	6	5	25	75	100
23PPHCC12	CLASSICAL MECHANICS	6	5	25	75	100
23PPHCP11	PRACTICAL - I	6	4	25	75	100
Part – III	**Elective courses**					
23PPHEC11	PHYSICS OF NANO SCIENCE AND TECHNOLOGY	6	3	25	75	100
23PPHEC12	LINEAR AND DIGITAL ICS AND APPLICATIONS	6	3	25	75	100
	Total	30	20	125	375	500
SECOND SEMESTER						
Part – III	**Core courses**					
23PPHCC21	STATISTICAL MECHANICS	6	5	25	75	100
23PPHCC22	QUANTUM MECHANICS – I	6	5	25	75	100
23PPHCP21	PRACTICAL – II	6	4	25	75	100
Part – III	**Elective courses**					
23PPHEC21	ADVANCED OPTICS	5	3	25	75	100
23PPHEC22	MEDICAL PHYSICS	5	3	25	75	100
Part – IV	**Skill Enhancement course**					
23PPHSC21	SEWAGE AND WASTE WATER TREATMENT AND REUSE	2	2	25	75	100
	Total	30	22	150	450	600

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
THIRD SEMESTER						
Part – III	**Core courses**					
23PPHCC31	QUANTUM MECHANICS - II	6	5	25	75	100
23PPHCC32	CONDENSED MATTER PHYSICS	6	5	25	75	100
23PPHCP31	PRACTICAL –III	6	4	25	75	100
Part – III	**Elective course**					
23PPHEC31	ELECTROMAGNETIC THEORY	6	3	25	75	100
Part - IV	**Skill Enhancement course**					
23PPHSC31	COMMUNICATION ELECTRONICS	2	2	25	75	100
Part - IV	**Non Major Elective course**					
23PPHNM31	SOLAR ENERGY UTILIZATION	4	3	25	75	100
23PPHINT1	INTERNSHIP REPORT	-	2	40	60	100
	Total	30	24	190	510	700
FOURTH SEMESTER						
Part – III	**Core courses**					
23PPHCC41	NUCLEAR AND PARTICLE PHYSICS	6	5	25	75	100
23PPHCC42	SPECTROSCOPY	6	5	25	75	100
23PPHCP41	PRACTICAL – IV	6	4	25	75	100
23PPHPRJ1	PROJECT AND VIVA VOCE	6	4	25	75	100
Part – III	**Elective course**					
23PPHEC41	NUMERICAL METHODS AND COMPUTER PROGRAMMING	4	3	25	75	100
Part – IV	**Skill Enhancement course**					
23PPHSC41	PHYSICS FOR NET/SET	2	2	25	75	100
Part - V	**Extension Activities**					
23PEXTG41	EXTENSION ACTIVITY	-	1	40	60	100
	Total	30	24	190	510	700
	Grand Total	120	90	655	1845	2500


THIRD SEMESTER

Course Name	QUANTUM MECHANICS – II			
Course Code	23PPHCC31	**L**	**P**	**C**
Category	CORE	6	-	5

COURSE OBJECTIVES:

- Formal development of the theory and the properties of angular momenta, both orbital and spin
- To familiarize the students to the crucial concepts of scattering theory such as partial wave analysis and Barn approximation.
- Time-dependent Perturbation theory and its application to study of interaction of an atom with the electromagnetic field
- To give the students a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts
- To introduce the concept of covariance and the use of Feynman graphs for depicting different interactions

UNIT - I SCATTERING THEORY **17**

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

UNIT - II PERTURBATION THEORY **19**

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

UNIT - III RELATISTIC QUANTUM MECHANICS **17**

Klein – Gordon Equation – Charge And Current Densities – Dirac Matrices – Dirac Equation – Plane Wave Solutions – Interpretation Of Negative Energy States – Antiparticles – Spin of Electron – Magnetic Moment Of An Electron Due To Spin.

UNIT - IV DIRAC EQUATION **19**

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

UNIT - V CLASSICAL FIELDS AND SECOND QUANTIZATION **18**

Classical fields – Euler Lagrange equation – Hamiltonian formulation – Noether's theorem – Quantization of real and complex scalar fields – Creation, Annihilation and Number operators – Fock states – Second Quantization of K-G field.

Total Lecture Hours **90**

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- G. Aruldhas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi, 2009.
- L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill Kogakusha, Tokyo, 1968.
- V. Devanathan, Quantum Mechanics, 1st Edition, Narosa Publishing House, New Delhi, 2005.
- Nouredine Zettili, Quantum mechanics concepts and applications, 2nd Edition, Wiley, 2017
- P. A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition, Oxford University Press, London, 1973.
- B. K. Agarwal & HariPrakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009.
- Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics,1st Edition, I.K.International Publishing house Pvt. Ltd., 2006
- Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi.
- E. Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970.

WEB RESOURCES:

- **https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf – Quantum Mechanics - II**
- **http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf - General Properties in Quantum Mechanics**
- **http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf - Scattering Theory**
- **https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf - Relativistic Quantum Mechanics**
- **https://web.mit.edu/dikaiser/www/FdsAmSci.pdf - Application of Quantum Mechanics**

Nature of Course	EMPLOYABILITY			SKILL ORIENTED	✓		ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL			GLOBAL	✓	
Changes Made in the Course	Percentage of Change	**70%**		No Changes Made			New Course			

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Familiarize the concept of scattering theory such as partial wave analysis and Born approximation	**K1 to K5**
CO2	Give a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts	**K1 to K5**
CO3	Discuss the relativistic quantum mechanical equations namely, Klein-Gordon and Dirac equations and the phenomena accounted by them like electron spin and magnetic moment	**K1 to K5**
CO4	Introduce the concept of covariance and the use of Feynman graphs for depicting different interactions	**K1 to K5**
CO5	Demonstrate an understanding of field quantization and the explanation of the scattering matrix.	**K1 to K5**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	3	3	3	3
CO3	3	2	2	3	3	2	3	3	3	3
CO4	2	1	1	3	3	1	2	2	3	3
CO5	2	1	1	3	3	2	2	2	3	3

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	2	3	3	3	3	3	3	3
CO 3	3	2	2	3	3	2	3	3	3	3
CO 4	2	1	1	3	3	1	2	2	3	3
CO 5	2	1	1	3	3	2	2	2	3	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE										

CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	QUANTUM MECHANICS – II	HRS	PEDAGOGY
I	Scattering amplitude – Cross sections – Born approximation and its validity – Scattering by a screened coulomb potential – Yukawa potential – Partial wave analysis – Scattering length and Effective range theory for s wave – Optical theorem – Transformation from centre of mass to laboratory frame	17	Chalk &Talk, PPT, Seminar
II	Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule – Transition probability Einstein's A and B Coefficients – Adiabatic approximation – Sudden approximation – Semi – classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation.	19	Chalk &Talk, PPT
III	Klein – Gordon Equation – Charge And Current Densities – Dirac Matrices – Dirac Equation – Plane Wave Solutions – Interpretation Of Negative Energy States – Antiparticles – Spin of Electron – Magnetic Moment Of An Electron Due To Spin.	17	Chalk &Talk, Assignment
IV	Covariant form of Dirac Equation – Properties of the gamma matrices – Traces – Relativistic invariance of Dirac equation – Probability Density – Current four vector – Bilinear covariant – Feynman's theory of positron (Elementary ideas only without propagation formalism).	19	Chalk &Talk, Group discussion
V	Classical fields – Euler Lagrange equation – Hamiltonian formulation – Noether's theorem – Quantization of real and complex scalar fields – Creation, Annihilation and Number operators – Fock states – Second Quantization of K-G field.	18	Seminar, PPT, Chalk &Talk

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	Cos	K Level	Section A MCQs		Section B Either or Choice	Section C Either or Choice
			No. of. Questions	K - Level		
CI AI	CO1	K2	2	K1, K2	2 (K2, K2)	2 (K2, K2)
	CO2	K3	2	K1, K2	2 (K3, K3)	2 (K3, K3)
CI AII	CO3	K3	2	K1, K2	2 (K2, K2)	2 (K3, K3)
	CO4	K4	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.57**	**54**
	K2	2	10	16	28	**50**	
	K3		10	16	26	**46.43**	**46**
	K4						
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.57**	**25**
	K2	2	10		12	**21.43**	
	K3		10	16	26	**46.43**	**46**
	K4			16	16	**28.57**	**29**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	**COs**	**K - Level**	**Section A (MCQs)**		**Section B (Either / or Choice) With K - LEVEL**	**Section C (Either / or Choice) With K - LEVEL**
			No. of Questions	**K – Level**		
1	**CO1**	**K2**	2	K1, K2	2 (K2, K2)	2 (K2, K2)
2	**CO2**	**K3**	2	K1, K2	2 (K3, K3)	2 (K3, K3)
3	**CO3**	**K3**	2	K1, K2	2 (K2, K2)	2 (K3, K3)
4	**CO4**	**K4**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
5	**CO5**	**K5**	2	K1, K2	2 (K4, K4)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	**Section A (Multiple Choice Questions)**	**Section B (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5			5	**3.57**	**4**
K2	5	20	16	41	**29.29**	**29**
K3		20	32	52	**37.14**	**37**
K4		10	16	26	**18.57**	**19**
K5			16	16	**11.43**	**11**
Marks	**10**	**50**	**80**	**140**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions		**PART – A**		**(10 x 1 = 10 Marks)**	
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K4**	
		OR		
15. b)	**Unit - V**	**CO5**	**K4**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K2**	
		OR		
16. b)	**Unit - I**	**CO1**	**K2**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	

Course Name	CONDENSED MATTER PHYSICS			
Course Code	23PPHCC32	**L**	**P**	**C**
Category	CORE	6	-	5

COURSE OBJECTIVES:

- To describe various crystal structures, symmetry and to differentiate different types of bonding.
- To construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat.
- To critically assess various theories of electrons in solids and their impact in distinguishing solids.
- Outline different types of magnetic materials and explain the underlying phenomena.
- Elucidation of concepts of superconductivity, the underlying theories – relate to current areas of research.

UNIT - I CRYSTAL PHYSICS 17

Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures – Atomic Packing Factor- Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc). Structure and properties of liquid crystals. Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).

UNIT - II LATTICE DYNAMICS 19

Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umkalapp processes.

UNIT - III THEORY OF METALS AND SEMICONDUCTORS 17

Free electron gas in three dimensions - Electronic heat capacity - Wiedemann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration – Temperature Dependence - Mobility - Impurity conductivity – Impurity states - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies - de Hass-van Alphen effect.

UNIT - IV MAGNETISM 19

Diamagnetism - Quantum theory of paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.

