M.Sc., PHYSICS

Syllabus

Program Code: PPH

2021-2022 onwards

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

Re-accredited with "A" Grade by NAAC

PASUMALAI, MADURAI – 625 004

Regulations

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) (B.Sc., Physics) 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.

The scheme of Examination

The components for continuous internal assessment are:

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

Total	25 Marks

Pattern of the questions paper for the continuous Internal Assessment

(For Part I, Part II, Part III, NME & Skilled Paper in Part IV)

The components for continuous internal assessment are:

Part –A

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

Part –B

Three short answers questions (answer all) 3 x02= 06 Marks

Part –C

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

Part –D

Two questions out of three 2 x 10 =20 Marks

Total 40 Marks

Pattern of the question paper for the Summative Examinations:

Note: Duration- 3 hours

Part –A

Ten multiple choice questions 10 x01 = 10 Marks

No Unit shall be omitted: not more than two questions from each unit.)

Part –B

Short answer questions (one question from each unit) 5 x02 = 10 Marks

Part –C

Five Paragraph questions (‘either …. or ‘type) 5 x 05 = 25 Marks

(One question from each Unit)

Part –D

Three Essay questions out of five 3 x 10 =30 Marks

(One question from each Unit)

Total 75 Marks

Minimum Marks for a Pass

50% of the aggregate (Internal +Summative Examinations).
No separate pass minimum for the Internal Examinations.
34 marks out of 75 is the pass minimum for the Summative Examinations.

VISION

The Department of P.G. Physics undertakes the responsibility to preserve and enhance an atmosphere in which scholarly activities in the young minds of the students and thereby improving the total personality.

MISSION

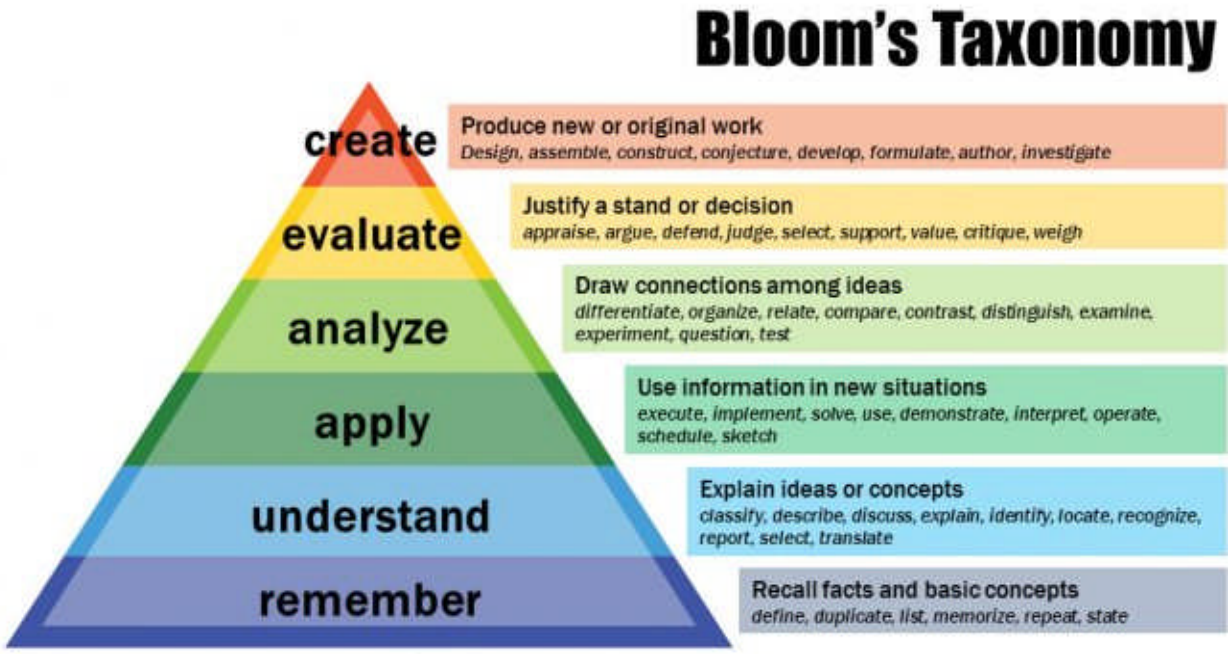
- To produce employable graduates in many areas such as research, teaching, industry etc.
- To inculcate social responsibility.
- To nurture environmental awareness.
- To develop communal harmony & national integration.

The 12 Graduate Attributes:

1. (KB) A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. (PA) Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions
3. (Inv.) Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.
4. (Des.) Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. (Tools) Use of engineering tools: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. (Team) Individual and teamwork: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. (Comm.) Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

8. (Prof.) Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. (Impacts) Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. (Ethics) Ethics and equity: An ability to apply professional ethics, accountability, and equity.
11. (Econ.) Economics and project management: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. (LL) Life-long learning: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

WA	Graduate Attributes	Caption as
1	Knowledge Base	**KB**
2, 3	Problem Analysis & Investigation	**PA and Inv.**
7, 4	Communication Skills & Design	**Comm. & Des.**
6	Individual and Team Work	**Team**
8, 10	Professionalism, Ethics and equity	**Prof. & Ethics**
12	Lifelong learning	**LL**



PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO1:	Gain broad knowledge on various fields in Physics such as Solid state Physics, Optics, Electronics, Quantum Mechanics etc.,
PEO2:	Develop the interest to take up competitive exams such as GATE, SET and NET and also opt for higher education to achieve their dream career.
PEO3:	Communicate effectively by writing reports, speaking fluently, listening to give effective response and comprehending the documentations.
PEO4:	Acquire a wide range of skills such as reasoning, problem solving and soft skills to get placement in Educational institutions, Research & Development and Industrial sectors.
PEO5:	Solve societal problems with innovative and creative ideas.
PEO6:	Upgrade to join as a researcher to work independently by the experience acquired during the project period.

PROGRAMME OUTCOMES (POs)	
PO1:	Demonstrate analytical and practical knowledge in the field of Science, Technology and other domains.
PO2:	Make proficiency by using Computer Technology in learning activities and update their knowledge, skills to fulfill the requirements at the workplace in their life span.
PO3:	Employ critical and analytical thinking in understanding the concepts of Mathematical &Computing Sciences and qualify competitive examinations like CSIR NET/ SET/ TET etc.
PO4:	Identify Mathematical and Computational methods in order to solve critical problems.
PO5:	Work independently and do detailed study of various concepts of Science.
PO6:	Plan, execute, report the results of an experiment/investigation together as a group/team with interest and work efficiently as a member of a team.

PROGRAM SPECIFIC OUTCOME (PSOs)	
PSO1:	Understand, demonstrate and solve the major findings in all branches of Physics
PSO2:	Employ critical thinking and scientific ideas to design, carry out the work and analyze the problems in real time
PSO3:	Communicate effectively and develop skills such as effective oral presentations, writing of reports of practical works and documentation work of research projects
PSO4:	Work effectively in a team to use modern techniques, recent equipments and software's in Physics in the fields of Electronics, Optics, Condensed Matter Physics and Quantum Mechanics
PSO5:	Inculcate the scientific temperament and green route for sustainable development and moral values in their profession with active participation
PSO6:	Extend contemporary research innovations based on societal needs regarding new renewable energy harvesting methods

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous), Madurai

DEPARTMENT OF PG PHYSICS

M.Sc., PHYSICS Curriculum

(For the student admitted during the academic year 2021-2022 onwards)

I SEMESTER							
S. No.	***Subject Code***	***Title of the Subject***	***Hrs***	***Credit***	***Int.***	***Ext.***	***Total***
1	21PPHC11	Mathematical Physics-I	6	4	25	75	100
2	21PPHC12	Classical Mechanics	6	4	25	75	100
3	21PPHC13	Analog Electronics and Communications	6	4	25	75	100
4	21PPHC14	Electrodynamics	6	4	25	75	100
5	21PPHCP1	Practical-I- General Physics	6	4	40	60	100
		TOTAL	**30**	**20**	**140**	**360**	**500**
II SEMESTER							
S. No.	***Subject Code***	***Title of the Subject***	***Hrs***	***Credit***	***Int.***	***Ext.***	***Total***
1	21PPHC21	Mathematical Physics-II	6	4	25	75	100
2	21PPHC22	Quantum Mechanics-I	6	4	25	75	100
3	21PPHC23	Digital Electronics	6	4	25	75	100
4	21PPHCP2	Practical-II-Electronics I	6	4	40	60	100
5	21PPHN21	NME-Nanotechnology	6	6	25	75	100
		TOTAL	**30**	**22**	**140**	**360**	**500**
III SEMESTER							
S. No.	***Subject Code***	***Title of the Subject***	***Hrs***	***Credit***	***Int.***	***Ext.***	***Total***
1	21PPHC31	Solid State Physics-I	6	4	25	75	100
2	21PPHC32	Quantum Mechanics-II	6	4	25	75	100
3	21PPHCP3	Practical-III- Electronics-II	6	4	40	60	100
4		**Elective-I**					
	21PPHE31	Energy Physics	6	6	25	75	100
	21PPHE32	Computational Physics	6	6	25	75	100
	21PPHE33	Physics of Human body	6	6	25	75	100
5		**Elective-II**					
	21PPHE34	Microprocessor and Microcontroller	6	6	25	75	100
	21PPHE35	Analytical Instrumentation	6	6	25	75	100
	21PPHE36	Crystal Growth Methods & Characterization	6	6	25	75	100
		TOTAL	**30**	**24**	**140**	**360**	**500**
IV SEMESTER							
S. No.	***Subject Code***	***Title of the Subject***	***Hrs***	***Credit***	***Int.***	***Ext.***	***Total***
1	21PPHC41	Solid State Physics-II	6	4	25	75	100
2	21PPHC42	Nuclear and Particle Physics	6	4	25	75	100
3	21PPHPR1	Project	6	4	40	60	100
4		**Elective-III**					

	21PPHE41	Astrophysics	6	6	25	75	100
	21PPHE42	Communication Electronics	6	6	25	75	100
	21PPHE43	Advanced Optics	6	6	25	75	100
5		**Elective-IV**					
	21PPHE44	Atomic and Molecular Spectroscopy	6	6	25	75	100
	21PPHE45	Bio-medical Instrumentation	6	6	25	75	100
	21PPHE46	Computer Oriented Numerical methods	6	6	25	75	100
		Total	**30**	**24**	**140**	**360**	**500**
		Grand Total	**120**	**90**	**560**	**1440**	**2000**

Semester	Sub Code	List of Elective Courses
I		Nil
II	21PPHN21	NME-Nanotechnology
III		**Elective-I**
	21PPHE31	Energy Physics
	21PPHE32	Computational Physics
	21PPHE33	Physics of Human body
		Elective-II
	21PPHE34	Microprocessor and Microcontroller
	21PPHE35	Analytical Instrumentation
	21PPHE36	Crystal Growth Methods & Characterization
IV		**Elective-III**
	21PPHE41	Astrophysics
	21PPHE42	Communication Electronics
	21PPHE43	Advanced Optics
		Elective-IV
	21PPHE44	Atomic and Molecular Spectroscopy
	21PPHE45	Bio-medical Instrumentation
	21PPHE46	Computer Oriented Numerical methods


FIRST SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	**Mathematical Physics-I**			
Course Code	**21PPHC11**	**L**	**P**	**C**
Category	Core	6	-	4

Nature of course:	EMPLOYBILITY		SKILL ORIENTED	✓	ENTREPRENURSHIP	

Course Objectives:

- To recall various matrices and also know to apply characteristic equations for determining the Eigen values and Eigen vectors
- To remember the basics of vectors and to solve their differentiations
- To compare different integrals and to relate their relations between them
- To perform differentiation and integration operations to bring down complex functions to analytic forms
- To determine residues of various complex functions and also can able to evaluate real definite integrals by contour integration

Unit: I	**Matrix**	18 Hrs.

Definition - various types of matrices –algebra of matrices -Adjoint of a square matrix -property of adjoint matrix - Inverse of a matrix - elementary transformations - elementary transformations – elementary matrices and its theorem - to compute the inverse of a matrix from elementary- the inverse of a symmetric matrix. Consistency of linear system of equations and their solution: Solution of simultaneous equations - types of linear equations - consistency of a system of linear equations. Eigen values, Eigen vectors, Cayley Hamilton theorem: Eigen values - Cayley Hamilton theorem - power of matrix - Eigen vectors and its properties – orthogonal vectors –non symmetric and symmetric matrices with repeated and non-repeated Eigen values – matrix having only one and two Eigen vectors.

Unit: II	**Vectors**	15 Hrs.

Vectors- Addition of vectors- rectangular resolution of a vectors- unit vectors- position vector of a point- ratio formula- product of two vectors- scalar or dot product- useful results-work done as a scalar product- vector product or cross product- vector product expressed as a determinant - Area of a parallelogram, moment of a force-angular velocity - scalar triple product - geometrical interpretation – co-planarity questions - vector product of three vector - scalar product of four vector - vector product of four vectors. Differentiation of vectors: Vector function - differentiation of vectors - formulae of differentiation - scalar and vector point functions - gradient of a scalar function - geometrical meaning of gradient, normal - normal and directional derivative - divergence of a vector function- physical interpretation of divergence – curl and its physical meaning.

Unit: III	**Integration of vectors**	21 Hrs.

Line integral- surface integral- volume integral- Green's theorem – Stokes theorem –Another method of proving Stokes theorem – Gauss's theorem of divergence - deductions from Gauss divergence theorem – Helmholtz theorem.

Unit: IV	**Complex variables**	18 Hrs.
Complex variable – functions and limit of a complex variable –continuity – differentiability – analytic function – necessary and sufficient condition for complex function to be analytic-Cauchy's integral theorem-extension of Cauchy's theorem to multiple connected region-Cauchy integral formula -Cauchy integral formula for the derivative of an analytic function-Poisson integral formula for a circle. Series: Taylor's and Laurent's series: Convergence of a series of complex terms-power series-region of convergence-radius of convergence of a power series-method of expansion of a function –Taylor's theorem – Laurent's theorem.		
Unit: V	**Calculus of residues**	18 Hrs.
Zero of analytic function-singular point– residue at a pole-residue at infinity-method of finding residues- residue by definition – finding residues of various functions - residue theorem - evaluation of real definite integrals by contour integration – Integration round unit circle of the type – Evaluation of polynomials – Rectangular contour – Indented semi-circular contour.		
	Total Lecture Hours	90

Book for study:

1. H. K. Dass & Dr. Rama Verma, Mathematical Physics, VIII Edition, S. Chand and Company limited, Ram Nagar, New Delhi – 55, 2018.