UNIT - V SUPERCONDUCTIVITY	18
Experimental facts: Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors. **Theoretical Explanation:** Thermodynamics of super conducting transition - London equation - Coherence length – Isotope effect - Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory – BCS to Bose – Einstein Condensation (BEC) regime- Nature of paring and condensation of Fermions. Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS.	
Total Lecture Hours	**90**

BOOKS FOR STUDY:

- C. Kittel, Introduction to Solid State Physics, 7th Edition, Wiley, New York, 1996.

BOOKS FOR REFERENCES:

- Rita John, Solid State Physics, Tata Mc-Graw Hill Publication.
- J. Dekker, Solid State Physics, Macmillan India, New Delhi.
- M. Ali Omar, Elementary Solid State Physics – Principles and Applications, Addison – Wesley, 1974.
- H. P. Myers, Introductory Solid State Physics, 2nd Edition, Viva Book, New Delhi, 1998.
- J. S. Blakemore, Solid state Physics, 2nd Edition, W.B. Saunder, Philadelphia, 1974.
- H. M. Rosenburg, The Solid State, 3rd Edition, Oxford University Press, Oxford, 1993.
- J. M. Ziman, Principles of the Theory of Solids, Cambridge University Press, London, 1971.
- C. Ross-Innes and E. H. Rhoderick, Introduction to Superconductivity, Pergamon, Oxford, 1976.
- J. P. Srivastava, Elements of Solid State Physics, Prentice-Hall of India, New Delhi, 2001.

WEB RESOURCES:

- **http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html - Crystal Structure**
- **http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html - Condensed Matter Physics**
- **https://www.britannica.com/science/crystal - Crystal Defects, Structure and its types**
- **https://www.nationalgeographic.org/encyclopedia/magnetism/ - Magnetism**
- **https://www.brainkart.com/article/Super-Conductors_6824/ - Superconductivity**

Nature of Course	EMPLOYABILITY			SKILL ORIENTED	✓		ENTREPRENEURSHIP				
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL			GLOBAL	✓		
Changes Made in the Course	Percentage of Change	**50%**		No Changes Made			New Course				

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Student will be able to list out the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure	K1 to K5
CO2	Students will be able to visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids.	K1 to K5
CO3	Student will be able to comprehend the heat conduction in solids	K1 to K5
CO4	Student will be able to generalize the electronic nature of solids from band theories.	K1 to K5
CO5	Student can compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	2	2	2	2	2	2
CO2	3	2	3	2	3	2	3	3	2	3
CO3	3	3	3	2	3	2	3	3	2	3
CO4	2	2	2	2	2	2	2	2	2	3
CO5	2	2	2	2	2	2	2	2	2	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	2	3	2	2	2	2	2	2	2
CO 2	3	2	3	2	3	2	3	3	2	3
CO 3	3	3	3	2	3	2	3	3	2	3
CO 4	2	2	2	2	2	2	2	2	2	3
CO 5	2	2	2	2	2	2	2	2	2	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	CONDENSED MATTER PHYSICS	HRS	PEDAGOGY
I	Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures – Atomic Packing Factor- Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal	17	Chalk &Talk, PPT,

	Lattice (sc, bcc, fcc). Structure and properties of liquid crystals. Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).		**Seminar**
II	Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umkalapp processes.	**19**	**Chalk &Talk, PPT**
III	Free electron gas in three dimensions - Electronic heat capacity - Wiedemann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration – Temperature Dependence - Mobility - Impurity conductivity – Impurity states - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies - de Hass-van Alphen effect.	**17**	**Chalk &Talk, Assignment**
IV	Diamagnetism - Quantum theory of paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.	**19**	**Chalk &Talk, Group discussion**
V	**Experimental facts:** Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors. **Theoretical Explanation:** Thermodynamics of super conducting transition - London equation - Coherence length – Isotope effect - Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory – BCS to Bose – Einstein Condensation (BEC) regime- Nature of paring and condensation of Fermions. Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS.	**18**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	**Cos**	**K Level**	**Section A MCQs**		**Section B Either or Choice**	**Section C Either or Choice**
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K4**	2	K1,K2	2 (K3, K3)	2 (K4, K4)
	CO2	**K4**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
CI AII	**CO3**	**K4**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
	CO4	**K5**	2	K1, K2	2 (K4, K4)	2 (K5, K5)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.57**	**7**
	K2	2			2	**3.57**	
	K3		20		20	**35.71**	**36**
	K4			32	32	**57.14**	**57**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.57**	**7**
	K2	2			2	**3.57**	
	K3		10		10	**17.86**	**18**
	K4		10	16	26	**46.43**	**46**
	K5			16	16	**28.57**	**29**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	Cos	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K4	2	K1, K2	2 (K3, K3)	2 (K4, K4)
2	CO2	K4	2	K1, K2	2 (K3, K3)	2 (K4, K4)
3	CO3	K4	2	K1, K2	2 (K3, K3)	2 (K4, K4)
4	CO4	K5	2	K1, K2	2 (K4, K4)	2 (K5, K5)
5	CO5	K5	2	K1, K2	2 (K4, K4)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.57	7
K2	5			5	3.57	
K3		30		30	21.43	21
K4		20	48	68	48.57	49
K5			32	32	22.86	23
Marks	10	50	80	140	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K3**	
		OR		
11. b)	**Unit - I**	**CO1**	**K3**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K4**	
15. a)	**Unit - V**	**CO5**	**K4**	
		OR		
15. b)	**Unit - V**	**CO5**	**K4**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K4**	
		OR		
16. b)	**Unit - I**	**CO1**	**K4**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K4**	
		OR		
18. b)	**Unit - III**	**CO3**	**K4**	
19. a)	**Unit - IV**	**CO4**	**K5**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K5**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	

Course Name	PRACTICAL - III			
Course Code	23PPHCP31	**L**	**P**	**C**
Category	CORE	-	6	4

COURSE OBJECTIVES:

- To understand the theory and working of Microprocessor, Microcontroller and their applications
- To use microprocessor and Microcontroller in different applications.

COURSE DETAILS

(Any Twelve Experiments)

1. 8-bit addition and subtraction, multiplication and division
2. Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending order
3. Code conversion (8-bit number): a) Binary to BCD b) BCD to binary
4. Addition of multi byte numbers, Factorial
5. Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal Counters
6. Interfacing of LED – Binary up/down counter, BCD up/down counter and N/2N up/down counter
7. Interfacing of seven segment display
8. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves
9. DAC 0800/ DAC 1048 interface and wave form generation (Unipolar/ Bipolar output)
10. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action
11. Key board Interface
12. Addition, Subtraction, Multiplication and Division of 8-bit numbers.
13. Sum of a series of 8-bit numbers
14. Average of N numbers
15. Factorial of number
16. Construct the half adder and full adder circuits using ICs
17. Construct the different logic gates using IC7400 (NAND) and IC7402 (NOR)
18. Study the law of Boolean function and Demorgan's theorem by using ICs
19. Simplify a given Boolean expression using Karnaugh map method and implement the expression using logic circuit.
20. Voltage regulator using ICs

BOOKS FOR STUDY:

- Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata McGraw Hill Publications, 2008.
- K. Udaya Kumar, S. Uma Shankar, The 8085 Microprocessor, Architecture, Programming and Interfacing, Pearson.

BOOKS FOR REFERENCES:

- Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2008.
- V. Vijayendran, Fundamentals of Microprocessor-8085", 3rd Edition S. VisvanathanPvt., Ltd., 2005.
- B. Ram, Fundamentals of Microprocessors and Microcontrollers, DhanpatRai Publications.
- W. A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
- S. Malarvizhi, Microprocessor and Its Application, Anuradha Agencies Publications
- R.S. Gaonkar, Microprocessor Architecture, Program And Its Application With 8085, New Age International (P) Ltd
- Barry B. Brey, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi, 1995.
- J. Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED		✓	ENTREPRENEURSHIP		✓			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓				
Changes Made in the Course	Percentage of Change		**80%**	No Changes Made			New Course					
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**												

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Develop the programming skills of Microprocessor	K1 to K5
CO2	Appreciate the applications of Microprocessor programming	K1 to K5
CO3	Understand the structure and working of 8085 microprocessor and apply it.	K1 to K5
CO4	Acquire knowledge about the interfacing peripherals with 8085 microprocessor.	K1 to K5
CO5	Acquire knowledge about the interfacing 8051 microcontroller with various peripherals.	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	3	3	2	2	2	3	3
CO2	2	2	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	2	2	2	3	3	2	2	2	3	3
CO 2	2	2	3	3	3	2	2	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3
CO 4	3	2	3	3	3	3	2	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

EXPERIMENTS	PRACTICAL - III	HRS	PEDAGOGY
1 to 4	8-bit addition and subtraction, multiplication and division Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending	30	Chalk & Talk, PPT

	order Code conversion (8-bit number): a) Binary to BCD b) BCD to binary Addition of multi byte numbers, Factorial		
5 to 8	Addition, Subtraction, Multiplication and Division of 8-bit numbers. Sum of a series of 8-bit numbers Average of N numbers Factorial of number	**30**	**Chalk & Talk, PPT**
9 to 12	Construct the half adder and full adder circuits using ICs and Voltage regulator using ICs Construct the different logic gates using IC7400 (NAND) and IC7402 (NOR) Study the law of Boolean function and Demorgan's theorem by using ICs Simplify a given Boolean expression using Karnaugh map method and implement the expression using logic circuit.	**30**	**Chalk & Talk, PPT**

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total
25	75	100

Record Note and Attendance -10 mark
Model examination - 15 mark
Total CIA - 25 mark

Model examination should be conducted for 30 mark and it has to be converted to 15 mark

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	**Cos**	**K Level**	**No. of. Questions**	**K - Level**
CIA-I	**CO1 – CO5**	**K1 – K5**	**1** Question for Each Student	**K1 – K5**
Question Pattern CIA - I		No. of Questions to be asked	**1** Question for Each Student	
		No. of Questions to be answered	**1**	
		Marks for each question	**30**	
		Total Marks for each section	**30**	

	Distribution of Marks with COs &K Level for

			Correction of CIA I		
	COs	**K - Level**	**Distribution of the work of the experiment**	**K - Level**	**MARKS**
CIA I	**CO1**	**K1 to K5**	Aim and apparatus	**K1**	**2.0**
	CO2	**K1 to K5**	Formula and Tabular Column	**K3**	**5.0**
	CO3	**K1 to K5**	Understanding and Observation	**K5**	**10.0**
	CO4	**K1 to K5**	Calculation and Graph	**K4**	**10.0**
	CO5	**K1 to K5**	Interpretation of result	**K2**	**3.0**
	Total Marks				**30**

Distribution of Marks with K Level CIA I					
	K Level	**Distribution of the work of the experiment**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	K1	Aim and apparatus	2	6.67	-
	K3	Formula and Tabular Column	5	16.67	
	K5	Understanding and Observation	10	33.33	**23.34**
	K4	Calculation and Graph	10	33.33	**56.67**
	K2	Interpretation of result	3	10.00	**90.00**
	Marks		**30**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

K5 – Evaluating, interpreting and concluding the results with accurate measurements**.**

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)			
COs	**K - Level**	**No. of Questions**	**K – Level**
CO1- CO5	**K1 – K5**	**1** Question for Each Student	**K1 – K5**
No. of Questions to be Asked		**1** Question for Each Student	
No. of Questions to be answered		**1**	
Marks for each question		**75**	
Total Marks for each section		**75**	

Distribution of Marks with COs &K Level for Correction of the Summative Exam

COs	K - Level	Distribution of the work of the experiment	K - Level	MARKS
CO1	K1 to K5	Aim and apparatus	K1	10
CO2	K1 to K5	Formula and Tabular Column	K3	15
CO3	K1 to K5	Understanding and Observation	K5	30
CO4	K1 to K5	Calculation and Graph	K4	15
CO5	K1 to K5	Interpretation of result	K2	5
Total Marks				75

Distribution of Marks with K Level				
K Level	Parameters for K-Level	Total Marks	% of (Marks without choice)	Consolidated %
K1	Aim and apparatus	10	13.33	13
K3	Formula and Tabular Column	15	20	20
K5	Understanding and Observation	30	40	40
K4	Calculation and Graph	15	20	20
K2	Interpretation of result	5	6.67	7
Marks		75	100	100

Course Name	ELECTROMAGNETIC THEORY			
Course Code	23PPHEC31	**L**	**P**	**C**
Category	ELECTIVE	6	-	3

COURSE OBJECTIVES:

- To acquire knowledge about boundary conditions between two media and the technique of method of separation of variables
- To understand Biot – Savart's law and Ampere's circuital law
- To comprehend the physical ideas contained in Maxwell's equations, Coulomb & Lorentz gauges, conservation laws
- To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves
- To grasp the concept of plasma as the fourth state of matter

UNIT - I ELECTROSTATICS 17

Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in one, two, three dimension – Work and energy in electrostatistics.

Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion.

UNIT - II MAGNETOSTATICS 19

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

UNIT - III MAXWELL EQUATIONS 17

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

UNIT - IV WAVE PROPAGATION 19

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

UNIT - V RELATIVISTIC MECHANICS AND ELECTRODYNAMICS	18
Proper time and proper velocity – Relativistic Energy and momentum – Relativistic kinematics – Relativistic Dynamics – Magnetism as a relativistic phenomenon – How the fields transform – The field tensor – Electrodynamic in tensor notation – Relativistic Potentials.	
Total Lecture Hours	**90**

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- J. R. Reitz, F. J. Milford and R. W. Christy, Foundations of Electromagnetic Theory, 3rd edition, Narosa Publishing House, New Delhi, 1986.
- J. D. Jackson, Classical Electrodynamics, Wiley Eastern Ltd. New Delhi, 1975.
- J. A. Bittencourt, Fundamentals of Plasma Physics, Pergamon Press, Oxford, 1988.
- Gupta, Kumar and Singh, Electrodynamics, S. Chand & Co., New Delhi
- W. Panofsky and M. Phillips, Classical Electricity and Magnetism, Addison Wesley, London, 1962.
- J. D. Kraus and D. A. Fleisch, Electromagnetics with Applications, 5th Edition, WCB McGraw-Hill, New York, 1999.
- B. Chakraborty, Principles of Electrodynamics, Books and Allied, Kolkata, 2002.
- P. Feynman, R. B. Leighton and M. Sands, The Feynman Lectures on Physics, Vols. 2, Narosa Publishing House, New Delhi, 1998.
- Andrew Zangwill, Modern Electrodynamics, Cambridge University Press, USA, 2013.

WEB RESOURCES:

- **http://www.plasma.uu.se/CED/Book/index.html – Electromagnetic Field Theory**
- **http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html - Electrodynamics**
- **http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html – Electrodynamics and relativistic**
- **http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/ - Electromagnetism**
- **https://www.cliffsnotes.com/study-guides/physics/electricity-and-magnetism/electrostatics - electricity-and-magnetism**

Nature of Course	EMPLOYABILITY			SKILL ORIENTED			ENTREPRENEURSHIP		✓			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL			GLOBAL	✓			
Changes Made in the Course	Percentage of Change	**30%**		No Changes Made			New Course					

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Solve the differential equations using Laplace equation and to find solutions for boundary value problems	K1 to K5
CO2	Use Biot-Savart's law and Ampere circuital law to find the magnetic induction & magnetic vector potential for various physical problems	K1 to K5
CO3	Apply Maxwell's equations to describe how electromagnetic field behaves in different media	K1 to K5
CO4	Apply the concept of propagation of EM waves through wave guides in optical fiber communications and also in radar installations, calculate the transmission and reflection coefficients of electromagnetic waves	K1 to K5
CO5	Investigate the interaction of ionized gases with self-consistent electric and magnetic fields	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	2	2	3	3	1	3
CO2	3	3	3	1	2	2	3	3	1	3
CO3	3	3	3	1	2	2	3	3	1	3
CO4	3	3	3	1	2	2	3	3	1	3
CO5	3	3	3	1	2	2	3	3	1	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	1	2	2	3	3	1	3
CO 2	3	3	3	1	2	2	3	3	1	3
CO 3	3	3	3	1	2	2	3	3	1	3
CO 4	3	3	3	1	2	2	3	3	1	3
CO 5	3	3	3	1	2	2	3	3	1	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	ELECTROMAGNETIC THEORY	HRS	PEDAGOGY
I	Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems. Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion.	17	Chalk &Talk, PPT, Seminar
II	Biot-Savart's Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magneto static energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetized sphere.	19	Chalk &Talk, PPT
III	Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem - Lorentz force - Conservation laws for a system of charges and electromagnetic fields.	17	Chalk &Talk, Assignment
IV	Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface - Waves in a conducting medium - Propagation of waves in a rectangular wave guide. Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole.	19	Chalk &Talk, Group discussion
V	The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations - The Debye shielding problem - Plasma confinement in a magnetic field - Magneto-hydrodynamic waves - Alfven waves and magnetosonic waves.	18	Seminar, PPT, Chalk &Talk

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	**Cos**	**K Level**	**Section A MCQs**		**Section B Either or Choice**	**Section C Either or Choice**
			No. of. Questions	**K - Level**		
CI	**CO1**	**K2**	**2**	**K1, K2**	**2 (K2, K2)**	**2 (K2, K2)**
AI	**CO2**	**K3**	**2**	**K1, K2**	**2 (K3, K3)**	**2 (K3, K3)**
CI	**CO3**	**K3**	**2**	**K1, K2**	**2 (K2, K2)**	**2 (K3, K3)**
AII	**CO4**	**K2**	**2**	**K1, K2**	**2 (K2, K2)**	**2 (K2, K2)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**4**	**4**
		No. of Questions to be answered	**4**		**2**	**2**
		Marks for each question	**1**		**5**	**8**
		Total Marks for each section	**4**		**10**	**16**

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.57**	**54**
	K2	2	10	16	28	**50**	
	K3		10	16	26	**46.43**	**46**
	K4						
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.57**	**71**
	K2	2	20	16	38	**67.86**	
	K3			16	16	**28.57**	**29**
	K4						
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K2	2	K1, K2	2 (K2, K2)	2 (K2, K2)
2	CO2	K3	2	K1, K2	2 (K3, K3)	2 (K3, K3)
3	CO3	K3	2	K1, K2	2 (K3, K3)	2 (K3, K3)
4	CO4	K2	2	K1, K2	2 (K2, K2)	2 (K2, K2)
5	CO5	K4	2	K1, K2	2 (K3, K3)	2 (K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.57	4
K2	5	20	32	57	40.72	41
K3		30	32	62	44.28	44
K4			16	16	11.43	11
Marks	10	50	80	140	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K2**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K2**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K2**	
		OR		
16. b)	**Unit - I**	**CO1**	**K2**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K2**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K2**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	COMMUNICATION ELECTRONICS			
Course Code	23PPHSC31	**L**	**P**	**C**
Category	SKILL ENHANCEMENT COURSE	**2**	**-**	**2**

COURSE OBJECTIVES:

- To comprehend the transmission of electromagnetic waves thorough different types of antenna and also to acquire knowledge about the propagation of waves through earth's atmosphere and along the surface of the earth.
- To gain knowledge in the generation and propagation of microwaves.
- To acquire knowledge about radar systems and its applications and also the working principle of colour television.
- To learn the working principle of fiber optics and its use in telecommunication.
- To understand the general theory and operation of satellite communication systems

UNIT - I ANTENNAS AND WAVE PROPAGATION **06**

Radiation field and radiation resistance of short dipole antenna-grounded antenna-ungrounded antenna-antenna arrays-broadside and end side arrays-antenna gain-directional high frequency antennas-sky wave-ionosphere- Ecles and Larmor theory- Magnento ionic theory-ground wave propagation

UNIT - II MICROWAVES **06**

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

UNIT - III RADAR AND TELEVISION **06**

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

UNIT - IV OPTICAL FIBER **06**

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

UNIT - V SATELLITE COMMUNICATION **06**

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

Total Lecture Hours **30**

BOOKS FOR STUDY:

- Handbook of Electronics by Gupta and Kumar, 2008 edition.

BOOKS FOR REFERENCES:

- Electronic communication systems – George Kennedy and Davis, Tata McGraw Hill, 4th edition, 1988.
- Taub and Schilling, principles of communication systems, second edition, Tata McGraw Hill, 1991.
- M. Kulkarani, Microwave and radar engineering, Umesh Publications, 1998.
- R. R. Ghulathi, Mono Chrome and colour television.
- Electronic communications – Dennis Roody and Coolen, Prentice Hall of India, 4th edition, 1995.
- Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall of India, 1998
- Dennis Roddy and Coolen, Electronics communications, Prentice Hall of India, 4th Edition, 1995.
- Wayne Tomasi, Advanced Electronics communication System, 4th edition, Prentice Hall of India, 1998.
- S. Salivahanan, N. Suersh Kumar & A. Vallavaraj, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition, 2009.