UNIT I - Chapters 38, 40 (40.1 - 40.3), 41 (41. 1 – 41. 13)
UNIT II - Chapters 1, 2
UNIT III - Chapter 3
UNIT IV - Chapters 22 (22.1-22.11), 24 (24.1-24.6, 24.11), 25(25.1-25.8)
UNIT V - Chapter 26

Books for References:

1. G. B. Arfken, H. J. Weber and Harris, Mathematical methods for Physicists, IV Edition, Academic press, India, 2005
2. Advanced Engineering Mathematics, Erwin Kreyszig, IX Edition, 2014, Wiley publishers
3. B. D. Gupta, Mathematical Physics, IV Edition, Vikas Publishing House Private Ltd., New Delhi-55, Reprint 2018.

Web Resources:

https://www.coursera.org/courses?query=vector%20calculus
https://nptel.ac.in/courses/111/105/111105122/
https://nptel.ac.in/courses/111/106/111106100

Course Outcomes		**K Level**
On Completion of this course, the student will be able to		
CO1:	Determine the rank of a matrix and also apply characteristic equation to find Eigen values and Eigen vectors	K3
CO2:	Solve the differential operations in vectors	K3
CO3:	Understand and compare different integrals such as line, surface and volume exclusively	K4
CO4:	Simplify complex functions through differentiation and integration	K4
CO5:	Determine residues of various complex functions and can evaluate the definite integrals	K5

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO6
CO 1	2	2	2	3	2	3
CO 2	2	2	2	2	2	2
CO 3	2	3	3	1	2	2
CO 4	2	2	2	2	2	1
CO 5	1	2	1	2	1	2
Weightage	9	11	10	10	9	10

3 –Advanced Application; **2 –** Intermediate Development; **1 –** Introductory Level

LESSON PLAN

UNIT	Course Name	Hrs	Pedagogy
I	Matrix Definition, various types of matrices , algebra of matrices, Adjoint of a square matrix, property of adjoint matrix, Inverse of a matrix, elementary transformations, elementary transformations, elementary matrices and its theorem, to compute the inverse of a matrix from elementary, the inverse of a symmetric matrix.	**6**	Chalk & Talk, PPT
	Rank of matrix: Rank of a matrix, Normal form. Consistency of linear system of equations and their solution: Solution of simultaneous equations, types of linear equations, consistency of a system of linear equations.	**6**	
	Eigen values, Eigen vectors, Cayley Hamilton theorem: Eigen values, Cayley Hamilton theorem , power of matrix, Eigen vectors and its Properties, orthogonal vectors, non-symmetric and symmetric matrices with repeated and non, repeated Eigen values, matrix having only one and two Eigen vectors	**6**	
II	Vectors Vectors, Addition of vectors, rectangular resolution of a vectors, unit vectors, position vector of a point, ratio formula, product of two vectors, scalar or dot product, useful results, work done as a scalar product, vector product or cross product, vector product expressed as a determinant, Area of a parallelogram, moment of a force, angular velocity, scalar triple product, geometrical interpretation, coplanarity questions, vector product of three vector, scalar product of four vector, vector product of four vectors.	**4**	Chalk, Talk& Assignment
	Differentiation of vectors: Vector function, differentiation of vectors, formulae of differentiation, scalar and vector point functions, gradient of a scalar function, geometrical meaning of gradient, normal, normal and directional derivative.	**5**	

	Divergence of a vector function, physical interpretation of divergence, curl and its physical meaning	**6**	
III	Line integral, surface integral, volume integral, Green's theorem, area of a plane region by Green's theorem	**7**	Chalk, Talk& Exercise
	Stokes theorem, another method of proving Stokes theorem	**7**	
	Gauss's theorem of divergence, deductions from gauss divergence theorem, Helmholtz theorem.	**7**	
IV	Complex variable, functions and limit of a complex variable, continuity, differentiability, analytic function , necessary and sufficient condition for complex function to be analytic, Cauchy's integral theorem	**6**	Chalk & Talk, PPT
	Extension of Cauchy's theorem to multiple connected region, Cauchy integral formula , Cauchy integral formula for the derivative of an analytic function, Poisson integral formula for a circle	**6**	
	Series: Taylor's and Laurent's series: Convergence of a series of complex terms, power series, region of convergence, radius of convergence of a power series, method of expansion of a function, Taylor's theorem, Laurent's theorem.	**6**	
V	Zero of analytic function, singular point– residue at a pole, residue at infinity, method of finding residues, residue by definition, finding residues of various functions, residue theorem	**7**	Chalk, Talk& Seminar
	Evaluation of real definite integrals by contour integration, Integration Round unit circle of the type	**5**	
	Evaluation of polynomials, Rectangular contour, Indented Semi-circular contour.	**6**	

Course Designed by: **Dr. D. Ruby Josephine**
Mrs. S. Nagadeepa

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CIAI	**CO1**	K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	K3	2	K1 & K2	2	K2	2 (K3&K3)	2(K2 & K3)
CIAII	**CO3**	K2	2	K1 & K2	1	K2	2 (K2&K2)	1(K2)
	CO4	K4	2	K1 & K2	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	2	-	-	4	6.67	67
	K2	2	4	10	20	36	60	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	**K1**	2	2	-	-	4	6.67	50
	K2	2	4	10	10	26	43.33	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	10	10	16.67	17
	Marks	4	6	20	30	60	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**	**MCQs**		**Short Answers**		**Section C (Either / or Choice)**	**Section D (Open Choice)**
			No. of Questions	**K – Level**	**No. of Question**	**K – Level**		
1	CO1	Up to K 3	2	K1,K2	1	K1	2 (K3&K3)	1(K3)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 5	2	K1&K2	1	K2	2 (K5&K5)	1(K3)
4	CO4	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
5	CO5	Up to K 5	2	K1&K2	1	K2	2 (K3&K3)	1(K5)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**5**	**4**	-	-	**9**	**7.5**	**17**
K2	5	6		-	11	9.16	
K3	-	-	40	40	80	66.67	83
K4	-	-	-	-	-	-	
K5	-	-	10	10	20	16.6	
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions)

Answer All Questions **(10x1=10 marks)**

Q. No	CO	K Level	Questions
1	CO1	K1	Select a idempotent matrix a) $\begin{pmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{pmatrix}$ b) $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$ c) $\begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$ d) $\begin{pmatrix} -1 & 0 & 1 \\ 4 & 5 & 1 \\ 3 & 6 & 8 \end{pmatrix}$
2	CO1	K2	Show AB, if A= $\begin{pmatrix} 1 & -2 & 3 \\ 2 & 3 & 1 \\ -3 & 1 & 2 \end{pmatrix}$ and B = $\begin{pmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 1 & 2 & 0 \end{pmatrix}$ a) $\begin{pmatrix} -1 & 0 & 1 \\ 4 & 5 & 1 \\ 3 & 6 & 8 \end{pmatrix}$ b) $\begin{pmatrix} 4 & 4 & -2 \\ 1 & 1 & 10 \\ -1 & 5 & -4 \end{pmatrix}$ c) $\begin{pmatrix} 0 & 0 & 1 \\ 4 & 0 & 1 \\ 3 & 0 & 8 \end{pmatrix}$ d) $\begin{pmatrix} -1 & 0 & 1 \\ 4 & 5 & 1 \\ 3 & 6 & 8 \end{pmatrix}$
3	CO2	K1	Identify the directional derivative of the function $\Phi=x^2yz+4xz^2$ at (1, -2, 1) in the direction of $2\hat{\imath}-\hat{\jmath}-2\hat{k}$
4	CO2	K2	Express grad Φ at the point (1, -2, -1) Where $\Phi = 3xz^2y-y^3z^2$ a) $-16\hat{\imath}+9\hat{\jmath}+3\hat{k}$ b) $-16\hat{\imath}+4\hat{\jmath}+4\hat{k}$ c) $-16\hat{\imath}+\hat{\jmath}+4\hat{k}$ d) $-16\hat{\imath}+9\hat{\jmath}+4\hat{k}$
5	CO3	K1	Which is defined as the integral of the components of F along the normal to the surface a) Surface integral of scalar function b) surface integral of a vector function c) even function d) odd function
6	CO3	K2	Indicate the volume integral a) $\iiint \vec{F}\, dv$ b) $\int \vec{F}.dv$ c) $\iint \vec{F}.dv$ d) none of these
7	CO4	K1	Identify the other names of analytic function a) holomorphic b) regular c) monogenic d) all the above
8	CO4	K2	Express the polar form of complex variable a) $z=r(\cos\theta - i\sin\theta)$ b) $z=r(\cos\theta + \sin\theta)$ c) $z=r(\cos\theta + 2i\sin\theta)$ d) $z=r(\cos\theta + i\sin\theta)$
9	CO5	K1	Locate the definition for singular point a) a point at which a function f(z) is not analytic b) a point at which a function f(z) is negative c) a point at which a function f(z) is positive d) none of these
10	CO5	K2	When m=1, the pole is said to be a a) Small pole b) simple pole c) elongated pole d) closed pole

Section B (Short Answers)

Answer All Questions **(5x2=10 marks)**

Q.No	CO	K Level	Questions
11	CO1	K1	Define a singular matrix
12	CO2	K1	Define vector point function

13	CO3	K2	Describe in short on stroke's theorem
14	CO4	K2	Write in short on single valued and multi valued function
15	CO5	K2	Explain in short about isolated singular point
Section C (Either/Or Type) **Answer All Questions** **(5 x 5 = 25 marks)**			
Q. No	**CO**	**K Level**	**Questions**
16) a	1	K3	Determine AB and BA and show that AB=BA or not, if A= $\begin{pmatrix} 1 & 3 & 0 \\ -1 & 2 & 1 \\ 0 & 0 & 2 \end{pmatrix}$ and B= $\begin{pmatrix} 2 & 3 & 4 \\ 1 & 2 & 3 \\ -1 & 1 & 2 \end{pmatrix}$
16) b	1	K3	Determine the values of α, β, γ when $\begin{pmatrix} 0 & 2\beta & \gamma \\ \alpha & \beta & -\gamma \\ \alpha & -\beta & \gamma \end{pmatrix}$ is orthogonal
17) a	2	K3	Find the constants a, b, c so that $\vec{F}$= (x+2y+az) $\hat{\imath} + (bx - 3y - z)\hat{\jmath} + (4x + cy + 2z)\vec{k}$ is irrotational and hence find function φ *such that* $\vec{F} = \delta\varphi$
17) b	2	K3	Show that $\vec{A} = (6xy + z^3)\hat{\imath} + (3x^2 - z)\hat{\jmath} + (3xz^2 - y)\vec{k}$ is irrotational and find Φ such that A=$\vec{\Delta}\Phi$
18) a	3	K5	Using stoke s theorem or otherwise evaluate $\int$(2x − y)dx − yz 2dy – y2 dz where c is the circle $x^2+y^2=1$ corresponding to the surface of sphere of unit radius
18) b	3	K5	Evaluate $\iint \vec{F}.\ \hat{n}$ ds where $\vec{F}$= 4xz$\hat{\imath}$ –$y^2\hat{\jmath}$+yz$\hat{k}$ and s is the surface of the cube bounded by x=0, x=1, y=0, y=1, z=0 and z=1
19) a	4	K3	Find the value $\int_0^{1+i}(x - y + ix^2)dz$ a) Along the straight line from z=0 to z= 1+i b) Along the real axis from z=0 to z=1 and then along a line parallel to the imaginary axis from z=1 to z=1+i
19) b	4	K3	Find the value of the integral $\int (x + y)\ dx + x^2y\ dy$ (a) Along y=x^2 *having* (0,0), (3,9)*end points* (b) Along y= 3x between the same points Do the values depend upon path
20) a	5	K3	Determine the poles of the following function and residue at each pole f(z)=$\frac{z^2}{(z-1)^2(z+2)}$ *and hence evaluate* $\int_c \frac{z^2\,dz}{(z-1)^2(z+2)}$ *where* $c: |z| =$ 3
20) b	5	K3	Find the value of $\oint z\, e^{\frac{1}{z}}$ around the unit circle
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions** **(3x10=30 marks)**			
Q. No	**CO**	**K Level**	**Questions**

21	**CO1**	**K3**	Apply A= $\begin{matrix}1 & 2 & 2\\ 2 & 1 & 2\\ 2 & 2 & 1\end{matrix}$ and show that A^2-4A-5I=0, Where I and 0 are unit and null matrix of order 3 respectively. Use this result to find A^{-1}
22	**CO2**	**K3**	If r is the distance of a point (x, y, z) from the origin, solve for curl (k×grad $\frac{1}{r}$) + $grad\ \left(k.grad\ \frac{1}{r}\right) = 0$, where k is the unit vector in the direction OZ
23	**CO3**	**K3**	Determine surface integral $\iint \vec{F}.\ \hat{n}$ ds where $\vec{F}$=(x^2+y^2+z^2) ($\hat{\imath}$+$\hat{\jmath}$+$\hat{k}$), S is the surface of the tetrahedron x=0, y=0, z=0, x+y+z=2 and n is the unit normal in the outward direction to the closed surface S
24	**CO4**	**K3**	Determine $\int_{1-i}^{2+i}(2x+iy+1)\ dz\ along\ the\ two\ paths$ i) x=t+1, $y=2t^2$-1 ii) the straight line joining 1-i and 2 +i
25	**CO5**	**K5**	Evaluate $\int \frac{12z-7}{(z-1)^2(2z+3)}\ dz, where\ C\ is\ the\ circle$ i) |z|=2 ii) |z+i|=$\sqrt{3}$

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	Classical Mechanics									
Course Code	21PPHC12							**L**	**P**	**C**
Category	Core							6	-	4
Nature of Course	EMPLOYBILITY		SKILL ORIENTED	✓	ENTREPRENURSHIP					

Course Objectives:

- To understand the knowledge about Lagrangian formulations.
- To generalize a solid foundation in the motion of particles and its extension to Hamiltonian formulation
- To analyze the Kepler's law in central force problem
- To agree the knowledge about oscillatory motion and stability of oscillatory motion
- To apply the concept of Canonical transformation and to gain knowledge on Lagrange and Poisson brackets

Unit: I	**Lagrangian Dynamics**	18 Hrs

Basic Concepts-Constraints-Generalized Coordinates-Principle of Virtual work-D'Alembert's principle-Lagrange's Equations from D'Alembert's principle-Procedure for formation of Lagrange's Equations-Lagrange's equations in presence of non-conservative forces-Generalized potential-Lagrangian for a charged particle moving in an electromagnetic field.