WEB RESOURCES:

- **https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/ - Digital Electronics**
- **https://www.polytechnichub.com/difference-analog-instruments-digital-instruments/ - Analog and Digital Electronics**
- **http://nptel.iitm.ac.in/ - Electronics Communication**
- **http://web.ewu.edu/ - Communication Electronics**
- **http://nptel.iitm.ac.in/- Communication Systems**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change	**50%**	No Changes Made		New Course			

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Discuss and compare the propagation of electromagnetic waves through sky and on earth's surface Evaluate the energy and power radiated by the different types of antenna	K1 to K5
CO2	Compare and differentiate the methods of generation of microwaves analyze the propagation of microwaves through wave guides- discuss and compare the different methods of generation of microwaves	K1 to K5
CO3	Classify and compare the working of different radar systems- apply the principle of radar in detecting locating, tracking, and recognizing objects of various kinds at considerable distances – discuss the importance of radar in military- elaborate and compare the working of different picture tube	K1 to K5
CO4	Classify, discuss and compare the different types of optical fiber and also to justify the need of it-discover the use of optical fiber as wave guide	K1 to K5
CO5	Explain the importance of satellite communication in our daily life-distinguish between orbital and geostationary satellites elaborate the linking of satellites with ground station on the earth	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	2	2	3	2	1	3
CO2	3	3	3	1	2	2	3	2	1	3
CO3	3	3	3	1	2	2	3	2	1	3
CO4	3	3	3	1	2	2	3	2	1	3
CO5	3	3	3	1	2	2	3	2	1	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	1	2	2	3	2	1	3
CO 2	3	3	3	1	2	2	3	2	1	3
CO 3	3	3	3	1	2	2	3	2	1	3
CO 4	3	3	3	1	2	2	3	2	1	3
CO 5	3	3	3	1	2	2	3	2	1	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:			
UNIT	**COMMUNICATION ELECTRONICS**	**HRS**	**PEDAGOGY**
I	Radiation field and radiation resistance of short dipole antenna-grounded antenna-ungrounded antenna-antenna arrays-broadside and end side arrays-antenna gain-directional high frequency antennas-sky wave-ionosphere- Ecles and Larmor theory- Magnento ionic theory-ground wave propagation	**06**	**Chalk &Talk, PPT, Seminar**
II	Microwave generation—multi cavity Klystron-reflex klystron-magnetron travelling wave tubes (TWT) and other microwave tubes-MASER-Gunn diode-wave guides-rectangular wave guides-standing wave indicator and standing wave ratio(SWR)	**06**	**Chalk &Talk, PPT, Seminar**
III	Elements of a radar system-radar equation-radar performance Factors radar transmitting systems-radar antennas-duplexers-radar receivers and indicators-pulsed systems-other radar systems- colour TV transmission and reception-colour mixing principle-colour picture tubes- Delta gun picture tube-PIL colour picture tube-cable TV, CCTV and theatre TV	**06**	**Chalk &Talk, PPT, Seminar**
IV	Propagation of light in an optical fibre-acceptance angle-numerical aperture-step and graded index fibres-optical fibres as a cylindrical wave guide-wave guide equations-wave guide equations in step index fibres - fibre losses and dispersion-applications	**06**	**Chalk &Talk, PPT, Seminar**
V	Orbital satellites-geostationary satellites-orbital patterns-satellite system link models-satellite system parameters-satellite system link equation link budget-INSAT communication satellites	**06**	**Chalk &Talk, PPT, Seminar**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	**Cos**	**K Level**	**Section A MCQs**	
			No. of. Questions	**K - Level**
CI AI	**CO1**	**K1 – K2**	**25**	**K1,K2**
	CO2	**K1 – K2**	**25**	**K1,K2**
CI AII	**CO3**	**K1 – K2**	**25**	**K1,K2**
	CO4	**K1 – K2**	**25**	**K1,K2**
Question Pattern CIA I & II		**No. of Questions to be asked**	**50**	
		No. of Questions to be answered	**50**	
		Marks for each question	**1**	
		Total Marks for each section	**50**	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (I[st] Test-2 CO's & II[nd] Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100
CIA II	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	**Section A (Multiple Choice Questions)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**40**	**40**	**53**	**100**
K2	**35**	**35**	**47**	
K3				
K4				
Marks		**75**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				

Course Name	SOLAR ENERGY UTILIZATION			
Course Code	23PPHNM31	**L**	**P**	**C**
Category	NON-MAJOR ELECTIVE	4	-	3

COURSE OBJECTIVES:

- To impart fundamental aspects of solar energy utilization.
- To give adequate exposure to solar energy related industries
- To harness entrepreneurship skills
- To understand the different types of solar cells and channelizing them to the different sectors of society
- To develop an industrialist mindset by utilizing renewable source of energy

UNIT - I HEAT TRANSFER & RADIATION ANALYSIS **12**

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

UNIT - II SOLAR COLLECTORS **12**

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

UNIT - III SOLAR HEATERS **10**

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

UNIT - IV SOLAR ENERGY CONVERSION **13**

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

UNIT - V NANOMATERIALS IN FUEL CELL APPLICATIONS **13**

Use of nanostructures and nanomaterials in fuel cell technology - high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of Nano technology in hydrogen production and storage.

Total Lecture Hours **60**

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- Maheshwar Sharon, Madhuri Sharon, Carbon "Nano forms and Applications", McGraw-Hill, 2010.
- Soteris A. Kalogirou, „Solar Energy Engineering: Processes and Systems", Academic Press, London, 2009.
- Tiwari G.N, "Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
- Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
- R.H.Romer, W.H.Freeman, Energy – An Introduction to Physics, 1976.
- John A.Drife and William, Solar energy thermal processes, 1974.
- John W. Twidell& Anthony D.Weir, 'Renewable Energy Resources, 2005.
- John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, john Wiley and Sons, 2013.
- Duffie, J.A., Beckman, W.A. "Solar Energy Thermal Process", John Wiley and Sons, 2007.

WEB RESOURCES:

- **https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb - Solar Energy Conservation**
- **https://books.google.vg/books?id=1-XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read – Solar Energy – Principles of Thermal Collection and Storage.**
- **www.nptel.ac.in/courses/112105051 - Energy and Dependence on External Sources**
- **www.freevideolectures.com – Solar Energy**
- **http://www.e-booksdirectory.com - Solar Energy e-book**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made		New Course	✓		

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Gained knowledge in fundamental aspects of solar energy utilization	K1 to K5
CO2	Equipped to take up related job by gaining industry exposure	K1 to K5
CO3	Develop entrepreneurial skills	K1 to K5
CO4	Skilled to approach the needy society with different types of solar cells	K1 to K5
CO5	Gained industrialist mindset by utilizing renewable source of energy	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	3	3	2	2	2	3	2
CO2	2	3	2	2	3	3	2	3	2	2
CO3	2	3	2	2	2	2	3	3	3	2
CO4	2	2	2	3	2	3	2	3	3	2
CO5	2	2	3	2	3	3	3	3	3	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	2	3	3	3	2	2	2	3	2
CO 2	2	3	2	2	3	3	2	3	2	2
CO 3	2	3	2	2	2	2	3	3	3	2
CO 4	2	2	2	3	2	3	2	3	3	2
CO 5	2	2	3	2	3	3	3	3	3	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:			
UNIT	**SOLAR ENERGY UTILIZATION**	**HRS**	**PEDAGOGY**
I	Conduction, Convection and Radiation – Solar Radiation at the earth's surface - Determination of solar time – Solar energy measuring instruments.	**12**	**Chalk &Talk, PPT, Seminar**
II	Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.	**12**	**Chalk &Talk, PPT**
III	Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.	**10**	**Chalk &Talk, Assignment**
IV	Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo - electric conversion - process flow of silicon solar cells- different approaches on the process- texturization, diffusion, Antireflective coatings, metallization.	**13**	**Chalk &Talk, Group discussion**
V	Use of nanostructures and nanomaterials in fuel cell technology - high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of Nano technology in hydrogen production and storage. Industrial visit – data collection and analysis – presentation.	**13**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	**Cos**	**K Level**	**Section A**		**Section B Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1**	**2**	**K1, K1**	**2 (K1, K1)**	**2 (K1, K1)**
	CO2	**K2**	**2**	**K2, K2**	**2 (K2, K2)**	**2 (K2, K2)**
CI AII	**CO3**	**K3**	**2**	**K1, K2**	**2 (K3, K3)**	**2 (K3, K3)**
	CO4	**K4**	**2**	**K1, K2**	**2 (K3, K3)**	**2 (K4, K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**4**	**4**
		No. of Questions to be answered	**4**		**2**	**2**
		Marks for each question	**1**		**5**	**8**
		Total Marks for each section	**4**		**10**	**16**

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	10	16	28	**50**	**50**
	K2	2	10	16	28	**50**	**50**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.57**	**7**
	K2	2			2	**3.57**	
	K3		20	16	36	**64.29**	**64**
	K4			16	16	**28.57**	**29**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	**COs**	**K - Level**	**Section A (MCQs)**		**Section B (Either / or Choice) With K - LEVEL**	**Section C (Either / or Choice) With K - LEVEL**
			No. of Questions	**K – Level**		
1	**CO1**	**K1**	**2**	**K1, K1**	**2 (K1, K1)**	**2 (K1, K1)**
2	**CO2**	**K2**	**2**	**K2, K2**	**2 (K2, K2)**	**2 (K2, K2)**
3	**CO3**	**K3**	**2**	**K1, K2**	**2 (K3, K3)**	**2 (K3, K3)**
4	**CO4**	**K4**	**2**	**K1, K2**	**2 (K3, K3)**	**2 (K4, K4)**
5	**CO5**	**K5**	**2**	**K1, K2**	**2 (K4, K4)**	**2 (K5, K5)**
No. of Questions to be Asked			**10**		**10**	**10**
No. of Questions to be answered			**10**		**5**	**5**
Marks for each question			**1**		**5**	**8**
Total Marks for each section			**10**		**25**	**40**
(Figures in parenthesis denotes, questions should be asked with the given K level)						

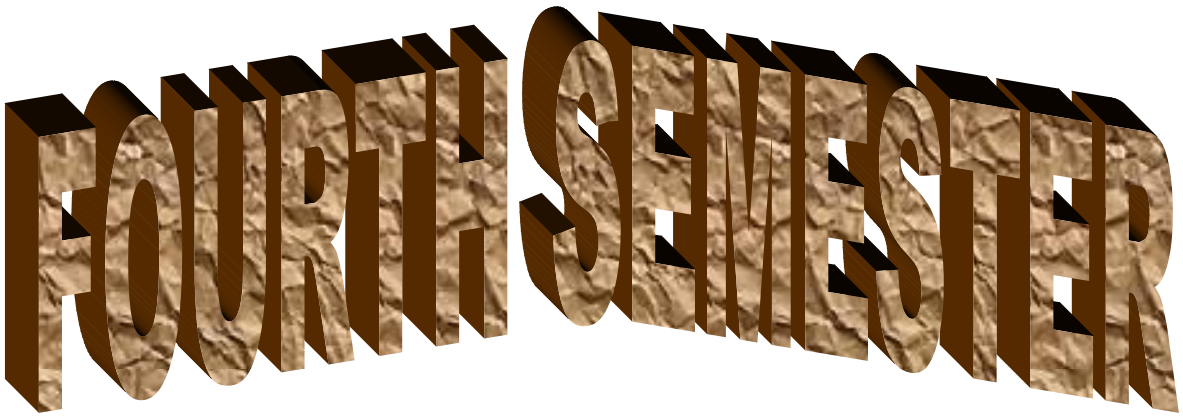
Distribution of Marks with K Level						
K Level	**Section A (Multiple Choice Questions)**	**Section B (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	10	16	31	**22.14**	**22**
K2	5	10	16	31	**22.14**	**22**
K3		20	16	36	**25.72**	**26**
K4		10	16	26	**18.57**	**19**
K5			16	16	**11.43**	**11**
Marks	**10**	**50**	**80**	**140**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions			**PART – B**	**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K1**	
		OR		
11. b)	**Unit - I**	**CO1**	**K1**	
12. a)	**Unit - II**	**CO2**	**K2**	
		OR		
12. b)	**Unit - II**	**CO2**	**K2**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K4**	
		OR		
15. b)	**Unit - V**	**CO5**	**K4**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K1**	
		OR		
16. b)	**Unit - I**	**CO1**	**K1**	
17. a)	**Unit - II**	**CO2**	**K2**	
		OR		
17. b)	**Unit - II**	**CO2**	**K2**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	


FOURTH SEMESTER

Course Name	NUCLEAR AND PARTICLE PHYSICS			
Course Code	23PPHCC41	**L**	**P**	**C**
Category	CORE	6	-	5

COURSE OBJECTIVES:

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

UNIT - I NUCLEAR MODELS **17**

Liquid drop model – Weizacker mass formula – Isobaric mass parabola –Mirror Pair - Bohr Wheeler theory of fission – shell model – spin-orbit coupling – magic numbers – angular momenta and parity of ground states – magnetic moment – Schmidt model – electric Quadrapole moment - Bohr and Mottelson collective model – rotational and vibrational bands.

UNIT - II NUCLEAR FORCES **19**

Nucleon – nucleon interaction – Tensor forces – properties of nuclear forces – ground state of deuteron – Exchange Forces - Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering – effective range theory – spin dependence of nuclear forces - charge independence and charge symmetry – isospin formalism.

UNIT - III NUCLEAR REACTIONS **17**

Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – four factor formula.

UNIT - IV NUCLEAR DECAY **19**

Beta decay – Continuous Beta spectrum – Fermi theory of beta decay - Comparative Half-life –Fermi Kurie Plot – mass of neutrino – allowed and forbidden decay — neutrino physics – Helicity– Parity violation – Gamma decay – multipole radiations – Angular Correlation - internal conversion – nuclear isomerism – angular momentum and parity selection rules.

UNIT - V ELEMENTARY PARTICLES **18**

Classification of elementary particles – Fundamental interactions (Gravitational, electromagnetic, strong, weak) – Conservation laws – Invariance under charge, parity , C.P., time and CPT –Electron and positron – Proton and anti- proton – Neutron and anti- neutron – Neutrino and antineutrino Photon and Gluon – Meson: muons, Tauons, Pions, K- meson ,η - mesons, Hyperons : Λ -, Ξ, ∑, Ω- hyperons. Quarks.

Total Lecture Hours **90**

BOOKS FOR STUDY:

- S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers, 2011.
- D. C. Tayal – Nuclear Physics – Himalaya Publishing House, 2011.

BOOKS FOR REFERENCES:

- M.L.Pandya, R.P.S.Yadav and Amiya Dash, Elements of Nuclear Physics, Eighth Edition, Kedarnath Ram nath, Meerut,2018.
- K. S. Krane, Introductory Nuclear Physics, John Wiley & Sons, 2008.
- R. Roy and P. Nigam, Nuclear Physics, New Age Publishers, 1996.
- S. Glasstone, Source Book of Atomic Energy, Van Nostrand Reinhold Inc., U.S., 3rd Revised edition, 1968.
- L. J. Tassie, The Physics of elementary particles, Prentice Hall Press, 1973.
- H. A. Enge, Introduction to Nuclear Physics, Addison Wesley, Publishing Company. Inc. Reading. New York, 1974.
- Kaplan, Nuclear Physics, 2nd Ed., Narosa, 2002.
- L. C. Bernard, Concepts of Nuclear Physics, McGraw Hill Education (India) Private Limited; 1st edition, 2001.
- B.L. Cohen, Concepts of Nuclear Physics, TMCH, New Delhi, 1971.

WEB RESOURCES:

- **http://bubl.ac.uk/link/n/nuclearphysics.html - Nuclear Physics**
- **http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdfhttp://www.scholarpedia.org/article/Nuclear_Forces - Nuclear Forces**
- **https://www.nuclear-power.net/nuclear-power/nuclear-reactions/ - Nuclear Power and Reactors**
- **http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.html - Nuclear Reactor Models**
- **https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.html - Radioactive Decay**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change	**60%**	No Changes Made		New Course			

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion.	K1 to K5
CO2	Demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter.	K1 to K5
CO3	Use the different nuclear models to explain different nuclear phenomena and the concept of resonances through Briet-Weigner single level formula	K1 to K5
CO4	Analyze data from nuclear scattering experiments to identify different properties of the nuclear force.	K1 to K5
CO5	Summarize and identify allowed and forbidden nuclear reactions based on conservation laws of the elementary particles.	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	2	2	2	2	2
CO2	3	3	2	2	1	2	1	2	2	2
CO3	3	3	1	2	1	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	3	3
CO5	3	3	2	3	2	3	2	3	3	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	2	2	2	2	2	2	2	2
CO 2	3	3	2	2	1	2	1	2	2	2
CO 3	3	3	1	2	1	2	1	1	2	2
CO 4	3	3	2	3	2	3	2	2	3	3
CO 5	3	3	2	3	2	3	2	3	3	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:			
UNIT	**NUCLEAR AND PARTICLE PHYSICS**	**HRS**	**PEDAGOGY**
I	Liquid drop model – Weizacker mass formula – Isobaric mass parabola –Mirror Pair - Bohr Wheeler theory of fission – shell model – spin-orbit coupling – magic numbers – angular momenta and parity of ground states – magnetic moment – Schmidt model – electric Quadrapole moment - Bohr and Mottelson collective model – rotational and vibrational bands.	**17**	**Chalk &Talk, PPT, Seminar**
II	Nucleon – nucleon interaction – Tensor forces – properties of nuclear forces – ground state of deuteron – Exchange Forces - Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering – effective range theory – spin dependence of nuclear forces - charge independence and charge symmetry – isospin formalism.	**19**	**Chalk &Talk, PPT**
III	Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – four factor formula.	**17**	**Chalk &Talk, Assignment**
IV	Beta decay – Continuous Beta spectrum – Fermi theory of beta decay - Comparative Half-life –Fermi Kurie Plot – mass of neutrino – allowed and forbidden decay — neutrino physics – Helicity - Parity violation - Gamma decay – multipole radiations – Angular Correlation - internal conversion – nuclear isomerism – angular momentum and parity selection rules.	**19**	**Chalk &Talk, Group discussion**
V	Classification of elementary particles – Fundamental interactions (Gravitational, electromagnetic, strong, weak) – Conservation laws – Invariance under charge, parity , C.P., time and CPT – Electron and positron – Proton and anti- proton – Neutron and anti- neutron – Neutrino and antineutrino Photon and Gluon – Meson: muons, Tauons, Pions, K- meson ,η - mesons, Hyperons : Λ -, Ξ, ∑, Ω- hyperons. Quarks.	**18**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	**Cos**	**K Level**	**Section A MCQs**		**Section B Either or Choice**	**Section C Either or Choice**
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K5**	2	K1, K2	2 (K4, K4)	2 (K5, K5)
	CO2	**K3**	2	K1, K2	2 (K3, K3)	2 (K3, K3)
CI AII	**CO3**	**K3**	2	K1, K2	2 (K3, K3)	2 (K3, K3)
	CO4	**K4**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.57**	**8**
	K2	2			2	**3.57**	
	K3		10	16	26	**46.43**	**46**
	K4		10		10	**17.86**	**18**
	K5			16	16	**28.57**	**28**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.57**	**8**
	K2	2			2	**3.57**	
	K3		20	16	36	**64.29**	**64**
	K4			16	16	**28.57**	**28**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	Cos	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K5	2	(K1, K2)	2 (K4, K4)	2 (K5, K5)
2	CO2	K3	2	(K1, K2)	2 (K3, K3)	2 (K3, K3)
3	CO3	K3	2	(K1, K2)	2 (K3, K3)	2 (K3, K3)
4	CO4	K4	2	(K1, K2)	2 (K3, K3)	2 (K4, K4)
5	CO5	K5	2	(K1, K2)	2 (K5, K5)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.57	4
K2	5			5	3.57	4
K3		30	32	62	44.29	44
K4		10	16	26	18.57	18
K5		10	32	42	30	30
Marks	10	50	80	140	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K4**	
		OR		
11. b)	**Unit - I**	**CO1**	**K4**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**		
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K5**	
		OR		
15. b)	**Unit - V**	**CO5**	**K5**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K5**	
		OR		
16. b)	**Unit - I**	**CO1**	**K5**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	

Course Name	SPECTROSCOPY			
Course Code	23PPHCC42	**L**	**P**	**C**
Category	CORE	6	-	5

COURSE OBJECTIVES:

- To comprehend the theory behind different spectroscopic methods
- To know the working principles along with an overview of construction of different types of spectrometers involved
- To explore various applications of these techniques in R &D.
- Apply spectroscopic techniques for the qualitative and quantitative analysis of various chemical compounds.
- Understand this important analytical tool

UNIT - I MICROWAVE SPECTROSCOPY 17

Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules - Hyperfine structure and quadrupole moment of linear molecules - Instrumentation techniques – block diagram - Information Derived from Rotational Spectra- Stark effect- Problems.

UNIT - II INFRA-RED SPECTROSCOPY 19

Vibrations of simple harmonic oscillator – Zero-point energy- Anharmonic oscillator – Fundamentals, overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch- Fundamental modes of vibration of H_2O and CO_2 -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy - Interpretation of vibrational spectra– remote analysis of atmospheric gases like N2O using FTIR by National Remote Sensing Centre (NRSC), India– other simple applications.

UNIT - III RAMAN SPECTROSCOPY 17

Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- SR branch -Raman activity of H_2O and CO_2 .Mutual exclusion principle- determination of N_2O structure -Instrumentation technique and block diagram -structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy- SERS.