Unit: II	**Hamiltonian Dynamics**	16 Hrs

Generalized momentum and cyclic coordinates-Conservation theorems-Hamiltonian function H and conservation of energy: Jacobi's integral-Hamilton's Equations- Examples in Hamiltonian Dynamics

Unit: III	**Two-body central force problem**	18 Hrs

Reduction of Two-body central force problem to the equivalent one-body problem-Central force and motion in a plane-equations of motion under central force and first integral-Differential equation for an orbit- inverse square law of force-Kepler's laws of Planetary motion and their deduction-Stability of orbit under central force- artificial satellites-Virial theorem

Unit: IV	**The rigid body equations of motion and Oscillations**	20 Hrs

Angular momentum and Kinetic energy of motion about a point- Tensors-The inertia tensor and the moment of inertia-The Eigen values of the inertia tensor and the principal axis transformation-solving rigid body problems and the Euler equations of motion-Torque-free motion of a rigid body
Oscillation: Formulation of the problem-The Eigen value equation and the principal axis transformation-Frequencies of free vibration and normal coordinates-Free vibrations of a linear triatomic molecule-Forced vibrations and the effect of dissipative forces.

Unit: V	**Canonical transformations**	18 Hrs

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:

1. J.C.Upadhyaya, Classical Mechanics, 2nd Edition, Himalaya Publishing House Ltd, Mumbai, Reprint 2018.

UNIT – I: Chapter 2 , 2.1-2.10
UNIT – II: Chapter 3, 3.1-3.7
UNIT – III: Chapter 4, 4.1-4.9

2. Herbert Goldstein, Charles P.Poole, John Safko, Classical Mechanics, 3rd Edition, 21st impression, Pearson Education, Inc., Uttar Pradesh, 2018

UNIT – IV: Chapter 5 , 5.1-5.6, Chapter 6, 6.1-6.5
UNIT – V: Chapter 9, 9.1-9.9

Books for References:

1. **Gupta Kumar Sharma, Classical Mechanics, Pragati Prakashan, Meerut, 30th edition 2004**
2. **S.N.Biswas, Classical Mechanics, Books and Allied Ltd, Kolkata,3rd Edition 1998**

Web Resources:

https://nptel.ac.in/courses/115/106/115106123/
https://nptel.ac.in/courses/115/103/115103113/

Course Outcomes		**K Level**
On Completion of this course, the student will be able to		
CO1:	Demonstrate the Lagrangian principles and D'alembert Principle	K1
CO2:	Acquire the fundamental Principles of Hamiltonian principles in various classical mechanical problems.	K3
CO3:	Connect the principles of central body problems into Kepler's law.	K2
CO4:	Analyze the fundamentals of rigid body problem and oscillations.	K4
CO5:	Apply Hamilton's characteristic function to solve problems in Lagrange's and Poisson's brackets	K3

CO & PO Mapping:

Course Outcomes (CO's)	**Programme Outcomes (PO's)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	2	2	2
CO2	3	1	2	2	2	3
CO3	2	2	1	1	2	2
CO4	2	1	2	2	2	3
CO5	2	3	1	3	1	1
Weightage	12	9	8	10	9	11

***3- Advanced Application 2- Intermediate Development 1-Introductory Level**

LESSON PLAN:

Units	Classical & Statistical Mechanics	Hrs	Pedagogy
I Lagrangian Dynamics	Basic Concepts-Constraints, Generalized Coordinates, Principle of Virtual work, D'Alembert's principle	6	Chalk & Talk, PPT
	Lagrange's Equations from D'Alembert's principle, Procedure for formation of Lagrange's Equations	6	
	Lagrange's equations in presence of non-conservative forces, Generalized potential, Lagrangian for a charged particle moving in an electromagnetic field.	6	
II Hamiltonian Dynamics	Generalized momentum and cyclic coordinates, Conservation theorems	6	Chalk, Talk& Assignment
	Hamiltonian function H and conservation of energy: Jacobi's integral, Hamilton's Equations	5	
	Examples in Hamiltonian Dynamics	5	
III Two-body central force problem	Reduction of Two-body central force problem to the equivalent one-body problem, Central force and motion in a plane	5	Chalk, Talk& Exercise
	equations of motion under central force and first integral, Differential equation for an orbit, inverse square law of force, Kepler's laws of Planetary motion and their deduction	6	
	Stability of orbit under central force, artificial satellites, Virial theorem	7	
IV The rigid body equations of motion and Oscillations	Angular momentum and Kinetic energy of motion about a point, Tensors, The inertia tensor and the moment of inertia, The Eigen values of the inertia tensor and the principal axis transformation	6	Chalk & Talk, PPT
	solving rigid body problems and the Euler equations of motion, Torque, free motion of a rigid body Oscillation: Formulation of the problem	6	
	The Eigen value equation and the principal axis	5	

	transformation, Frequencies of free vibration and normal coordinates, Free vibrations of a linear triatomic molecule, Forced vibrations and the effect of dissipative forces.		
V Canonical transformations	The equations of canonical transformation, Examples of canonical transformations, The harmonic oscillator, The simplistic approach to canonical transformations-	6	Chalk, Talk& Seminar
	Poisson brackets and other canonical invariants, Equation of motion, infinitesimal canonical transformations, and conservation theorems in the Poisson Bracket formulation	5	
	The angular momentum Poisson bracket relations, symmetry groups in mechanical systems, Liouville's theorem	6	

Course Designed by: **Mrs. S. Nagadeepa & Dr. P.P. Kannan**

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**		**Section C**	**Section D**
			MCQs		**Short Answers**		**Either or Choice**	**Open Choice**
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**K2**	2	K1	1	K1	2 (K2&K2)	1(K2)
	CO2	**K4**	2	K2	2	K2	2 (K3&K3)	2 (K3 & K4)
CI AII	**CO3**	**K2**	2	K1	1	K2	2 (K2&K2)	1(K2)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	2 (K3 & K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	2	-	-	4	6.67	50
	K2	2	4	10	10	26	43.33	
	K3	-	-	10	10	20	33.33	50
	K4	-	-	-	10	10	16.67	
	Marks	4	6	20	30	60	100	100
CIA II	**K1**	2	2	-	-	4	6.67	50
	K2	2	4	10	10	26	43.33	
	K3	-	-	10	10	20	33.33	50
	K4	-	-	-	10	10	16.67	
	Marks	4	6	20	30	60	100	100

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	**COs**	**K - Level**	**MCQs**		**Short Answers**		**Section C (Either / or Choice)**	**Section D (Open Choice)**
			No. of Questions	**K – Level**	**No. of Question**	**K – Level**		
1	CO1	K2	2	K1 & K2	1	K1	2 (K1 & K1)	1 (K2)
2	CO2	K3	2	K1 & K2	1	K1	2 (K2 & K2)	1 (K3)
3	CO3	K3	2	K1 & K2	1	K2	2 (K2 & K2)	1 (K3)
4	CO4	K4	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K4)
5	CO5	K5	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K5)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4	10	-	19	15.83	50
K2	5	6	20	10	41	34.17	
K3	-	-	20	20	40	33.34	50
K4	-	-	-	10	10	8.33	
K5	-	-	-	-	10	8.33	
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions** **(10x1=10 marks)**			
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	Each parcel in the Lagrangian formulation is tagged using _____ a)time-dependent position vector b)time-independent position vector c)time-dependent velocity vector d) time-independent velocity vector
2	CO1	K2	Scleronomous constraints have: a) Explicit time dependence. b) no explicit time dependence. c) both explicit time dependence and no explicit time dependence. d) neither explicit time dependence nor no explicit time dependence. e) a sclerous time dependence.
3	CO2	K1	Generalized coordinate is defined as_____ coordinates to describe the system a) Maximum b) Minimum c) Finite d) Infinite
4	CO2	K2	Hamilton's equations are _____order equations a) first b) second c) third d) fourth
5	CO3	K1	The electrostatic forces are very much _____than the gravitational forces in the interaction of atomic and subatomic particles. (a) Poor (b) Stronger (c) Equal (d) Lower
6	CO3	K2	All the planet moves around the Sun in _____ orbit. (a) circular (b) parabolic (c) hyperbolic (d) elliptical
7	CO4	K1	On which of the following factor does the moment of inertia of an object not depend upon (a) Axis of rotation (b) Angular velocity (c) Distribution of mass d) Mass of an object
8	CO4	K2	If simple harmonic variations of a pendulum die away after some time, Due to energy dissipation by viscous forces in the air, then oscillation is

			said to be… a. undamped b. damped c. free d dependent
9	CO5	K1	In case of canonical transformation a) Hamilton's principle is satisfied in old as well as in new coordinates b) The form of the Hamilton's equations is preserved c) The form of Hamilton's equations cannot be preserved d) The form of Hamilton's equations may or may not be preserved
10	CO5	K2	For Lagrange brackets a) {pi,pj}=δij b) {pi,pj}=0 c) {qi,pj}=0 d) {qi,pj}=δijs
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	Define D'Alembert principle.
12	CO2	K1	What is meant by constrained motion?
13	CO3	K2	Define Kepler's thrird law.
14	CO4	K2	What is the condition for stable oscillation?
15	CO5	K2	Define the term generating function
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	Write a short note on Lagrangian formulations.
16) b	CO1	K1	Describe the particle in electromagnetic field in Lagrangian approach.
17) a	CO2	K2	Write about the advantage of Hamiltonian approach
17) b	CO2	K2	Give Hamilton's equation of motion for particle moving near the surface of Earth
18) a	CO3	K2	Write a note on Kepler's law
18) b	CO3	K2	Write a neat sketch on artificial satellite in classical mechanics.
19) a	CO4	K3	Write about moment of inertia tensor.
19) b	CO4	K3	Describe the effect of dissipative forces.
20) a	CO5	K3	Demonstrate the advantage of canonical transformation and give some example for it
20) b	CO5	K3	Give the relation between Lagrange and Poisson bracket
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions (3x10=30 marks)**			
Q.No	**CO**	**K Level**	**Questions**
21	**CO1**	**K2**	Describe the procedure for forming Lagrange's equations.
22	**CO3**	**K3**	Elaborate an equation of motion for fictious force
23	**CO4**	**K3**	Derive the central force equation in detailed manner.
24	**CO2**	**K4**	Analyze the theory of Free vibrations of a linear triatomic molecule.
25	**CO5**	**K5**	Compare the normal transformation and canonical transformation?

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	**Analog Electronics and Communications**			
Course Code	**21PPHC13**	**L**	**P**	**C**
Category	Core	6	-	4

Nature of Course:	EMPLOYBILITY	✓	SKILL ORIENTED	✓	ENTREPRENURSHIP

COURSE OBJECTIVES:

- To summarize different type of transistors and amplifiers and to be explained how it works
- To demonstrate the knowledge of operational amplifiers in both linear and non-linear analog systems and their applications
- To relate the oscillators which are constructed with operational amplifiers
- To understand the various modulation and demodulation techniques
- To compare the type of modulations and make use of them for communications

Unit: I	**JFETs and MOSFETs**	19 Hrs

Basic Ideas- Drain curves- Transconductance curves- Biasing in the ohmic region, Biasing in the active region, Voltage-Divider bias, Current-source bias. Transconductance- JFET amplifiers- Depletion mode MOSFET: Amplifiers-Enhancement mode MOSFET- Ohmic regions.

Unit: II	**Operational amplifiers and linear applications**	17 Hrs

Bias and offsets- CMRR- Slew rate- Inverting amplifier- Virtual ground- Voltage gain- Band width- Non-inverting amplifier- Op-amp applications: Summing amplifier, Voltage follower, Linear IC amplifier- Differential amplifiers and Instrumentation amplifiers.

Unit: III	**Non-linear OPAMP circuit and Oscillators**	17 Hrs

Integrator- Wave form conversion- Wave form generation-Triangular generator- Active diode circuits- Differentiator. Type of Oscillators: Sinusoidal, Wien bridge, RC type, phase shift, Colpitt and Hartley (CE-connection only) Oscillators.

Unit: IV	**Amplitude Modulation**	19 Hrs

Need for frequency translation- Double side band – Suppressed carrier modulation- Double side band with carrier- Single side band modulation-Angle modulation Tone modulated FM signal-Arbitrary modulated FM signal.

Unit: V	**Modulators and Communications**	18 Hrs

Variation method-Armstrong's direct method- Frequency multiplication- Armstrong FM system- FM demodulator- SSB-AM, SSB-FM- Stereophonic FM broadcasting. Optical communication - Mobile communication - Satellite communication- Radar system.

	Total Lecture Hours	90

Books for study:

1. Albert Malvino and David J Bates, Electronic Principles, VII Edition, McGraw Hill Education(India) Pvt. Ltd, New Delhi-16, Seventeenth Reprint, 2015.

Unit I – Chapter 13, Sec.13.1-13.7, Chapter 14, Sec.14.1 - 14.5

Unit II – Chapter 18, Sec.18.1 -18.6, Chapter 20, Sec.20.4 -20.5

Unit III – Chapter 22, Sec.22.5-22.10, Chapter 23, Sec.23.1 -23.5

2. Herbert Taub, Donald L Schilling and Goutam Saha, Principles of Communication Systems, III Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi-8, 2008 .

Unit IV – Chapter 3, Sec.3.1-3.4, Chapter 4, Sec.4.1-4.3

Unit V – Chapter 4, Sec.4.4-4.6, Chapter 16, Sec. 16.3-16.6

Books for References:

1. B.L. Theraja, Basic Electronics, Ist. Multicolour Edition, 2005, S.Chand & Company Pvt.Ltd, New Delhi-55, Reprint 2014.
2. V.K.Mehta and Rohit Mehta, Principles of Electronics, First Edition, 1980, S.Chand &Company Pvt.Ltd, New Delhi-55, Reprint 2013.
3. B.P.Lathi and ZhiDing , Modern Digitaland Analog Communication systems, International IVth Edition, 2010, Oxford University Press, New York, Reprint 2011

Books for References:

https://www.mooc-list.com/tags/analogue-electronics

https://www.classcentral.com/course/swayam-digital-electronic-circuits-12953

https://nptel.ac.in/courses/108/105/108105132/

COURSE OUTCOMES		**K Level**
On Completion of this course, the student will be able to		
CO1:	Recognize the working of different semiconductor devices and describe their functions	K2
CO2:	Acquire the knowledge of operations of OP-AMP to perform the various	K1

	mathematical logics	
CO3:	Use the significance of Op-amps and their importance in oscillator circuits	K4
CO4:	Appraise the use of amplitude and frequency modulation techniques	K3
CO5:	Construct devices used for various Communication systems efficiently	K5

CO & PO Mapping:

Course Outcomes (CO's)	Programme Outcomes (PO's)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	3	2	2	1
CO2	3	1	3	2	2	3
CO3	1	2	1	2	2	2
CO4	2	3	2	2	2	3
CO5	3	2	2	2	3	1
Weightage	11	11	11	10	11	10

3 – Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Units	21PPHC13- ANALOG ELECTRONICS AND COMMUNICTIONS	Hrs	Pedagogy
Unit-1 JFETs and MOSFETs	Basic Ideas- Drain curves- Transconductance curves- Biasing in the ohmic region, Biasing in the active region.	6	Chalk &Talk, PPT
	Voltage-Divider bias, Current-source bias. Transconductance	6	
	JFET amplifiers-Depletion mode MOSFET: Amplifiers- Enhancement mode MOSFET- Ohmic regions.	7	
Unit-2 Operational amplifiers and linear applications	Bias and offsets- CMRR- Slew rate- Inverting amplifier- Virtual ground- Voltage gain.	6	Chalk &Talk, Assignment
	Band width- Non-inverting amplifier- Op-amp applications: Summing amplifier, Voltage follower.	5	
	Linear IC amplifier- Differential amplifiers and Instrumentation amplifiers.	6	
Unit-3 Non-linear OPAMP circuit and Oscillators	Integrator- Wave form conversion- Wave form generation- Triangular generator.	5	Chalk &Talk, Class test
	Active diode circuits- Differentiator. Type of Oscillators: Sinusoidal, Wien bridge	6	
	RC type, phase shift, Colpitt and Hartley(Ce-connectiononly)Oscillators.	6	
Unit-4 Amplitude Modulation	Need for frequency translation- Double side band – Suppressed carrier modulation.	6	Chalk &Talk,
	Double side band with carrier- Single side band modulation	6	

	Angle modulation Tone modulated FM signal- Arbitrary modulated FM signal	7	PPT
Unit-5 Modulators and Communications	Variation method-Armstrong's direct method- Frequency multiplication.	6	Chalk &Talk, Seminar
	Armstrong FM system- FM demodulator- SSB-AM, SSB-FM- Stereophonic FM broadcasting.	6	
	Optical communication - Mobile communication - Satellite communication- Radar system.	6	

Course Designed by: **Dr. M. Alagar & Dr.D.Ruby Josephine**

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**		**SectionC Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**K2**	2	K1	1	K1	2 (K2&K2)	1(K2)
	CO2	**K4**	2	K2	2	K2	2 (K3&K3)	2 (K3 & K4)
CI AII	**CO3**	**K2**	2	K1	1	K2	2 (K2&K2)	1(K2)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	2 (K3 & K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**50**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**50**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	**COs**	**K - Level**	**MCQs**		**Short Answers**		**Section C (Either / or Choice)**	**Section D (Open Choice)**
			No. of Questions	**K – Level**	**No. of Question**	**K – Level**		
1	CO1	K1	2	K1 & K2	1	K1	2 (K1 & K1)	1 (K2)
2	CO2	K2	2	K1 & K2	1	K1	2 (K2 & K2)	1 (K3)
3	CO3	K3	2	K1 & K2	1	K2	2 (K2 & K2)	1 (K3)
4	CO4	K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K4)
5	CO5	K4	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K5)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4	10	-	19	15.83	50
K2	5	6	20	10	41	34.17	
K3	-	-	20	20	40	33.34	50
K4	-	-	-	10	10	8.33	
K5	-	-	-	-	10	8.33	
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions** **(10x1=10 marks)**			
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	The modulation index lies between 0 and 1 a) 0-100 b) 0-5c) 0-16 d)0-90
2	CO1	K2	The total power in a amplitude modulated wave to the unmodulated carrier power is related by a) Pt/Pc=1+m2/2 b) Pt/Pc=1-m2/2 c) Pt/Pc=1+m2 d) Pt/Pc=1+13m2/2
3	CO2	K1	A differential amplifier …….. a) is a part of an Op-amp b) is a part of an Op-amp c) has two outputs d) has two outputs
4	CO2	K2	With zero volts on both inputs, an OP-amp ideally should have an output ……. a) equal to the positive supply voltage b) equal to the positive supply voltagec) equal to zero d) equal to zero
5	CO3	K1	FET is a ------ device a) unipolar b) bipolarc) tripolar d) all the above
6	CO3	K2	What is the output waveform of an integrator? a) sine wave b) square wave c) sawtooth wave d) triangle wave
7	CO4	K1	----- diodes are recently employed as microwave mixers a) Schottky barrier b) Varacter diode c) Crystal diodes d) Light emitting diode
8	CO4	K2	The first magnetron was discovered by a) E. W. Hull b) Faradayc) Gunn d) schottky
9	CO5	K1	Colpitt oscillator contains a) Two capacitors and one inductor b) Two capacitor and two inductors c) One capacitor and two inductors d) One capacitor and one inductor
10	CO5	K2	LC tuned oscillator produces

			a) Cos wave b) Square wave c) Triangular d) Sine wave
Section B (Short Answers) **Answer All Questions (5x2=10 marks)**			
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	What are the characteristics of an ideal Op-Amp?
12	CO2	K1	Give the principle of a mono-stable multivibrator.
13	CO3	K2	Write a note on Armstrong oscillator.
14	CO4	K2	Define SSB
15	CO5	K2	List examples for communication in real time
Section C (Either/Or Type) **Answer All Questions (5 x 5 = 25 marks)**			
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	Write elaborately on the representation and power of a amplitude modulated wave
16) b	CO1	K1	Explain about the effect of noise on carrier noise triangle
17) a	CO2	K2	Draw the equivalent circuit of an op-amp and explain the various parameters used in the equivalent circuit
17) b	CO2	K2	Explain how addition and subtraction may be accomplished using op-amp
18) a	CO3	K2	Discuss in detail on the characteristic parameters of JFET?
18) b	CO3	K2	How high pass RC circuit be used as a differentiator?
19) a	CO4	K3	Describe the detail behind isolators?
19) b	CO4	K3	Explain about Schottky - Barrier diode and about backward diode in detail
20) a	CO5	K3	RC phase shift oscillator using high pass filters
20) b	CO5	K3	Draw the circuit of Hartley oscillator using FET
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions (3x10=30 marks)**			
Q.No	**CO**	**K Level**	**Questions**
21	**CO1**	**K2**	Describe the direct method involve in the generation of frequency modulation
22	**CO3**	**K3**	Explain the Instrumentation amplifier. Draw a system whose gain is controlled by a variable resistance?
23	**CO4**	**K3**	Draw the Schmitt trigger circuit and explain with wave forms
24	**CO2**	**K4**	Elaborate on the detailed theory on Gunn effect with illustrations
25	**CO5**	**K5**	Evaluate the circuit of Colpitts oscillator. How is the feedback requirements met in it?

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	Electrodynamics							
Course Code	**21PPHC14**					**L**	**P**	**C**
Category	Core					6	-	4
Nature Of Course:	EMPLOYBILITY		SKILL ORIENTED	✓	ENTREPRENURSHIP			

Course objectives:

- To understand the concepts on electrostatics and to use Gauss's law in various applications
- To analyze the theory of magnetostatics, Biot-Savort's law and magnetic vector potential
- To derive Maxwell's equation in differential and integral forms, propagation of EM waves through different media
- To acquire the knowledge of the various modes of propagation of electromagnetic waves in waveguides
- To apply and analyze the concepts of interaction of electromagnetic waves with macroscopic matter

Unit: I	**Electrostatics and Electric Fields in Matter**	19

Poisson's equation and Laplace's equation – potential of a localized charge distribution – electrostatic boundary conditions. Work and energy in electrostatics: work done to move charge - energy of point charge distribution - energy of continuous charge distribution. Laplace's equation: Laplace's equation in one, two, and three dimensions - boundary conditions and uniqueness theorem – conductors and second uniqueness theorem. Multipole expansion: Approximate potentials at large distances - monopole and dipole terms. Polarization: Dielectrics - induced dipoles - alignment of polar molecules

Unit: II	**Magnetostatics and Magnetic Fields in Matter**	19

Lorentz force law: Magnetic fields – magnetic forces – currents. Biot-Savart law: Steady currents – magnetic field of steady current. Divergence and curl of **B**: Applications of Ampere's law – comparison of magnetostatics and electrostatics. Magnetic vector potential: Vector potential – magnetostatic boundary conditions – multipole expansion of the vector potential. Magnetization: Diamagnets, paramagnets and ferromagnets - torques and forces on magnetic dipoles – effect of a magnetic field on atomic orbits.

Unit: III	**Electrodynamics and Conservation Laws**	18

Maxwell's equations: Ampere's law – magnetic charge – Maxwell's equations in matter – boundary conditions. Charge and energy: Continuity equation - Poynting's theorem Momentum – Newton's third law in electrodynamics. Maxwell's stress tensor – Conservation of momentum and angular momentum.

Unit: IV	**Electromagnetic Waves**	17

Electromagnetic waves in vacuum: Wave equation for **E** and **B** – monochromatic plane waves – energy and momentum in electromagnetic waves. Electromagnetic waves in matter: Propagation in linear media – reflection and transmission at normal incidence – reflection and transmission at oblique incidence. Absorption and dispersion: Electromagnetic waves in conductors, reflection at a conducting surface, frequency dependence of permittivity.

Unit: V	**Electric Potential and Relativistic Electrodynamics**	17
Guided waves: Wave guides - waves in a rectangular wave guide – coaxial transmission line. The potential formulation – Scalar and vector potential Gauge transformation, Coulomb's Gauge and Lorentz Gauge. Relativistic electrodynamics: Magnetism as a relativistic phenomenon, field transform, field tensor, electrodynamics in tensor notation, relativistic potentials.		
	Total Lecture Hours	90

Books for Study:

D.J., Griffiths, Introduction to Electrodynamics, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, Reprint 1999.

UNIT I	:	Chapter 2: Sections 2.3.3 to 2.4
		Chapter 3: Sections 3.1 to 3.4
		Chapter 4: Sections 4.1
UNIT II	:	Chapter 5, Chapter 6: Sections 6.1
UNIT III	:	Chapter 7: Sections: 7.33 to 7.36
		Chapter 8: Section 8.1 and 8.2
UNIT IV	:	Chapter 9: Sections 9.2 to 9.4
UNIT V	:	Chapter 9: Section 9.5
		Chapter 10: Sections 10.1.1, 10.1.2 and 10.1.3
		Chapter 12: Section 12.3

Books for References:

1. Capri, A.Z., and Panat, P.V., Introduction to Electrodynamics, 3rd Edition, Reprint 2006, Narosa Publishing House, New Delhi.
2. Jackson, J.D., Classical Electrodynamics, 3rd Edition, Reprint 2007, Wiley India Pvt. Ltd. New Delhi, 2007.
3. Puri, S.P., Classical Electrodynamics, First Edition, Reprint 2011, Narosa Publishing House Pvt. Ltd., New Delhi.

Web Resources:

https://nptel.ac.in/courses/115/101/115101004/
https://www.coursera.org/learn/electrodynamics-electric-magnetic-fields
https://www.classcentral.com/course/swayam-electromagnetism-17586
https://www.my-mooc.com/en/mooc/electrodynamics-an-introduction/

Course Outcomes		**K Level**
CO1:	Solve electrostatic boundary value problems using Poisson's and Laplace equations	K3
CO2:	Acquire the knowledge in boundary conditions of electrostatics and Magnetostatics	K1
CO3:	Derive Maxwell's equation in differential and integral form	K4
CO4:	Discuss the propagation of electromagnetic waves in different medium	K2
CO5:	Use the concept of interactions in electromagnetic waves with macroscopic matter for society	K5

CO & PO Mapping:

Course Outcomes (CO's)	Programme Outcomes (PO's)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	2	2	2
CO2	3	1	2	2	2	3
CO3	2	2	1	1	2	2
CO4	2	1	2	2	2	2
CO5	1	3	1	3	1	1
Weightage	11	9	8	10	9	10

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	Electrodynamics	Hrs	Pedagogy
I Electrostatics and Electric Fields in Matter	Poisson's equation and Laplace's equation, potential of a localized charge distribution, electrostatic boundary conditions.	**4**	Chalk, Talk& Assignment
	Work and energy in electrostatics: work done to move charge, energy of point charge distribution, energy of continuous charge distribution.	**5**	
	Laplace's equation: Laplace's equation in one, two, and three dimensions, boundary conditions and uniqueness theorem, conductors and second uniqueness theorem.	**5**	
	Multipole expansion: Approximate potentials at large distances, monopole and dipole terms. Polarization: Dielectrics, induced dipoles, alignment of polar molecules.	**5**	
II Magnetostatics and Magnetic Fields in Matter	Lorentz force law: Magnetic fields, magnetic forces, currents. Biot-Savart law: Steady currents, magnetic field of steady current.	**6**	Chalk, Talk& Exercise
	Divergence and curl of **B**: Applications of Ampere's law, comparison of magnetostatics and electrostatics. Magnetic vector potential: Vector potential, magnetostatic boundary conditions, multipole expansion of the vector potential.	**7**	
	Magnetization: Diamagnets, paramagnets and ferromagnets, torques and forces on magnetic dipoles, effect of a magnetic field on atomic orbits.	**6**	
III Electrodynamics and Conservation Laws	Maxwell's equations: Ampere's law, magnetic charge, Maxwell's equations in matter, boundary conditions.	**6**	Chalk, Talk& PPT
	Charge and energy: Continuity equation, Poynting's theorem Momentum, Newton's third	**6**	

	law in electrodynamics.		
	Maxwell's stress tensor, Conservation of momentum and angular momentum.	**6**	
IV Electromagnetic Waves	Electromagnetic waves in vacuum: Wave equation for **E** and **B,** monochromatic plane waves, energy and momentum in electromagnetic waves.	**6**	Chalk, Talk, PPT & Seminar
	Electromagnetic waves in matter: Propagation in linear media, reflection and transmission at normal incidence, reflection and transmission at oblique incidence.	**6**	
	Absorption and dispersion: Electromagnetic waves in conductors, reflection at a conducting surface, frequency dependence of permittivity.	**5**	
V Electric Potential and Relativistic Electrodynamics	Guided waves: Wave guides, waves in a rectangular wave guide, coaxial transmission line.	**6**	Chalk, Talk, PPT &Assignment
	The potential formulation, Scalar and vector potential Gauge transformation, Columb's Gauge and Lorentz Gauge.	**6**	
	Relativistic electrodynamics: Magnetism as a relativistic Phenomenon, field transform, field tensor, electrodynamics in tensor notation, relativistic potentials.	**5**	