UNIT - IV RESONANCE SPECTROSCOPY	19
Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance- Chemical shift and its measurement - NMR of Hydrogen nuclei - Indirect Spin -Spin Interaction – interpretation of simple organic molecules - Instrumentation techniques of NMR spectroscopy – NMR in Chemical industries- MRI Scan Electron Spin Resonance: Basic principle – Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors – Instrumentation - Medical applications of ESR.	
UNIT - V UV SPECTROSCOPY	**18**
Origin of UV spectra - Laws of absorption – Lambert Bouguer law – Lambert Beer law - Molar absorptivity – Transmittance and Absorbance - Color in organic compounds– Absorption by organic Molecule –Chromophores– Effect of conjugation on chromophores–Choice of Solvent and Solvent effect – Absorption by inorganic systems – Instrumentation – Double beam UV–Spectrophotometer –Simple applications.	
Total Lecture Hours	**90**

BOOKS FOR STUDY:

- C. N. Banwell and E M McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi, 1994.
- G. Aruldhas, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi, 1994.

BOOKS FOR REFERENCES:

- D.N. Satyanarayana, Vibrational Spectroscopy and Applications, New Age International Publication, 2001.
- B.K. Sharma, Spectroscopy, Goel Publishing House Meerut, 2015.
- Kalsi.P.S, Spectroscopy of Organic Compounds (7th Edition), New Age International Publishers, 2016.
- J. L. McHale, Molecular Spectroscopy, Pearson Education India, New Delhi, 2008.
- J M Hollas, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge, 2002.
- B. P. Straughan and S. Walker, Spectroscopy Vol. I, Chapman and Hall, New York, 1976.
- K. Chandra, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi, 1989.
- W. Demtroder, Laser Spectroscopy: Basic concepts and Instrumentation, Springer Link.

WEB RESOURCES:

- **https://www.youtube.com/watch?v=0iQhirTf2PI – Remote Sensing**
- **https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5 - Introduction to Molecular Spectroscopy**
- **https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee - Infrared Spectroscopy**
- **https://onlinecourses.nptel.ac.in/noc20_cy08/preview - Molecular Spectroscopy**
- **https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu - Spectroscopy**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change	**70%**	No Changes Made		New Course			
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**								

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Understand fundamentals of rotational spectroscopy, view molecules as elastic rotors and interpret their behaviour. Able to quantify their nature and correlate them with their characteristic properties.	**K1 to K5**
CO2	Understand the working principles of spectroscopic instruments and theoretical background of IR spectroscopy. Able to correlate mathematical process of Fourier transformations with instrumentation. Able to interpret vibrational spectrum of small molecules.	**K1 to K5**
CO3	Interpret structures and composition of molecules and use their knowledge of Raman Spectroscopy as an important analytical tool	**K1 to K5**
CO4	Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances	**K1 to K5**
CO5	Learn the electronic transitions caused by absorption of radiation in the UV/Vis region of the electromagnetic spectrum and be able to analyze a simple UV spectrum.	**K1 to K5**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	3	3	3	2
CO3	3	2	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	2	3	3	3	3	3	2
CO 2	2	2	2	3	3	3	3	3	3	2
CO 3	3	2	3	3	3	3	3	3	3	3
CO 4	3	2	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3

WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	SPECTROSCOPY	HRS	PEDAGOGY
I	Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules - Hyperfine structure and quadrupole moment of linear molecules - Instrumentation techniques – block diagram -Information Derived from Rotational Spectra- Stark effect- Problems.	**17**	**Chalk &Talk, PPT, Seminar**
II	Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch- Fundamental modes of vibration of H_2O and CO_2 -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy - Interpretation of vibrational spectra– remote analysis of atmospheric gases like N2O using FTIR by National Remote Sensing Centre (NRSC), India– other simple applications.	**19**	**Chalk &Talk, PPT**
III	Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- SR branch -Raman activity of H_2O and CO_2 .Mutual exclusion principle- determination of N_2O structure -Instrumentation technique and block diagram -structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy- SERS	**17**	**Chalk &Talk, Assignment**
IV	Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance- Chemical shift and its measurement - NMR of Hydrogen nuclei - Indirect Spin -Spin Interaction – interpretation of simple organic molecules - Instrumentation techniques of NMR spectroscopy – NMR in Chemical industries- MRI Scan Electron Spin Resonance: Basic principle –Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors – Instrumentation - Medical applications of ESR.	**19**	**Chalk &Talk, Group discussion**
V	Origin of UV spectra - Laws of absorption – Lambert Bouguer law – Lambert Beer law - molar absorptivity – transmittance and absorbance -	**18**	**Seminar, PPT, Chalk**

	Color in organic compounds- Absorption by organic Molecule - Chromophores -Effect of conjugation on chromophores - Choice of Solvent and Solvent effect - Absorption by inorganic systems - Instrumentation - double beam UV-Spectrophotometer -Simple applications.		**&Talk**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	**Cos**	**K Level**	**Section A MCQs**		**Section B Either or Choice**	**Section C Either or Choice**
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K4**	**2**	**K1, K2**	**2 (K3, K3)**	**2 (K4, K4)**
	CO2	**K4**	**2**	**K1, K2**	**2 (K3, K3)**	**2 (K4, K4)**
CI AII	**CO3**	**K1**	**2**	**K1, K1**	**2 (K1, K1)**	**2 (K1, K1)**
	CO4	**K4**	**2**	**K2, K2**	**2 (K3, K3)**	**2 (K4, K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**4**	**4**
		No. of Questions to be answered	**4**		**2**	**2**
		Marks for each question	**1**		**5**	**8**
		Total Marks for each section	**4**		**10**	**16**

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.57**	**7**
	K2	2			2	**3.57**	
	K3		20		20	**35.71**	**36**
	K4			32	32	**57.14**	**57**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2	10	16	28	**50**	**50**
	K2	2			2	**3.57**	**21**
	K3		10		10	**17.86**	
	K4			16	16	**28.57**	**29**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K4	2	K1, K2	2 (K3, K3)	2 (K4, K4)
2	CO2	K4	2	K1, K2	2 (K3, K3)	2 (K4, K4)
3	CO3	K1	2	K1, K1	2 (K1, K1)	2 (K1, K1)
4	CO4	K5	2	K1, K2	2 (K3, K3)	2 (K5, K5)
5	CO5	K3	2	K1, K2	2 (K2, K2)	2 (K3, K3)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	6	10	16	32	22.86	23
K2	4	10		14	10	10
K3		30	16	46	32.86	33
K4			32	32	22.86	23
K5			16	16	11.43	11
Marks	10	50	80	140	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions			**PART – A**	**(10 x 1 = 10 Marks)**	
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions			**PART – B**	**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K3**	
		OR		
11. b)	**Unit - I**	**CO1**	**K3**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K1**	
		OR		
13. b)	**Unit - III**	**CO3**	**K1**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K2**	
		OR		
15. b)	**Unit - V**	**CO5**	**K2**	

Answer **ALL** the questions			**PART – C**	**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K4**	
		OR		
16. b)	**Unit - I**	**CO1**	**K4**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K1**	
		OR		
18. b)	**Unit - III**	**CO3**	**K1**	
19. a)	**Unit - IV**	**CO4**	**K5**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K5**	
20. a)	**Unit - V**	**CO5**	**K3**	
		OR		
20. b)	**Unit - V**	**CO5**	**K3**	

Course Name	PRACTICAL - IV			
Course Code	23PPHCP41	**L**	**P**	**C**
Category	CORE	-	6	4

COURSE OBJECTIVES:

- The aim and objective of the course on Computational Practical is to familiarize the of M.Sc. students with the numerical methods used in computation and programming using any high level language such as C/FORTRAN
- To equip the computational skill using various mathematical tools.
- To apply the software tools to explore the concepts of physical science.
- To approach the real time activities using physics and mathematical formulations.

COURSE DETAILS

(Any Twelve Experiments)

40. Lagrange interpolation with Algorithm, Flow chart and output.
41. Newton forward interpolation with Algorithm, Flow chart and output.
42. Newton backward interpolation with Algorithm, Flow chart and output.
43. Curve-fitting: Least squares fitting with Algorithm, Flow chart and output.
44. Numerical integration by the trapezoidal rule with Algorithm, Flow chart and output.
45. Numerical integration by Simpson's rule with Algorithm, Flow chart and output.
46. Numerical solution of ordinary first-order differential equations by the Runge– Kutta method with Algorithm, Flow chart and output.
47. Finding Roots of a Polynomial – Bisection Method
48. Finding Roots of a Polynomial – Newton Raphson Method
49. Solution of Simultaneous Linear Equation by Gauss elimination method.
50. Solution of Ordinary Differential Equation by Euler method
51. Runge–Kutta Fourth Order Method for solving first order Ordinary Differential Equations
52. Trapezoidal rule
53. Simpson's 1/3 rule
54. Gaussian quadrature method (2 point and 3 point formula)
55. Find the thickness of the mica sheet using edser butler fringes
56. Pulse width modulation using IC555
57. Amplitude modulation using transistor
58. Analog computation using OPAMPs
59. Determination of dielectric constant of liquid (kerocine) using the passive circuit

BOOKS FOR STUDY:

- V. Rajaraman, Computer Oriented Numerical Methods, 3rd Ed. (Prentice-Hall, New Delhi, 1993.
- V. Rajaraman,Programming in FORTRAN/ Programming in C, PHI, New Delhi.

BOOKS FOR REFERENCES:

- John Mathews, Kurtis Fink, Numerical methods using Matlab, Prentice Hall, New Jersey, 2006.
- M.K. Venkataraman, Numerical methods in Science and Engineering, National Publishing Co. Madras, 1996.
- M.K. Jain, S.R. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 3rd Ed. New Age International, New Delhi, 1995.
- S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi.
- S.D. Conte and C. de Boor, Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., International Ed. (McGraw-Hill), 1981.
- B.F. Gerald and P.O. Wheately, Applied Numerical Analysis, 5th Edition, Addison Wesley, Reading, MA, 1994.
- B. Carnahan, H.A. Luther and J.O. Wikes, Applied Numerical Methods (Wiley, New York, 1969.
- S.S. Kuo, Numerical Methods and Computers, Addison - Wesley, London, 1996.