Course Designed by: **Dr. P.P. Kannan & Mrs. S. Nagadeepa**

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**		**SectionC Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**K2**	2	K1	1	K1	2 (K2&K2)	1(K2)
	CO2	**K4**	2	K2	2	K2	2 (K3&K3)	2 (K3 & K4)
CI AII	**CO3**	**K2**	2	K1	1	K2	2 (K2&K2)	1(K2)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	2 (K3 & K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for	1		2		5	20

	each question						
	Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**50**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**50**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	**COs**	**K - Level**	**MCQs**		**Short Answers**		**Section C (Either / or Choice)**	**Section D (Open Choice)**
			No. of Questions	**K – Level**	**No. of Question**	**K – Level**		
1	CO1	K2	2	K1 & K2	1	K1	2 (K1&K1)	1 (K2)
2	CO2	K3	2	K1 & K2	1	K1	2 (K2&K2)	1 (K3)
3	CO3	K3	2	K1 & K2	1	K2	2 (K2&K2)	1 (K3)
4	CO4	K4	2	K1 & K2	1	K2	2 (K3&K3)	1 (K4)
5	CO5	K5	2	K1 & K2	1	K2	2 (K3&K3)	1 (K5)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4	10	-	19	15.86	50
K2	5	6	20	10	41	34.17	
K3	-	-	20	20	40	33.34	50
K4	-	-	-	20	10	8.33	
K5	-	-	-	-	10	8.33	
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions** **(10x1=10 marks)**			
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	From the below equations, which one is correct Poisson's equation? a) ∇^2 V=0 b) ∇^2 V= ρ/ε0 c) ∇^2 V= -ρ/ε0 d) ∇V=0
2	CO1	K2	The solutions of spherical co ordinates are Legendre polynomials in the variable of a) sin θ b) tanθ c) cos θ d) cot θ
3	CO2	K1	Steady currents produce a magnetic filed in a constant time are called as a) Electrostatics b) Magnetostatics c) Continuity equation d) Uniqueness theorem
4	CO2	K2	Biot-Savart law plays a role analogous to ____ law in electrostatics a) Gauss b) Coloumb's c) Maxwell d) Ampere
5	CO3	K1	The component of D is perpendicular to the interfaces between _____ a) Continuous b) Discontinuous c) Infinity d) All the above
6	CO3	K2	The Maxwell's equation ∇ x E could be derived from a) Faraday law b) Coloumb's law c) Maxwell law d) Ampere's law
7	CO4	K1	The value of Reflection+Transmission=____for the electromagnetic wave at normal incidence a) Constant b) Infinity d) Unity d) Zero
8	CO4	K2	The divergence of H will be a) 1 b) Infinity c) -1 d) Zero
9	CO5	K1	The dominant mode in a rectangular wave guide is a) TE9 b) TE8 c) TE10 d) TE6
10	CO5	K2	If the propagation constant of an electromagnetic wave v=α+jβ then α is called a) Real propagation constant b) Phase constant c) Attenuation constant d) None of the above

Section B (Short Answers) Answer All Questions (5x2=10 marks)			
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	List out the Poisson's equations in electrostatics
12	CO2	K1	Define the term magnetization
13	CO3	K2	Describe about Ampere's law
14	CO4	K2	Discuss about absorption and dispersion
15	CO5	K2	Explain the concept of guided waves
Section C (Either/Or Type) **Answer All Questions (5 x 5 = 25 marks)**			
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	Show the potential of a uniformly charged spherical shell of radius R
16) b	CO1	K1	Define the boundary conditions and uniqueness theorem
17) a	CO2	K2	Explain the term currents in magnetostatics
17) b	CO2	K2	Describe the effect of a magnetic field on atomic orbits
18) a	CO3	K2	Explain Maxwell's equations in matter
18) b	CO3	K2	Write Maxwell's equations in differential form
19) a	CO4	K3	Build the energy and momentum in electromagnetic waves
19) b	CO4	K3	Compute the phenomena of electromagnetic waves in conductors
20) a	CO5	K3	Manipulate TE waves in a rectangular wave guide
20) b	CO5	K3	Identify the theory of relativistic phenomenon in magnetism
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions (3x10=30 marks)**			
Q.No	**CO**	**K Level**	**Questions**
21	**CO1**	**K2**	Elaborate the electric potentials for Laplace's equations in one, two and three dimensions
22	**CO3**	**K3**	Use the straight line currents in magnetostatics and divergence & curl of B
23	**CO4**	**K3**	Build the Poynting theorem in electrodynamics.
24	**CO2**	**K4**	Categorize the reflection and transmission at oblique incidence
25	**CO5**	**K5**	Evaluate the theory about magnetic dipole radiation

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	**PRACTICAL – I GENERAL PHYSICS LABORATORY**			
Course Code	**21PPHC15**	**L**	**P**	**C**
Category	Core	-	6	4

Nature of the Course	EMPLOYBILITY		SKILL ORIENTED	✓	ENTREPRENURSHIP	

Course Objectives:

- To learn various experimental and computational tools thereby developing analytical skills.
- To acquire the appropriate data accurately and keep systematic record of laboratory activities.
- To prepare graphical presentations of laboratory data and computational results.
- To interpret findings using the physical scientific tools
- To evaluate possible causes of discrepancy in practical experimental observations

ANY TWELVE EXPERIMENTS:

1. Error analysis of experimental data
2. Refractive index of a liquid hollow prism
3. Determination of Cauchy's constant
4. Determination of wavelength of the prominent lines by grating-Oblique incidence
5. Resolving power of a prism
6. Determination of Young's modulus and Poisson's ratio of a Perspex scale by forming Elliptical fringes.
7. Laser based diffraction experiments.
8. Determination of the co-efficient of coupling between the pair of coils using Anderson's Bridge
9. Determination of mutual inductance of a pair of coils by forming Maxwell's Bridge
10. Wien's bridge and Owen's bridge
11. Runge-Kutta Method I& II using C++Programming
12. Gauss Elimination Method using C++Programming
13. Newton Raphson's method using C++Programming
14. Simpson's one third rule using C++ Programming
15. Trapezoidal rule using C++ Programming

COURSE OUTCOMES		**K Level**
On Completion of this course, the student will be able to		
CO1	Gain practical exposure about theoretical concepts and investigate the principles & effects of optics	K3
CO2	Cultivate technical skills to troubleshoot the errors in various instruments and determine accurate results.	K1
CO3	Examine the strength of material by doing Young's modulus experiment.	K4
CO4	Interpret the science behind the electrical components and their properties.	K2
CO5	Develop the computer programming for Numerical method problems	K5

Course Designed by: **Mrs. S. Nagadeepa & Dr.M.Alagar**


SECOND SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	Mathematical Physics-II			
Course Code	21PPHC21	**L**	**P**	**C**
Category	Core	6	-	4

Nature of course:	EMPLOYBILITY		SKILLORIENTED	✓	ENTREPRENURSHIP	

Course Objectives:

- To recall and solve various types of differential equations
- To solve various complex functions by Fourier series and also to determine its transforms
- To explore about the concepts of different types of tensors
- To analyze special functions using Legendre and Laguerre polynomials
- To evaluate the functions using Bessel and Hermite functions

Unit: I	**Differential equations of first and second order**	19 Hrs

Order, degree, formation, solution and the geometrical meaning of a differential equation – solving methods of differential equation: variables separable - Homogenous differential equations - equations reducible to homogenous form - linear differential equations - equations reducible to linear and exact form – exact differential equation. Linear differential equations of second order: Linear and Non-linear differential equations - linear differential equations of second order with constant coefficients - dimension of space of solution - Non-homogenous – Homogenous-superposition or linearity principle equations - linear independence and dependence –Wronskian - Existence of linearly independence –method to find complementary function and particular integral for any differential equation.

Unit: II	**Transforms**	20 Hrs

Fourier Transform**:** Integral transforms-Fourier integral theorem-Fourier sine and cosine integrals – Fourier's complex integral - Fourier transforms - Fourier sine and cosine transforms - properties of Fourier transforms – convolution – Perseval's identity for Fourier transforms – Parseval's identity for cosine transform – Perseval's identity for sine transform - Fourier transform of derivatives - relationship between Fourier and Laplace transforms - solution of boundary value problems by using integral transform.

Unit: III	**Vector space and tensors**	15 Hrs

Introduction – definition of real vector space – sub space – construction of vector space – linear dependence and independence – linear dependence and independence – basis and dimension – fundamental subspaces of a matrix – transformation – linear transformation – properties of linear transformation – matrices of linear transformation.

Tensors of rank zero, one and two – dummy suffix- transformations – Cartesian tensors – relation between the direction cosines and kroneckar delta – substitution property of kroneckar delta – algebra of Cartesian tensor – quotient law – symmetric and antisymmetric tensor –scalar invariant of a second rank tensor.

Unit: IV	**Special functions I**	18 Hrs

Legendre's equation – Legendre's polynomial $p_n(x)$ - Legendre's function of second kind -general solution of Legendre's equation - Rodrigue's formula - Legendre's polynomial - a generating function of Legendre's polynomial - orthogonality of Legendre's polynomial - a generating

function of Legendre's polynomial, orthogonality of Legendre polynomials -recurrence formulae – Laplace's first definite integral - Laplace second definite integral- Fourier Legendre expansion – Strum – Liouville equation – orthogonality – orthoganility of Eigen function -Laguerre's function – Laguerre's function for different values of n - generating function of Laguerre polynomial - recurrence relation - orthogonal property		
Unit: V	**Special function II**	18 Hrs
Bessel's function: Bessel's equation - solution of Bessel's equation- Bessel's function j_{nx} - Bessel function of the second kind of order n - recurrence formulae - equations reducible to Bessel's equation - orthogonality of Bessel function - a generating function for $j_n(x)$- trigonometric expansion involving Bessel function - Bessel integral –Fourier-Bessel expansion - Ber and Bei functions. Hermite function: Hermite's equation - generating function of Hermite polynomials - orthogonal property - recurrence formula for h_n (x) of Hermite equation.		
	Total Lecture Hours	90

Books for Study:

1. H. K. Dass & Rama Verma, Mathematical Physics, VIII Edition, S. Chand and Company limited, Ram Nagar, New Delhi – 55, Reprint 2019

UNIT I (Chapter 12 (12.1 -12.13), 13)
UNIT II (Chapter 45(45.1- 45.15)
UNIT IV (Chapter 28, 31)
UNIT V(Chapter 29, 30)

2. Vinod K. Sharma, Matrix methods and vector spaces in Physics, 2009, PHI Learning private limited, New Delhi -15

UNIT III (Chapter 3(3.1- 3. 7) 4 (4.1-4.4, 4.7), 8 (8.1- 8.11),

Books for References:

1. G. B. Arfken, H. J.Weber and Harris, Mathematical methods for Physicists, IV edition, Academic press, 2005,
2. Advanced Engineering Mathematics, Erwin Kreyszig, IX Edition, Wiley publishers, 2014.
3. B. D. Gupta, Mathematical Physics, IV edition, Vikas Publishing House private Ltd., New Delhi-55, Reprint 2018.

Web Resources:

1. https://www.grc.nasa.gov/www/k12/Numbers/Math/documents/Tensors_TM2002211716.pdf
2. https://doi.org/10.1121/1.4776198
3. https://mathworld.wolfram.com/ModifiedBesselFunctionoftheFirstKind.html

Course Outcomes		**K Level**
On Completion of this course, the student will be able to		
CO1:	Define differential equations of first and second order respectively	K3
CO2:	Express various complex functions into simplified Fourier series form and as transforms	K3
CO3:	Distinguish tensors into different order and types	K3
CO4:	Analyze special function in terms of Legendre and Laguerre polynomials	K4
CO5:	Evaluate various special functions by using Hermite and Bessel functions	K5

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	3	2	2	2
CO 2	2	2	3	2	2	2
CO 3	1	2	1	2	2	2
CO 4	2	2	2	2	2	2
CO 5	2	2	1	1	2	2
Weightage	10	10	10	9	9	10

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	Order, degree, formation, solution and the geometrical meaning of a differential equation, solving methods of differential equation: variables separable, Homogenous differential equations, equations reducible to homogenous form, linear differential equations, equations reducible to linear and exact form, exact differential equation.	6	Chalk & Talk, PPT
	Linear differential equations of second order: Linear and Non-linear differential equations, linear differential equations of second order with constant coefficients, dimension of space of solution , Non-homogenous, Homogenous, superposition or linearity principle equations, linear independence and dependence, Wronskian, Existence of linearly independence	7	
	Method to find complementary function and particular integral for any differential equation.	6	
II	**Fourier Transform:** Integral transforms, Fourier integral theorem, Fourier sine and cosine integrals, Fourier's complex integral, convolution	7	Chalk, Talk& Assignment
	Fourier transforms , Fourier sine and cosine transforms , properties of Fourier transforms	6	
	Perseval's identity for Fourier transforms, Parseval's identity for cosine transform, Perseval's identity for sine transform, Fourier transform of derivatives, relationship between Fourier and Laplace transforms, solution of boundary value problems by using integral transform	7	
III	Introduction, definition of real vector space, sub space, construction of vector space, linear dependence and independence, linear dependence and independence, basis and dimension	4	Chalk, Talk&
	fundamental subspaces of a matrix, transformation, linear		

	transformation, properties of linear transformation, matrices of linear transformation. Tensors of rank zero, one and two, dummy suffix, transformations	4	Exercise
	Cartesian tensors – relation between the direction cosines and kroneckar delta – substitution property of kroneckar delta – algebra of Cartesian tensor – quotient law – symmetric and antisymmetric tensor –scalar invariant of a second rank tensor.	**7**	
IV	Legendre's equation, Legendre's polynomial $p_n(x)$, Legendre's function of second kind, general solution of Legendre's equation, Rodrigue's formula, Legendre's polynomial, a generating function of Legendre's polynomial	6	Chalk & Talk, PPT
	Orthogonality of Legendre's polynomial , a generating function of Legendre's polynomial, orthogonality of Legendre polynomials, recurrence formulae, Laplace's first definite integral , Laplace second definite integral, Fourier Legendre expansion, Strum – Liouville equation	6	
	Orthogonality, orthogonality of Eigen function, Laguerre's function, Laguerre's function for different values of n, generating function of Laguerre polynomial, recurrence relation, orthogonal property	6	
V	**Bessel's function:** Bessel's equation , solution of Bessel's equation, Bessel's function $j_{n(x)}$, Bessel function of the second kind of order n, recurrence formulae, equations reducible to Bessel's equation	6	Chalk, Talk& Seminar
	Orthogonality of Bessel function , a generating function for $j_n(x)$, trignomentric expansion involving Bessel function, Bessel integral , Fourier Bessel expansion , Ber and Bei functions.	6	
	Hermite function: Hermite's equation , generating function of Hermite polynomials , orthogonal property , recurrence formula for $h_n(x)$ of Hermite equation	6	

Course Designed by: **Dr. D. Ruby Josephine & Mr. P. Dharmaraja**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**K3**	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
	CO2	**K3**	2	K1 & K2	2	K2	2 (K3&K3)	2(K3& K3)
CI AII	**CO3**	**K3**	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
	CO4	**K4**	2	K1 & K2	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	2	-	-	4	6.67	17
	K2	2	4		-	6	10	
	K3	-	-	20	30	50	83.33	83
	K4	-	-	-	-	-	-	
	Marks	4	6	20	30	60	100	100
CIA II	**K1**	2	2	-	-	4	6.67	17
	K2	2	4	-	-	6	10	
	K3	-	-	20	20	40	66.67	83
	K4	-	-	-	10	10	16.67	
	Marks	4	6	20	30	60	100	100

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	**COs**	**K - Level**	**MCQs**		**Short Answers**		**Section C (Either / or Choice)**	**Section D (Open Choice)**
			No. of Questions	**K – Level**	**No. of Question**	**K – Level**		
1	CO1	Up to K 3	2	K1K2	1	K1	2 (K3&K3)	1(K3)
2	CO2	Up to K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
5	CO5	Up to K 5	2	K1&K2	1	K2	2 (K5&K5)	1(K5)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4	-	-	9	7.5	16.66
K2	5	6	-	-	11	9.16	
K3	-	-	40	40	80	66.67	83.27
K4	-	-	-	-	-		
K5	-	-	10	10	20	16.6	
Marks	10	10	50	50	120		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

Section A (Multiple Choice Questions) Answer All Questions (10x1=10 marks)			
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	Identify from the following, order of a differential equation can be obtained from a) Highest order of the derivative involved b) Lowest order of derivative involved c) Constants d) All the above
2	CO1	K2	Show an example for linear differential equation from the following a) $\frac{d^2y}{dx^2}+5\frac{dy}{dx}+6y=x^2+x+1$ b) $\frac{d^2y}{dx}+5\frac{dy}{dx}+y^3=e^x$ c) $\frac{d^2y}{dx}+5\frac{dy}{dx}+y^3=\sin x$ d) $\frac{d^2y}{dx}+5\frac{dy}{dx}+y^3=f(t)$
3	CO2	K1	Identify the fourier cosine integral a)f(x)= $\frac{2}{\pi}\int_0^\infty \sin ux\,du \int_0^\infty f(t)\sin ut\,dt$ b) f(x)= $\int_0^\infty \sin ux\,du \int_0^\infty f(t)\sin ut\,dt$ c) f(x)= $\frac{2}{\pi}\int_0^\infty 8\sin ux\,du \int_0^\infty f(t)\sin ut\,dt$ d) f(x)= $6\int_0^\infty \sin ux\,du \int_0^\infty f(t)\sin ut\,dt$
4	CO2	K2	Locate the function of integral transforms a) Solve partial differential equations with boundary condition b) Solve partial integral equations with boundary condition c) Solve non boundary problems d) All the above
5	CO3	K1	Identify ---- is the element of a vector space a) tensor b) scalar c) vector d) all the above
6	CO3	K2	Linear operator are also known to be a) Linear transformation b) non linear transformation c) symmetric transformation d) all the above
7	CO4	K1	Legendre equation can be expressed as a) $(1-x^2)\,d^2y/dx^2-2x\,dy/dx+n(n+1)y=0$ b) $(1-x)\,d^2y/dx^2-2x\,dy/dx+2n(n+1)y=0$ c) $(1-2x)\,d^2y/dx^2-2x\,dy/dx+4n(n+1)y=0$ d) $(1-x)\,d^2y/dx^2-2x\,dy/dx+8n(n+1)y=0$
8	CO4	K2	The general solution of Legendre equation can be expressed as a) y=APn(x) +BQn(x) b) 2y=APn(x) +BQn(x) c) y=APn(x) d) y=BQn(x)
9	CO5	K1	Hermite polynomial can be expressed as

			a) $\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2ny = 0$ b) $\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2ny = 6$ c) $\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2ny = 3$ d) $\frac{d^2y}{dx^2} - \frac{dy}{dx} + 2ny = 0$
10	CO5	K2	Bessel differential equation can be expressed as a) $X^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x2 - n2) = 0$ b) $X_2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x2 - n2) = 0$ c) $X\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x2 - n2) = 0$ d) $3X\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x2 - n2) = 0$
Section B (Short Answers) **Answer All Questions** **(5x2=10 marks)**			
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	Define Homogenous equation
12	CO2	K1	Express Laplace transform
13	CO3	K2	Define first order tensor
14	CO4	K2	Describe in short about Bessel function
15	CO5	K2	Describe in short about Legendre function
Section C (Either/Or Type) **Answer All Questions** **(5 x 5 = 25 marks)**			
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	Solve $y(xy+2x^2y^2)dx + x(xy-x^2y^2)dy=0$
16) b	CO1	K3	Find the value of λ for the differential equation $(xy^2+ \lambda x^2y\, dx + (x+y)\, x^2 dy = 0$ is exact, solve the equation for this value
17) a	CO2	K3	Find the Fourier transform of e^{-ax^2}, where a>0
17) b	CO2	K3	Find the Fourier transform of $\frac{1}{x}$
18) a	CO3	K3	Let u, v, w be linearly independent vectors. Find whether or not the following sets of vectors are linearly independent
18) b	CO3	K3	Find a proof for the following, if w_{ij} is a tensor, then its transpose also is a tensor
19) a	CO4	K3	Express the polynomial $f(x) = 4x^2-2x^2-3x+8$ in terms of Legendre Polynomials
19) b	CO4	K3	Express the polynomial $f(x) = 4x^3+6x^2+7x+2$ in terms of Legendre Polynomials
20) a	CO5	K5	Prove that $J_{-n}(x)=(-1)^nJn(x)$, Where n is a positive integer
20) b	CO5	K5	Show that (a) $J_{n+3} + J_{n+5} = 2/x\ (n+4)\ Jn+4$
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice)			

Answer Any Three questions (3x10=30 marks)			
Q.No	**CO**	**K Level**	**Questions**
21	1	K3	Find the complete solution of $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = xe^{3x} + sin\ 2x$
22	2	K3	Find Fourier cosine transform of $\frac{1}{1+x^2}$ and hence find fourier sine transform of $\frac{x}{1+x^2}$
23	3	K3	Discuss about the transformations in two dimensions
24	4	K3	Express the function f(x) = $\begin{cases} 0, -1 < x < 0 \\ x \quad 0 < x < 1 \end{cases}$ in Fourier Legendre expansion
25	5	K5	Prove that $\int xJo(x)\,dx = x2\{j2 + j1(x)\} + c$

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	**Quantum Mechanics – I**			
Course Code	**21PPHC22**	**L**	**P**	**C**
Category	Core	6	-	4

Nature of course:	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENURSHIP	

Course Objectives:

- To develop familiarity with the physical concepts and facility with the mathematical methods of quantum mechanics.
- To enable the students; learn the basic postulates of quantum mechanics.
- To cultivate the skills at formulating and solving physics problems
- To have acquired experience in using both types of methods on quantum mechanical problems.
- To apply the approximation methods for various quantum mechanical problems.

Unit: I	**GENERAL FORMALISM OF QUANTUM MECHANICS**	17 Hrs.

Linear Vector Space – Linear operator – Eigen functions and Eigen values – Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous Measurability of Observables – General Uncertainty Relation –Dirac's Notation – Equations of Motion: Schrodinger representations, Heisenberg representations and Interaction representations-momentum representation.

Unit: II	**EXACTLY SOLUBLE EIGEN VALUE PROBLEM**	19 Hrs.

One Dimensional Eigen value problem: Square-Well Potential with rigid walls- Square-Well Potential with finite walls – Square Potential Barrier-Alpha emission-Linear Harmonic oscillator: Schrodinger method-Linear Harmonic oscillator: Operator method-The free particle Three dimensional Eigen value problems: Particle moving in a spherically symmetric potential – Systems of two Interacting particles – Rigid rotator – Hydrogen atom –The Free particle – Three dimensional Square- Well potential – The Deuteron

Unit: III	**REPRESENTATIONS, TRANSFORMATIONS AND SYMMETRIES**	18 Hrs.

Heisenberg Method- Matrix representation of wave function-Matrix representation of operator-properties of matrix elements-Schrodinger equation in matrix form-Eigen value problem-Unitary transformations-linear harmonic oscillator: Matrix method-Symmetry transformation-Translation in space: conservation of linear momentum-translation in time: conservation of energy-Rotation in space: conservation of angular momentum-space inversion: pairty conservation-time reversal

Unit: IV	**APPROXIMATION METHODS FOR BOUND STATES**	17 Hrs.

Stationary (Time Independent) Perturbation Theory in Non-Degenerate Case –First-order perturbation- Degenerate Case-Stark Effect in Hydrogen atom - Variation Method – expectation value of energy-application to excited states-Ground state of Helium- -variation of the parameter Z

Unit: V	**WKB APPROXIMATION & TIME DEPENDENT PERTURBATION THEORY**	19 Hrs.

Classical limit-approximate solutions-asymptotic nature of the solutions-Time-Dependent perturbation theory: First order perturbation –Harmonic Perturbation- Transition probability-second order perturbation–Fermi's golden rule – Adiabatic approximation – choice of phases-connection with perturbation theory-discontinuous change in H-Sudden approximation.

	Total Lecture Hours	90

Books for Study:

1. G.Aruldhas, Quantum Mechanics, PHI Learning Private Limited, Second Edition, 2013

UNIT – I
Chapter 3 (Section3.1 to 3.10)

UNIT – II
Chapter 4 (Section 4.1 to 4.4 & 4.7 to 4.9)
Chapter 5 (Section 5.1 to 5.8)

UNIT-III
Chapter 6 (Section 6.1 to 6.8)
Chapter 7(Section 7.1 to 7.6)

2. L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo, 2015.

Unit-IV
Chapter 8(Section 31 & 32)

Unit-V

Chapter 8(Section 34 & 35)

Books for Reference:

1. P. M. Mathews and K. Venkatesan, 1976, A Text book of Quantum Mechanics, Tata McGraw-Hill, New Delhi.
2. V. Devanathan, 2005, Quantum Mechanics, Narosa Publishing House, New Delhi.
3. J.J. Sakurai, Modern Quantum Mechanics, Addison-Wesley, 1993
4. Kakani, Quantum Mechanics, Third Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2012.
5. B.K. Agarwal and Hari Prakash: Quantum Mechanics-Prentice-Hall of India, New Delhi, 2004.
6. Ghatak A., Introduction to Quantum Mechanics, MacMillan India Ltd., Madras, 2002

Web Resources:

1. http://bookboon.com/Introduction to Quantum Mechanics, Intermediate Quantum Mechanics, Chemistry: Quantum Mechanics and Spectroscopy I, Chemistry: Quantum Mechanics and Spectroscopy II
2. https://swayam.gov.in/courses/3485-quantum-chemistry
3. http://freevideolectures.com/Course/2876/Fundamentals-of-Physics-III/191.

Course Outcomes		**K Level**
The student will be able to		
CO1:	Have a clear understanding of the foundation of Quantum Mechanics	K1
CO2:	Express the Schrodinger equation to exactly solvable problems.	K2
CO3:	Determine the effects of symmetries in quantum mechanics	K3
CO4:	Classify the properties of operators in quantum mechanics	K4
CO5:	Deduct the various perturbation methods to solve the quantum mechanical problems.	K5

CO & PO Mapping:

Course Outcomes (CO's)	Programme Outcomes (PO's)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	1	2	1	2
CO2	2	2	3	2	2	2
CO3	1	3	2	2	2	1
CO4	2	2	2	1	2	2
CO5	1	3	2	3	3	1
Weightage	9	9	10	10	10	8

3 – Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Units	Quantum Mechanics-I	Hrs	Pedagogy
Unit-1	**GENERAL FORMALISM OF QUANTUM MECHANICS:** Linear Vector Space, Linear operator ,Eigen functions and Eigen values, Hermitian Operator ,Postulates of Quantum Mechanics	5	Chalk & Talk, Test
	Simultaneous Measurability of Observables , General Uncertainty Relation ,Dirac's Notation	6	
	Equations of Motion: Schrodinger representations, Heisenberg representations and Interaction representations, momentum representation.	6	
Unit-2	**EXACTLY SOLUBLE EIGEN VALUE PROBLEM:** One Dimensional Eigen value problem: Square Well Potential with rigid walls- Square Well Potential with finite walls	7	Chalk & Talk, PPT
	Square Potential Barrier,Alpha emission,Linear Harmonic oscillator: Schrodinger method,Linear Harmonic oscillator: Operator method,The free particle ,Three dimensional Eigen value problems: Particle moving in a spherically symmetric potential	6	
	Systems of two Interacting particles ,Rigid rotator ,Hydrogen atom,The Free particle, Three dimensional Square,Well	6	

	potential ,The Deuteron		
Unit-3	**REPRESENTATIONS, TRANSFORMATIONS AND SYMMETRIES:**Heisenberg Method,Matrix representation of wave function,Matrix representation of operator,properties of matrix elements, equation in matrix form	6	Chalk & Talk, seminar
	Eigen value problem,Unitary transformations,linear harmonic oscillator: Matrix method,Symmetry transformation,Translation in space: conservation of linear momentum	6	
	translation in time: conservation of energy,Rotation in space: conservation of angular momentum, space inversion: parity conservation,time reversal	6	
Unit-4	**APPROXIMATION METHODS FOR BOUND STATES:** Stationary (Time Independent) Perturbation Theory in Non-Degenerate Case	7	Chalk & Talk, Assignment
	First-order perturbation,Degenerate Case,Stark Effect in Hydrogen atom ,Variation Method ,expectation value of energy	5	
	application to excited states,Ground state of Helium,variation of the parameter Z.	5	
Unit-5	Classical limit, approximate solutions,asymptotic nature of the solutions,Time–Dependent perturbation theory: First order perturbation	6	Chalk & Talk , Exercise, test
	Harmonic Perturbation,Transition probability,second order perturbation,Fermi's golden rule ,Adiabatic approximation	6	
	choice of phases,connection with perturbation theory,discontinuous change in H-Sudden approximation	7	

Course Designed by: **Mrs. S. Nagadeepa & Mr. P. Dharmaraja**

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**		**Section Section C Either or Choice**	**Section Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**K2**	2	K1 & K2	1	K1	2(K2&K2)	1(K2)
	CO2	**K3**	2	K1 & K2	2	K2	2(K3&K3)	2(K2&K3)
CI AII	**CO3**	**K2**	2	K1 & K2	1	K2	2(K2&K2)	1(K2)
	CO4	**K4**	2	K1 & K2	2	K2	2(K3&K3)	2(K3&K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	K1	2	2	-	-	4	6.67	67
	K2	2	4	10	20	36	60	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	2	-	-	4	6.67	50
	K2	2	4	10	10	26	43.33	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	10	10	16.67	17
	Marks	4	6	20	30	60	100	100