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED		✓	ENTREPRENEURSHIP		✓		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL			GLOBAL		✓	
Changes Made in the Course	Percentage of Change		**75%**	No Changes Made			New Course				
***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**											

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Program with the C Program/ FORTRAN with the C or any other high level language	**K1 to K5**
CO2	Use various numerical methods in describing/solving physics problems.	**K1 to K5**
CO3	Solve problem, critical thinking and analytical reasoning as applied to scientific problems.	**K1 to K5**
CO4	To enhance the problem-solving aptitudes of students using various numerical methods.	**K1 to K5**

CO5	To apply various mathematical entities, facilitate to visualise any complicate tasks.	**K1 to K5**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	3	3	2	2	2	3	3
CO2	2	2	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	2	2	2	3	3	2	2	2	3	3
CO 2	2	2	3	3	3	2	2	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3
CO 4	3	2	3	3	3	3	2	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

EXPERIMENTS	PRACTICAL - IV	HRS	PEDAGOGY
1 to 4	Lagrange interpolation with Algorithm, Flow chart and output. Newton forward interpolation with Algorithm, Flow chart and output. Numerical integration by the trapezoidal rule with Algorithm, Flow chart and output. Numerical integration by Simpson's rule with Algorithm, Flow chart and output.	30	Chalk &Talk, PPT
5 to 8	Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart and output. Numerical solution of ordinary first-order differential equations by the Runge- Kutta method with Algorithm, Flow chart and output. Find the thickness of the mica sheet using edser butler fringes and Finding Roots of a Polynomial - Bisection Method. Finding Roots of a Polynomial - Newton Raphson Method.	30	Chalk &Talk, PPT

9 to 12	Pulse width modulation using IC555 Amplitude modulation using transistor Analog computation using OPAMPs Determination of dielectric constant of liquid (kerocine) using the passive circuit	**30**	**Chalk & Talk, PPT**

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total
25	75	100

Record Note and Attendance -10 mark
Model examination - 15 mark
Total CIA - 25 mark

Model examination should be conducted for 30 mark and it has to be converted to 15 mark

Learning Outcome Based Education & Assessment (LOBE) **Formative Examination - Blue Print** **Articulation Mapping – K Levels with Course Outcomes (COs)**				
Internal	**Cos**	**K Level**	**No. of. Questions**	**K - Level**
CIA-I	**CO1 – CO5**	**K1 – K5**	**1** Question for Each Student	**K1 – K5**
Question Pattern CIA - I		No. of Questions to be asked	**1** Question for Each Student	
		No. of Questions to be answered	**1**	
		Marks for each question	**30**	
		Total Marks for each section	**30**	

			Distribution of Marks with COs &K Level for Correction of CIA I		
	COs	**K - Level**	**Distribution of the work of the experiment**	**K - Level**	**MARKS**
CIA I	**CO1**	**K1 to K5**	Aim and apparatus	**K1**	**2.0**
	CO2	**K1 to K5**	Formula and Tabular Column	**K3**	**5.0**
	CO3	**K1 to K5**	Understanding and Observation	**K5**	**10.0**
	CO4	**K1 to K5**	Calculation and Graph	**K4**	**10.0**
	CO5	**K1 to K5**	Interpretation of result	**K2**	**3.0**
	Total Marks				**30**

Distribution of Marks with K Level CIA I					
	K Level	**Distribution of the work of the experiment**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	K1	Aim and apparatus	2	6.67	-
	K3	Formula and Tabular Column	5	16.67	
	K5	Understanding and Observation	10	33.33	**23.34**
	K4	Calculation and Graph	10	33.33	**56.67**
	K2	Interpretation of result	3	10.00	**90.00**
	Marks		**30**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

K5 – Evaluating, interpreting and concluding the results with accurate measurements**.**

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)			
COs	**K - Level**	**No. of Questions**	**K – Level**
CO1- CO5	**K1 – K5**	**1** Question for Each Student	**K1 – K5**
No. of Questions to be Asked		**1** Question for Each Student	
No. of Questions to be answered		**1**	
Marks for each question		**75**	
Total Marks for each section		**75**	

Distribution of Marks with COs &K Level for Correction of the Summative Exam				
COs	**K - Level**	**Distribution of the work of the experiment**	**K - Level**	**MARKS**
CO1	**K1 to K5**	**Aim and apparatus**	**K1**	**10**
CO2	**K1 to K5**	**Formula and Tabular Column**	**K3**	**15**
CO3	**K1 to K5**	**Understanding and Observation**	**K5**	**30**
CO4	**K1 to K5**	**Calculation and Graph**	**K4**	**15**
CO5	**K1 to K5**	**Interpretation of result**	**K2**	**5**
Total Marks				**75**

Distribution of Marks with K Level				
K Level	**Parameters for K-Level**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**Aim and apparatus**	**10**	**13.33**	**13**
K3	**Formula and Tabular Column**	**15**	**20**	**20**
K5	**Understanding and Observation**	**30**	**40**	**40**
K4	**Calculation and Graph**	**15**	**20**	**20**
K2	**Interpretation of result**	**5**	**6.67**	**7**
Marks		**75**	**100**	**100**

Course Name	PROJECT AND VIVA VOCE			
Course Code	23PPHPRJ1	**L**	**P**	**C**
Category	CORE	-	6	4

COURSE OBJECTIVES:

- To develop strong student competencies in Physics and its applications in a technology-rich, interactive environment.
- To enable the skills in research, analysis and interpretation of new findings.
- To prepare the students to successfully complete the projects offered a wide range of experience to meet the industrial needs.
- To apply knowledge and skill in the design and development of Instruments to cater to the needs of society.
- To become professionally trained in the area of electronics, optical Communications, nonlinear circuits, materials characterization and lasers etc.

COURSE DETAIL

METHOD OF EVALUATION FOR PROJECT:

Continuous Internal Assessment	**End Semester Examination**		**Total**	**Credit**
	Project Evaluation	**Viva Voce**		
25	**50**	**25**	**100**	**4**

- Internal examiners are the respective supervisors.
- Viva –voce examination to be evaluated by the external examiner.
- The report of the project must be in the prescribed form. It should be typed neatly in MS word with the equation editor or using Latex. The font size of the letter should be 12 or points with 1.5 space.
- The format of the project should have the following components.

First page should contain

Title of the project report

Name of the candidate

Register number

Name of the supervisor

Address of the institution

Month and year of submission

1. Contents
2. Declaration by candidate
3. Certificate by supervisor
4. Acknowledgement
5. Preface
6. Chapter-1-Preliminaries
7. Other chapters
8. References

The number of pages in the project may be 40 to 50

Each page should contain at least 18 lines

Two copies of the project report with binding should be submitted.

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Familiarize various theories behind the instrumentation involved in the Characterizations techniques.	**K1 to K5**
CO2	Get hands on experience on different instrumentation techniques to design a research problem and solve it using different research methods.	**K1 to K5**
CO3	Organize and pursue a scientific and industrial research project and work effectively as an individual in multidisciplinary settings	**K1 to K5**
CO4	Derive the theoretical problems and solve from knowledge of basic Physics ideas.	**K1 to K5**
CO5	Have a comprehensive idea on research methods, methodology and ethics to communicate the research findings	**K1 to K5**

MAPPING WITH PROGRAM OUTCOMES:						
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1	2	2
CO2	2	3	2	2	2	2
CO3	2	1	2	1	2	1
CO4	2	2	2	3	3	3
CO5	1	2	2	2	1	2
3- STRONG			**2 – MEDIUM**			**1 - LOW**

Distribution of Marks with COs &K Level for Correction of CIA					
	COs	**K - Level**	**Distribution of the work of the experiment**	**K - Level**	**MARKS**
CIA	**CO1**	**K1 to K5**	Preliminary Research Problem - Introduction	**K1**	**4.0**
	CO2	**K1 to K5**	Literature Survey	**K2**	**5.0**
	CO3	**K1 to K5**	Understanding and Observation of the Data	**K3**	**8.0**
	CO4	**K1 to K5**	Results and Discussion	**K4**	**4.0**
	CO5	**K1 to K5**	Interpretation of result and Conclusion	**K5**	**4.0**
	Total Marks				**25**

Distribution of Marks with K Level CIA					
	K Level	**Distribution of the work of the experiment**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA	K1	Preliminary Research Problem - Introduction	4	16.0	-
	K2	Literature Survey	5	20.0	
	K3	Understanding and Observation of the Data	8	32.0	**36.0**
	K4	Results and Discussion	4	16.0	**68.0**
	K5	Interpretation of result and Conclusion	4	16.0	**84.0**
	Marks		**25**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

K5 – Evaluating, interpreting and concluding the results with accurate measurements**.**

Distribution of Marks with COs &K Level for Correction of the Summative Exam				
COs	**K - Level**	**Distribution of the work of the experiment**	**K - Level**	**MARKS**
CO1	**K1 to K5**	Preliminary Research Problem - Introduction	**K1**	**10**
CO2	**K1 to K5**	Literature Survey and scope of the problem	**K2**	**10**
CO3	**K1 to K5**	Understanding and Observation of the Data	**K3**	**20**
CO4	**K1 to K5**	Results and Discussion	**K4**	**15**
CO5	**K1 to K5**	Viva Voce	**K5**	**20**
Total Marks				**75**

Distribution of Marks with K Level				
K Level	**Parameters for K-Level**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	Preliminary Research Problem - Introduction	**10**	**13.33**	**13.3**
K2	Literature Survey	**10**	**13.33**	**13.3**
K3	Understanding and Observation of the Data	**20**	**26.67**	**26.7**
K4	Results and Discussion	**15**	**20.0**	**20**
K5	Viva Voce	**20**	**26.67**	**26.7**
Marks		**75**	**100**	**100**

Course Name	NUMERICAL METHODS AND COMPUTER PROGRAMMING			
Course Code	23PPHEC41	**L**	**P**	**C**
Category	ELECTIVE	4	-	3

COURSE OBJECTIVES:

- To make students to understand different numerical approaches to solve a problem.
- To understand the basics of programming

UNIT - I	**SOLUTIONS OF EQUATIONS**	**12**

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

UNIT - II	**LINEAR SYSTEM OF EQUATIONS**	**13**

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

UNIT - III	**INTERPOLATION AND CURVE FITTING**	**11**

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

UNIT - IV	**DIFFERENTIATION, INTEGRATION AND SOLUTION OFDIFFERENTIAL EQUATIONS**	**12**

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

UNIT - V	**PROGRAMMING WITH C**	**12**

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

Total Lecture Hours	**60**

BOOKS FOR STUDY:

- V. Rajaraman, Computer Oriented Numerical Methods, 3rd Edition. PHI, New Delhi, 1993.
- V.Rajaraman, Programming in FORTRAN / Programming in C, PHI, New Delhi

BOOKS FOR REFERENCES:

- M. K .Jain, S. R. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi, 1995.
- S. S. Sastry, Introductory Methods of Numerical analysis, PHI, New Delhi
- F. Scheid, Numerical Analysis, 2nd Edition, Schaum's series, McGraw Hill, New York, 1998.
- W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, Numerical Recipes in FORTRAN, 2nd Edition, Cambridge Univ. Press, 1992.
- S. D. Conte and C. de Boor, Elementary Numerical analysis-an algorithmic approach, 3rd Edition, McGraw Hill, 1981.
- B. F. Gerald, and P. O. Wheatley, Applied Numerical analysis, 5th Edition, Addison-Wesley, MA, 1994.
- B. Carnagan, H. A. Luther and J. O. Wilkes, Applied Numerical Methods, Wiley, New York, 1969.
- S. S. Kuo, Numerical Methods and Computers, Addison-Wesley, 1969.