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	**COs**	**K - Level**	**MOQs**		**Short Answers**		**Section C (Either / or Choice)**	**Section D (Open Choice)**
			No. of Questions	**K – Level**	**No. of Question**	**K – Level**		
1	**CO 1**	Up to K 2	2	K1K2	1	K1	2(K1&K1)	1(K2)
2	**CO 2**	K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	**CO 3**	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
4	**CO 4**	Up to K 5	2	K1&K2	1	K2	2 (K4&K4)	1(K5)
5	**CO 5**	Up to K 3	2	K1&K2	1	K2	2 (K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	6	10	-	19	15.83	42
K2	**5**	4	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	-	10	8.3	8
K5	-	-	-	10	10	8.3	8
Marks	**10**	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions** **(10x1=10 marks)**			
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	The state vector changes with time but the operator remains constant which is called _____ Picture a) Heisenberg b) Schrodinger c) Interaction d) dual
2	CO1	K2	The Eigen values of Hermitian operators are _____ a) real b) imaginary c) constant d) varying
3	CO2	K1	In λ=A+BE Where A& B are constants. This is called _____law a) Bragg law b) Newton's law c) Geiger-Nuttal law d) Bloch law
4	CO2	K2	_____ is the smallest nucleus in which a proton and a neutron are held together by the nuclear potential a) Deuteron b) Proton c) neutron d) electron
5	CO3	K1	In discrete symmetry transformation, the reflection through the origin called_____ a) parity inversion b) space operation c) space inversion c) parity operator
6	CO3	K2	The time reversal invariance of the Schrodinger equation results only if the commutator [T,H]=___ a) 0 b) ih c) 1 c) h
7	CO4	K1	The helium atom consists of two electrons and a nucleus with a (a) One proton & one neutron (b) two protons & one neutron (c) Two protons & two neutrons (d) one proton & two neutrons
8	CO4	K2	The solution of the angular part of the equation called the (a) Linear harmonics (b) an harmonics (c) Spherical harmonics (d) circular harmonics
9	CO5	K1	A relation between β and V_o is called (a) WKB method (b) variation method (c) Range depth relation (d) Rayleigh – Ritz method
10	CO5	K2	The point at which E = V(x) is called the (a) Classical turning point (b) quantum turning point (c) Barrier penetration point (d) all the above
Section B (Short Answers) **Answer All Questions** **(5x2=10 marks)**			
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	Write any two postulates of Quantum Mechanics
12	CO2	K1	What is meant by hydrogenic orbitals?
13	CO3	K2	Define the symmetry transformation

14	CO4	K2	Explain non-degenerate case in quantum mechanics?
15	CO5	K2	What is meant by harmonic perturbation?
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	What are the properties of Orthogonal functions in the formalism of quantum mechanics?
16) b	CO1	K1	Describe the theorems involving in the Hermitian operator.
17) a	CO2	K3	Determine the Eigen value of Bloch waves in periodic potential
17) b	CO2	K3	Estimate the energy value of Rigid rotator.
18) a	CO3	K3	Calculate the space inversion with parity conservation
18) b	CO3	K3	Determine the energy with translation in time.
19) a	CO4	K4	Illustrate the first order stark effect in Hydrogen.
19) b	CO4	K4	Analyze the variation method to find the energy Eigen values.
20) a	CO5	K2	Describe the time independent perturbation theory.
20) b	CO5	K2	Summarize the adiabatic approximation.
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	**CO1**	**K2**	Classify the different types of equation of motion and explain any two of them.
22	**CO2**	K3	Calculate the energy Eigen values and energy functions for Hydrogen atom.
23	**CO3**	K4	Analyze the linear harmonic oscillator by matrix method.
24	**CO4**	K5	Evaluate the ground state energy values of Helium.
25	**CO5**	K3	Compute the energy levels using WKB approximation.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	**DIGITAL ELECTRONICS**			
Course Code	**21PPHC23**	**L**	**P**	**C**
Category	Core	6	-	4

Nature of course:	EMPLOYABILITY	✓	SKILL ORIENTED	✓	ENTREPRENURSHIP	

Course Objectives:

- To familiarize the combinational logic circuits and Karnaugh map simplifications.
- To formulate data processing circuits and programmable logics.
- To understand the basic principles of arithmetic and timing circuits.
- To give an insight about fundamental concepts, techniques and applications of Digital electronic Flip-flops.
- To describe the constructions of registers and counters for our regular use.

Unit: I	**Combinational Logic Circuits**	19 Hrs

Boolean laws and theorems: Basic laws-OR and AND operations-De Morgan's and Duality theorems-Exclusive-OR and Exclusive-NOR operations-Consensus and Shanan's theorems. Sum-of-products method: Sum-of-products equation. Truth table to Karnaugh map: Three variable, four variable and Entered variable maps. Pairs, Quads and Octets- Karnaugh simplifications: overlapping groups, Rolling the map and Eliminating redundant groups. Don't care conditions. Product –of-sums method: Converting a truth table to an equations-Logic circuit-Conversion between SOP and POS. Product-of-sums simplification: Sum-of-products and Complementary circuits- NOR-NOR circuit-Duality. Five variable Karnaugh maps- Minimization of multiple output function-Quine-McClusky method.

Unit: II	**Data processing circuits**	17 Hrs

Data processing circuits: Multiplexers – de-muliplexers - 1-of-16 decoder – BCD to decimal decoders – seven segment decoders – encoders – exclusive-OR gates – parity generators and checkers – magnitude comparator – read-only memory – programmable array logic – programmable logic arrays – troubleshooting with a logic probe.

Unit: III	**Arithmetic Circuits, Clocks and Timing circuits**	17 Hrs

Binary addition-Binary subtraction-Unsigned binary numbers-Sign magnitude numbers-2's complement arithmetic-Arithmetic building blocks: Half-adder, Full-adder, Controlled Inverter-Adder-Subtracter. Clocks: Clock wave forms-TTL clocks-Schmitt trigger. Multivibrator: 555timer, astable and monostable

Unit: IV	**Flip - flop, D/A conversion and A/D conversion**	19 Hrs

RS flip-flop: Basic idea, NOR-gate latch, NAND-gate latch. Gated flip-flops: Clocked RS flip-flops, clocked D flip-flops. Edge-triggered RS flip-flops: Positive-edge-triggered RS flip-flops, negative-edge-triggered RS flip-flops. Edge-triggered D flip-flops. Edge-triggered JK flip-flops: Positive-edge-triggered JK flip-flops, negative-edge-triggered JK flip-flops. Flip-flops timing

circuits. JK master-slave flip-flops. Variable resistor networks: Binary equivalent weight, resistive divider. Binary ladder. D/A converters: Multiple signals, D/A converter testing and available D/A converters. D/A accuracy and resolution. A/D converter: Simultaneous conversion.

Unit: V	**Registers and Counters**	18 Hrs

Types of registers: Serial in-serial out, serial in-parallel out, parallel in-serial out, parallel in-parallel out. Asynchronous Counters: Ripple Counters. Decoding gates-Synchronous counters. Counter modulus-Mod-3 and mod-6 counters. Decade counters: Mod-5mod-10 counters.

	Total Lecture Hours	90

Books for Study:

1. Leach, D.P., Malvino, A.P. and Saha, G., Digital Principles and Applications, VIII Edition, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2015.
   Unit I – Chapter 3, Sec.3.1-3.11
   Unit II – Chapter 4, Sec.4.1 -4.13
   Unit III – Chapter 6, Sec.6.1-6.8
   Chapter 7, Sec.7.1-7.5
   Unit IV – Chapter 8, Sec.8.1-8.8
   Chapter 12, Sec.12.1-12.5
   Unit V – Chapter 9, Sec. 9.1-9.5
   Chapter 10, Sec.10.1-10.5

Books for References:

1. Salivahanan, S. and Arivazhagan, S.,Digital Circuits and Design, Fourth Edition, Vikas Publishing House Pvt. Ltd., New Delhi-14, 2012.
2. Jacob Millman, Christos C. Halkias and Chetan Parith,Integrated Electronics, TaTa McGraw Hill Education Pvt. Ltd., New Delhi-8, 2008.
3. Jacob Millman and Herbert Taub, Pulse,Digital and Switching Wave forms, 28th Reprint,TaTa McGraw Hill Education Pvt. Ltd., New Delhi-8, 2005.

Web Resources:

EXPECTED COURSE OUTCOME		**K Level**
CO1:	Apply Boolean algebra and the Karnaugh map as tools in designing and to simplifying digital logic circuits.	K3
CO2:	Know the fundamental concepts and techniques used in data storage elements.	K2
CO3:	Construct arithmetic circuits and Digital Clocks in an accurate manner.	K5
CO4:	Demonstrate the basic logic gates used in the formation of memory devices.	K2
CO5:	Understand the behavior of a register with additional control signals and counters implementations.	K2

CO & PO Mapping:

Course Outcomes (CO's)	Programme Outcomes (PO's)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	2	2	2
CO2	3	3	3	2	2	2
CO3	2	2	1	2	2	1
CO4	2	2	2	2	2	2
CO5	1	3	2	3	2	3
Weightage	10	11	9	11	10	10

3 – Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Units	21PPHC23- Digital Electronics	Hrs.	Mode
Unit-1 Combinational Logic Circuits	Boolean laws and theorems: Basic laws, OR and AND operations, De Morgan's and Duality theorems,Exclusive-OR and Exclusive-NOR operations-Consensus and Shanan's theorems	5	Chalk &Talk, PPT
	Sum-of-products method: Sum-of-products equation. Truth table to Karnaugh map: Three variable, four variable and Entered variable maps. Pairs, Quads and Octets- Karnaugh simplifications: overlapping groups, Rolling the map and Eliminating redundant groups.	5	
	Don't care conditions. Product –of-sums method: Converting a truth table to an equations-Logic circuit-Conversion between SOP and POS.	4	
	Product-of-sums simplification: Sum-of-products and Complementary circuits- NOR-NOR circuit-Duality. Five variable Karnaugh maps- Minimization of multiple output function-Quine-McClusky method.	5	
Unit-2 Data processing circuits	Data processing circuits: Multiplexers – de-muliplexers - 1-of-16 decoder – BCD to decimal decoders – seven segment decoders.	5	Chalk &Talk, PPT
	encoders – exclusive-OR gates – parity generators and checkers – magnitude comparator.	6	
	Read-only memory – programmable array logic – programmable logic arrays – troubleshooting with a logic probe.	6	
Unit-3 Arithmetic Circuits, Clocks and Timing	Binary addition-Binary subtraction-Unsigned binary numbers-Sign magnitude numbers-2's complement arithmetic.	5	Chalk &Talk, Assignment
	Arithmetic building blocks: Half-adder, Full-adder,	6	

circuits	Controlled Inverter-Adder-Subtracter. Clocks: Clock wave forms-TTL clocks.		
	Schmitt trigger. Multivibrator: 555timer – astable and monostable.	6	
Unit-4 Flip - flop, D/A conversion and A/D conversion	RS flip-flop: Basic idea, NOR-gate latch, NAND-gate latch. Gated flip-flops: Clocked RS flip-flops, clocked D flip-flops. Edge-triggered RS flip-flops: Positive-edge-triggered RS flip-flops, negative-edge-triggered RS flip-flops. Edge-triggered D flip-flops.	5	Chalk &Talk, PPT, Class Test
	Edge-triggered JK flip-flops: Positive-edge-triggered JK flip-flops, negative-edge-triggered JK flip-flops. Flip-flops timing circuits. JK master-slave flip-flops.	5	
	Variable resistor networks: Binary equivalent weight, resistive divider. Binary ladder.	4	
	D/A converters: Multiple signals, D/A converter testing and available D/A converters. D/A accuracy and resolution. A/D converter: Simultaneous conversion.	5	
Unit-5 Registers and Counters	Types of registers: Serial in-serial out, serial in-parallel out, parallel in-serial out, parallel in-parallel out.	6	Chalk &Talk, PPT
	Asynchronous Counters: Ripple Counters. Decoding gates-Synchronous counters.	6	
	Counter modulus-Mod-3 and mod-6 counters. Decade counters: Mod-5mod-10 counters.	6	

Course Designed by: **Dr. M. Alagar & Dr. D. Ruby Josephine**

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**		**Section Section C Either or Choice**	**Section Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**K2**	2	K1 & K2	1	K1	2(K2&K2)	1(K2)
	CO2	**K3**	2	K1 & K2	2	K2	2(K3&K3)	2(K2&K3)
CI AII	**CO3**	**K2**	2	K1 & K2	1	K2	2(K2&K2)	1(K2)
	CO4	**K4**	2	K1 & K2	2	K2	2(K3&K3)	2(K3&K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**67**
	K2	**2**	**4**	**10**	**20**	**36**	**60**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	**17**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	**COs**	**K - Level**	**MOQs**		**Short Answers**		**Section C (Either / or Choice)**	**Section D (Open Choice)**
			No. of Questions	**K – Level**	**No. of Question**	**K – Level**		
1	**CO 1**	**Up to K 2**	**2**	**K1K2**	**1**	**K1**	**2 (K1&K1)**	**1(K2)**
2	**CO 2**	K 3	**2**	**K1&K2**	**1**	**K1**	**2 (K3&K3)**	**1(K3)**
3	**CO 3**	Up to K 4	**2**	**K1&K2**	**1**	**K2**	**2 (K3&K3)**	**1(K4)**
4	**CO 4**	Up to K 5	**2**	**K1&K2**	**1**	**K2**	**2 (K4&K4)**	**1(K5)**
5	**CO 5**	Up to K 3	**2**	**K1&K2**	**1**	**K2**	**2 (K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No.of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	**5**	**6**	**10**	**-**	**19**	**15.83**	**42**
K2	**5**	4	10	10	31	25.83	
K3	**-**	-	20	30	50	41.67	42
K4	-	-	10	-	10	8.3	8
K5	-	-	-	10	10	8.3	8
Marks	**10**	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions** **(10x1=10 marks)**			
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	Any two minterms in adjacent squares that are --------- together will cause a removal of the different variable. a) NOTed b) ANDed c) ORed d) NORed
2	CO1	K2	Eight adjacent squares represent a term of -------- literal. a) one b) two c) three d) four
3	CO2	K1	A combinational circuit that performs the addition of two bits is called a a) half-adder b) full-adder c) half-subtractor d) full-subtractor
4	CO2	K2	The bubbled Or gate is equivalent to the --------gate. a) AND b) OR c) NAND d) NOR
5	CO3	K1	A BCD adder is a circuit that adds two BCD digits in parallel and produces a sum digit also in ---------- a) MSI b) BCD c) LSI d) Decimal
6	CO3	K2	The ------ is a combinational circuit with AND gates connected as a decoder and a number of OR gates equal to the number output in the unit a) RAM b) CPU c) ROM d) EAROM
7	CO4	K1	A Flip-flop has ---- inputs a) 4 b) 2 c) 5 d) 1
8	CO4	K2	The memory elements used in clocked sequential circuits are called ---- a) counter b) register

			c) relay d) flip flop
9	CO5	K1	A group of flip flops sensitive to pulse duration is called a ------ a) dynamics b) memory entangle c) latch d) array
10	CO5	K2	A group of flip flops sensitive to pulse transition is called as ------ a) shifting b) register c) transfer d) memory

Section B (Short Answers)

Answer All Questions (5x2=10 marks)

Q.No	CO	K Level	Questions
11	CO1	K1	Define two variable map in the simplification of boolean functions
12	CO2	K1	Draw the three graphic symbol of invertor gate
13	CO3	K2	Describe half Adder with exclusive OR gate
14	CO4	K2	Why is NAND gate called as a universal gate
15	CO5	K2	What are BCD numbers, why is it called so?

Section C (Either/Or Type)

Answer All Questions (5 x 5 = 25 marks)

Q.No	CO	K Level	Questions
16) a	1	K3	Obtain the simplified expression in sum of products for the given Boolean function: a'b'+bc+a'bc'
16) b	1	K3	Narrate the NAND implementation procedure in the digital circuits.
17) a	2	K4	Give the construction details of full-adder and also present the map and logic circuits for it.
17) b	2	K4	How is the multilevel NOR circuits used as universal gate? Explain with an example.
18) a	3	K3	Show the designing procedure of a BCD-to-excess-3 code converter in brief.
18) b	3	K3	Discuss about the details of decoder in detail.
19) a	4	K3	Provide a detailed note on flip flop excitation table.
19) b	4	K3	Write about state equation in elaborate.
20) a	5	K5	Discuss a complete note on Shift registers.
20) b	5	K5	Give a detailed account on BCD counter.

NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels

Section D (Open Choice)

Answer Any Three questions (3x10=30 marks)

Q.No	CO	K Level	Questions
21	**CO1**	**K3**	Discuss the product of sums simplifications with the following function: F(A,B,C,D)=Π(0,1,2,5,8,9,10)
22	**CO2**	**K3**	Explain the exclusive OR function and equivalence function for the map with four variable.
23	**CO3**	**K5**	Narrate the function of magnitude comparator with 4 bit formations.
24	**CO4**	**K3**	Provide a detailed note on JK flip flop with logic diagram, graphical symbol, characteristic table and equation.
25	**CO5**	**K3**	Discuss about the working of Binary counter and binary up down counter.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	**PRACTICAL – II (Electronics – I)**			
Course Code	**21PPHCP2**	**L**	**P**	**C**
Category	Core	-	6	4

Nature of course:	EMPLOYABILITY		✓	SKILL ORIENTED	✓	ENTREPRENURSHIP	

Course Objectives:

- To acquire knowledge of semiconductor devices and their applications.
- To understand the concepts of OPAMPS and their uses.
- To study oscillator and amplifier circuits.
- To develop the skills in handling instruments and measuring devices.
- To prepare the students for the real life with electronic instruments.

ANY TWELVE EXPERIMENTS

1. FET amplifier
2. UJT characteristics
3. Single Stage Amplifier - Frequency response and bandwidth determination
4. IC Regulated Power Supply [Single (5V) and Dual (12-0-12V)]
5. Phase shift oscillator
6. Wien bridge oscillator
7. Saw tooth Wave generator
8. Emitter follower
9. UJT – Relaxation oscillator
10. Wave shaping circuits – Clipping and Clamping
11. Passive RC filter circuits – Low, High and Band pass filters – using OP AMP
12. Astable Multivibrators – using OP AMP
13. Bistable Multivibrators – using IC 555
14. Multiplexer and Demultiplexer circuits.
15. Characteristics of LED and Photo diode

COURSE OUTCOME		**K Level**
At the end of the programme, the student will be able to		
CO1:	Demonstrate UJT behavior in the detailed form with the electronic circuits.	K3
CO2:	Summarize different structural oscillators with their wave forms.	K2
CO3:	Develop the knowledge to construct various multivibrators and their uses.	K3
CO4:	Analyze the circuit performances with theoretical formulae.	K4
CO5:	Use the importance of applications of electronics in real life situations.	K5

CO & PO Mapping:

Course Outcomes (CO's)	Programme Outcomes (PO's)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	2	2	2
CO2	3	2	3	2	2	2
CO3	2	1	1	2	2	1
CO4	2	2	2	2	2	2
CO5	2	3	2	3	1	3
Weightage	11	9	9	11	9	10

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

Course Designed by: **Dr. M. Alagar**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF PG PHYSICS
(For those who joined in 2021-2022 and after)

Course Name	NME-Nanotechnology							
Course Code	21PPHN21					**L**	**P**	**C**
Category	NME					6	-	6
Nature of course:	EMPLOYBILITY	✓	SKILL ORIENTED		ENTREPRENURSHIP			

Course Objectives:

- To describe the detailed aspects of nanomaterials of various dimension
- To explain different techniques and application of nanomaterials
- To list different measurement tools used in the analyze of nanomaterials
- To elaborate the extended application of nanomaterials
- To understand the influence of applications in nanomaterials

Unit: I	**Fundamentals of nanotechnology and timeline**	18 Hrs.

Nanotechnology timeline: Pre 18th century -19th century and 20th century- 21st century. Core concepts of nanotechnology: nanotech generation- nanoscale – nanoscience -material science - new forms of carbon – nanocomposites - polymer nanocomposites - nanomaterials, properties of nanomaterials - one dimensional and two dimensional nanomaterials - nanomaterials in three dimension.

Unit: II	**Synthesis and Application**	18 Hrs.

Two types of construction – spintronics, molecular nanotechnology - nano structures material by self assembly - nanophotonics- electronics and optoelectronics - plastic electronics molecular electronics - biomedical science - nanodevice can do in medical field, nanopores - charge coupled devices – photometry - giant magneto resistance.

Unit: III	**Measurement tools**	18 hrs.

Tools and fabrication - tools and techniques microscopy, metrology, carbon nanotube fabrication – purification of CNTs – Dispersion – scanning probe microscopy – atomic force microscopy – scanning tunneling microscope - challenges for STM – how the challenges are solved - uses and capabilities of STM – near field scanning optical microscopy- electrical surface modification

Unit: IV	**Applications of Nanotechnology**	18 hrs.

Potential applications- types of applications- Nanotechnology addresses the challenges – new energy producers I and II – new applications - Nanotechnology for energy – portable power and solar – Nanotechnology for hydrogen energy- medicine : prevention, implants, artificial skin, nanocapsules, monitoring and treatment. Security – other applications

Unit: V	**Applications of Nanotechnology in nanoelectronics**	18 hrs.

Plastic Electronics - processes for nano Electronics, - nanocircuitry -nanoelectronic devices - nano electronic applications - Ambient intelligence – cleaner - safer and more comfortable transport - organic semiconductor materials for opto and microelectronic devices – nanoswitches based on crystalline conductive polymer nano needles – complementary metal oxide semiconductor – 45 nanometer - system on a chip.

	Total Lecture Hours	90

Books for Study:

1. Er. Rakesh Rathi, Nanotechnology, technology revolution of 21st century, Vikas Publishing House Pvt. Ltd, Ghaziabad –201010, Reprint 2019

Unit 1 - chapter 2, 3
Unit 2 - chapter 3
Unit 3 - chapter 4
Unit 4 - chapter 5
Unit 5 – chapter 7

Books for References:

1. Richard Boker and Earl Baysen, Nano technology, I st Edition, Wiley Dreamtech India (p) Ltd., Bangaluru, 2005.
2. C. Binns, Introduction to Nanoscience and Nanotechnology, Vol. 14, John Wiley and sons, 2010
3. N. Alian, An Introduction to Nanoscience and Nanotechnology, First Edition, Wiley India Pvt. Ltd., New Delhi, 2015.

Web Resources:

1.https://nptel.ac.in/courses/104/106/10410612
2.https://storage.googleapis.com/uniquecourses/course.html
3.https://epgp.inflibnet.ac.in/

Course Outcomes		**K Level**
At the end of the program, the student will be able to		
CO1:	Develop a detailed knowledge about the origin of nanomaterials and its timeline	K3
CO2:	Identify different synthesis techniques and learn about the applications of nanomaterials	K3
CO3:	Develop knowledge about analyzing tools of nanomaterials	K3
CO4:	Analyze various applications of nanomaterials in nanotechnology	K4
CO5:	Use the importance of learnt application of nanomaterials extensively in nanoelectronics	K5

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	3	2	2	2	2
CO 2	2	2	2	2	2	2
CO 3	2	1	2	2	2	2
CO 4	2	2	2	2	2	2
CO 5	2	3	2	1	2	2
Weightage	10	10	10	9	10	10

3 – Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**Fundamentals of nanotechnology and timeline** Nanotechnology timeline: Pre 18th century, 19th century and 20th century, 21st century.	6	Chalk & Talk, PPT
	Core concepts of nanotechnology: nanotech generation, nanoscale, nanoscience, material science, new forms of carbon, nanocomposites, polymer nanocomposites, nanomaterials, properties of nanomaterials,	6	
	one dimensional and two dimensional nanomaterials, nanomaterials in three dimension.	6	
II	**Synthesis and Application** Two types of construction, spintronics, molecular nanotechnology, nano structures material by self assembly, nanophotonics	6	Chalk, Talk& Assignment
	electronics and optoelectronics, plastic electronics molecular electronics , biomedical science, nanodevice can do in medical field,	6	
	nanopores, charge coupled devices, photometry, giant magnetoresistance	6	
III	**Measurement tools** Tools and fabrication, tools and techniques microscopy, metrology, carbon nanotube fabrication	6	Chalk, Talk& class test
	purification of CNTs, Dispersion , scanning probe microscopy, atomic force microscopy	6	
	scanning tunneling microscope, challenges for STM, how the challenges are solved, uses and capabilities of STM, near field scanning optical microscopy, electrical surface modification	6	
IV	**Applications of Nanotechnology** Potential applications, types of applications, Nanotechnology addresses the challenges, new energy producers I and II, new applications	6	Chalk & Talk, PPT
	Nanotechnology for energy, portable power and solar, Nanotechnology for hydrogen energy	6	
	medicine: prevention, implants, artificial skin, nanocapsules, monitoring and treatment, Security, other applications	6	
V	**Applications of Nanotechnology in nanoelectronics** Plastic Electronics, processes for nano Electronics, nanocircuitry, nanoelectronic devices, nano electronic applications,	6	Chalk, Talk& Seminar
	Ambient intelligence, cleaner, safer and more comfortable transport, organic semiconductor materials for opto and microelectronic devices	6	

	nanoswitches based on crystalline conductive polymer nano needles – complementary metal oxide semiconductor – 45 nanometer - system on a chip.	6	

Course Designed by: **Dr. D. Ruby Josephine & Dr. P.P. Kannan**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	K2	2	K1&K2	1	K1	2 (K2&K2)	1(K2)
	CO2	K3	2	K1&K2	2	K2	2 (K3&K3)	2(K2&K3)
CI AII	CO3	K2	2	K1&K2	1	K2	2 (K2&K2)	1(K2)
	CO4	K4	2	K1&K2	2	K2	2 (K3&K3)	2(K3&K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II

	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	6.67	67
	K2	2	4	10	20	36	60	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	2	-	-	4	6.67	50
	K2	2	4	10	10	26	43.33	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	10	10	16.67	17
	Marks	4	6	20	30	60	100	100

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MOQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
2	CO2	Up to K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K4&K4)	1(K4)
5	CO5	Up to K 5	2	K1&K2	1	K2	2 (K3&K3)	1(K5)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	16.67
K2	5	6	-	-	11	9.16	
K3	-	-	40	30	70	58.3	83.23
K4	-	-	10	10	20	16.6	
K5	-	-	-	10	10	8.33	
Marks	10	10	50	50	120		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

Section A (Multiple Choice Questions) Answer All Questions (10x1=10 marks)			
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	1. Identity the size of – silver and gold nanoparticles exhibiting unusual optical effects a) 80 nm b) 70 nm c) 30 nm d) 25 nm
2	CO1	K2	Locate ---- property of metal nanoparticles produces colour variations a) size b) shape c) colour d) surface
3	CO2	K1	Identify that the ferromagnetic and non ferrro magnetic layers in GMR are of —thickness a) macroscale b) microscale c) nanoscale d) bulk scale
4	CO2	K2	Magnetic nuclei are also referred to as --- a) magnetic spin b) colloidal spin c) electron spin d) electron affinity
5	CO3	K1	AFM is identified as a) atomic force microscopy b) added force microscopy c) acquired force microscopy d) additional force microscopy
6	CO3	K2	NSOM is located as a) near field scanning optical microscopy b) net field scanning optical microscopy c) narrow field scanning optical microscopy d) noted field scanning optical microscopy
7	CO4	K1	A self assembling nanoscale polymer carries ------ across the blood brain carrier a) anti cancer drug b) virus c) bacteria d) all the above
8	CO4	K2	LED is identified as a) Light Emitting diode b) low emissive diode c) lateral emissive diode d) longitudinal emission diode
9	CO5	K1	Nanocircuits are electrical circuits are on the scale identified as a) nano b) micro c) pico c) femto
10	CO5	K2	OTFT is identified as a) organic thin film transistors b) ordinary thin film transistor c) only thin film transistor d) open thin film transistor
Section B (Short Answers) **Answer All Questions (5x2=10 marks)**			
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	Define in short about C60
12	CO2	K1	Draw the schematic of multilayered magnetoresistive structure
13	CO3	K2	Describe electrical surface modification
14	CO4	K2	Describe about fuel cell short sentence

15	CO5	K2	Describe CMOS?
Section C (Either/Or Type) **Answer All Questions (5 x 5 = 25 marks)**			
Q.No	**CO**	**K Level**	**Questions**
16) a	CO 1	K3	Prepare a detailed note on Single electron tunneling transistor
16) b	CO1	K3	Collectively write about Quantum dots
17) a	CO2	K3	Prepare an elaborate note on nanophotonics in detail
17) b	CO2	K3	Develop a detailed description on Giant magnetoresistance
18) a	CO3	K3	Built details pertaining to tools and techniques that are used to measure and make nanostructures
18) b	CO3	K3	Prepare a detailed description about laser method
19) a	CO4	K4	Comment on artificial skin
19) b	CO4	K4	Comment on solar energy harvesting in nanotechnology in elaborate
20) a	CO5	K3	Identify and provide a detailed note on nanoelectronic devices
20) b	CO5	K3	Prepare a detailed note on nanoswitches
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions (3x10=30 marks)**			
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K3	Describe about the impact of Nanotechnology in human lives in 21st century comprising any 5 significant achievements
22	CO2	K3	Develop details about scanning tunneling microscope and the challenges in STM
23	CO3	K3	Collectively write about top down and bottom up approaches
24	CO4	K4	Comment on the importance of the prevention and implant techniques in medical nanotechnology
25	CO5	K5	Provide the importance of phase change memory, metal insulator metal technology, flexible substrate, photonic crystal and functional substrate packing technology