WEB RESOURCES:

- **https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-V-RajaRaman - Computer-Oriented-Numerical-Methods**
- **https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/referencespapers.aspx?referenceid=1682874 – Applied Numerical Methods**
- **https://nptel.ac.in/course/122106033/ - Computer Programming**
- **https://nptel.ac.in/course/103106074/ - Numerical Methods**
- **https://onlinecourses.nptel.ac.in/noc20_ma33/preview - Computer-Oriented-Numerical-Methods**

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED		✓	ENTREPRENEURSHIP				✓	
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL			GLOBAL		✓		
Changes Made in the Course	Percentage of Change		**60%**	No Changes Made			New Course					

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Recall the transcendental equations and analyze the different root finding methods. Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods, their limitations.	K1 to K5
CO2	Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations.	K1 to K5
CO3	Understand, how interpolation will be used in various realms of physics and Apply to some simple problems Analyze the newton forward and backward interpolation	K1 to K5
CO4	Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simson's method of numerical integration.	K1 to K5
CO5	Understand the basics of C-programming and conditional statements.	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	1	1	2	3	2	2	3
CO2	3	2	3	1	1	2	3	2	2	3
CO3	3	2	3	1	1	2	3	2	2	3
CO4	3	2	3	1	1	2	3	2	2	3
CO5	3	2	3	1	1	2	3	2	2	3

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	2	3	1	1	2	3	2	2	3
CO 2	3	2	3	1	1	2	3	2	2	3
CO 3	3	2	3	1	1	2	3	2	2	3
CO 4	3	2	3	1	1	2	3	2	2	3
CO 5	3	2	3	1	1	2	3	2	2	3
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:			
UNIT	**NUMERICAL METHODS AND COMPUTER PROGRAMMING**	**HRS**	**PEDAGOGY**
I	Zeros or Roots of an equation - Non-linear algebraic equation and transcendental equations - Zeros of polynomials –Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods – Convergence of solutions in Bisection and Newton-Raphson methods – Limitations of Bisection and Newton-Raphson methods.	**12**	**Chalk &Talk, PPT, Seminar**
II	Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations – Gaussian elimination method – Gauss Jordan method – Inverse of a matrix by Gauss elimination method - Eigen values and eigenvectors of matrices – Direct method - Power method and Jacobi Method to find the Eigen values and Eigen vectors.	**13**	**Chalk &Talk, PPT**
III	Interpolation with equally spaced points - Newton forward and backward interpolation - Interpolation with unevenly spaced points - Lagrange interpolation – Curve fitting – Method of least squares – Fitting a polynomial.	**11**	**Chalk &Talk, Assignment**
IV	Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule – Error estimates – Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite and Gauss-Chebyshev quadrature – solution of ordinary differential equations – Euler and RungaKutta methods.	**12**	**Chalk &Talk, Group discussion**
V	Flow-charts – Integer and floating point arithmetic expressions – Built-in functions – Executable and non-executable statements – Subroutines and functions – Programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials/non-linear equations by the Newton-Raphson method, (c) Newton's forward and backward interpolation, Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.	**12**	**Seminar, PPT, Chalk &Talk**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	**Cos**	**K Level**	**Section A MCQs**		**Section B Either or Choice**	**Section C Either or Choice**
			No. of. Questions	**K - Level**		
CI	**CO1**	**K1**	2	K1, K1	2 (K1, K1)	2 (K1, K1)
AI	**CO2**	**K2**	2	K2, K2	2 (K2, K2)	2 (K2, K2)
CI	**CO3**	**K3**	2	K1, K2	2 (K3, K3)	2 (K3, K3)
AII	**CO4**	**K4**	2	K1, K2	2 (K3, K3)	2 (K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	10	16	28	**50**	**50**
	K2	2	10	16	28	**50**	**50**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.57**	**7**
	K2	2			2	**3.57**	
	K3		20	16	36	**64.29**	**64**
	K4			16	16	**28.57**	**29**
	Marks	**4**	**20**	**32**	**56**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1	2	K1, K1	2 (K1, K1)	2 (K1, K1)
2	CO2	K2	2	K2, K2	2 (K2, K2)	2 (K2, K2)
3	CO3	K3	2	K1, K2	2 (K3, K3)	2 (K3, K3)
4	CO4	K4	2	K1, K2	2 (K3, K3)	2 (K4, K4)
5	CO5	K5	2	K1, K2	2 (K4, K4)	2 (K5, K5)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	10	16	31	22.14	22
K2	5	10	16	31	22.14	22
K3		20	16	36	25.72	26
K4		10	16	26	18.57	19
K5			16	16	11.43	11
Marks	10	50	80	140	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions			**PART – A**		**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions			**PART – B**	**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K1**	
		OR		
11. b)	**Unit - I**	**CO1**	**K1**	
12. a)	**Unit - II**	**CO2**	**K2**	
		OR		
12. b)	**Unit - II**	**CO2**	**K2**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K4**	
		OR		
15. b)	**Unit - V**	**CO5**	**K4**	

Answer **ALL** the questions			**PART – C**	**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K1**	
		OR		
16. b)	**Unit - I**	**CO1**	**K1**	
17. a)	**Unit - II**	**CO2**	**K2**	
		OR		
17. b)	**Unit - II**	**CO2**	**K2**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K5**	
		OR		
20. b)	**Unit - V**	**CO5**	**K5**	

Course Name	PHYSICS FOR NET/SET			
Course Code	23PPHSC41	**L**	**P**	**C**
Category	SKILL ENHANCEMENT COURSE	**2**	**-**	**2**

COURSE OBJECTIVES:

- To prepare the prospective teacher educator for appearing NET/SET examination.
- To enhance the eligibility for the award of Junior Research Fellowships (JRF).

UNIT - I CLASSICAL MECHANICS **06**

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Rigid body dynamics moment of inertia tensor. Non-inertial frames and pseudo forces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion and its applications - Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity Lorentz transformations, relativistic kinematics and mass–energy equivalence. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.

UNIT - II ELECTROMAGNETIC THEORY **06**

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields.

UNIT - III CONDENSED MATTER PHYSICS **06**

Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattices specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations.

UNIT - IV	NUCLEAR AND PARTICLE PHYSICS	06

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single particle shell model, its validity and limitations. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann Nishijima formula. Quark model, baryons and mesons. Parity nonconservation in weak interaction.

UNIT - V	ELECTRONICS	06

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Operational amplifiers and their applications - Digital Electronics Fundamentals – Number systems – Logic gates and logic circuits –Boolean algebra – Demorgan's theorem – K-Map – registers -counters, comparators - A/D and D/A converters.

Total Lecture Hours	30

BOOKS FOR STUDY:

- Goldstein, Poole&Safko, Classical Mechanics, PearsonEducation Inc., Seventh Indian, 2004.
- Paul Lorain & Dale R.Corson, Electromagnetic Fields and Waves,2nd Edition, CBS Publishers and distributors, New Delhi, 2003.
- C. Kittel, Introduction to Solid State Physics,7th Edition,Wiley, NewYork, 1996.
- S.B. Patel, Nuclear Physics - An Introduction, 2nd Edition, New AgeInternational (P) Limited, 2008.
- D.C.Tayal, Nuclear Physics, 1st Edition, HimalayaPublishing House, 2004.
- M.Morris Mano, Digital Logic and Computer Design, Prentice –Hallof India Private Limited, 2004.

BOOKS FOR REFERENCES:

- Dr. SurekhaTomar, CSIR-UGC NET/JRF/SET Physical sciences - Upkar'sprakashan, Agra, 2010.
- R. NageswaraRao, CSIR-UGC NET / SLET Physical Sciences, UV Physics Academy, Hyderabad.

Nature of Course	EMPLOYABILITY	✓	SKILL ORIENTED	✓	ENTREPRENEURSHIP	✓					
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓			
Changes Made in the Course	Percentage of Change		No Changes Made		New Course	✓					

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Outline the basic concepts of Physics.	K1 to K5
CO2	Discuss and practice repeated problems in various fields of physics.	K1 to K5
CO3	Apply suitable technique to solve problem.	K1 to K5
CO4	Use logical thinking skill to prepare competitive exams.	K1 to K5
CO5	Develop skills to attempt NET/SET examinations.	K1 to K5

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3				3				
CO2	3	3				3				
CO3	3	3				3				
CO4	3	3				3				
CO5	3	3				3				

3- STRONG 2 – MEDIUM 1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3				3				
CO 2	3	3				3				
CO 3	3	3				3				
CO 4	3	3				3				
CO 5	3	3				3				
WEIGTAGE										
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS										

LESSON PLAN:

UNIT	PHYSICS FOR NET/SET	HRS	PEDAGOGY
I	Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Rigid body dynamics moment of inertia tensor.Non-inertial frames and pseudo forces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion and its applications - Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity Lorentz transformations, relativistic kinematics and	06	Chalk &Talk, PPT, Seminar

	mass–energy equivalence. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.		
II	Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields.	**06**	**Chalk &Talk, PPT, Seminar**
III	Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations.	**06**	**Chalk &Talk, PPT, Seminar**
IV	Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single particle shell model, its validity and limitations. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann Nishijima formula. Quark model, baryons and mesons. Parity nonconservation in weak interaction.	**06**	**Chalk &Talk, PPT, Seminar**
V	Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Operational amplifiers and their applications - Digital Electronics Fundamentals – Number systems – Logic gates and logic circuits –Boolean algebra – Demorgan's theorem – K-Map – registers -counters, comparators - A/D and D/A converters.	**06**	**Chalk &Talk, PPT, Seminar**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	**Cos**	**K Level**	**Section A**	
			MCQs	
			No. of. Questions	**K - Level**
CI **AI**	**CO1**	**K1 – K2**	**25**	**K1,K2**
	CO2	**K1 – K2**	**25**	**K1,K2**
CI **AII**	**CO3**	**K1 – K2**	**25**	**K1,K2**
	CO4	**K1 – K2**	**25**	**K1,K2**
Question Pattern **CIA I & II**		**No. of Questions to be asked**	**50**	
		No. of Questions to be answered	**50**	
		Marks for each question	**1**	
		Total Marks for each section	**50**	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	**Section A (Multiple Choice Questions)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**30**	**30**	**60**	**100**
	K2	**20**	**20**	**40**	
	K3				
	K4				
	Marks	**50**	**50**	**100**	**100**
CIA II	**K1**	**30**	**30**	**60**	**100**
	K2	**20**	**20**	**40**	
	K3				
	K4				
	Marks	**50**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				