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.

Subjects of Study

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

1. Core Subjects
2. Electives
3. Non Major Electives (NME)

Pattern of the questions paper for the Continuous Internal Assessment

Note: Duration – 1 hour 30 minutes

The components for continuous internal assessment are:

Part –A

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

Part –B

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

The scheme of Examinations:

The components for continuous internal assessment are:

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

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

Total	25 Marks

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.

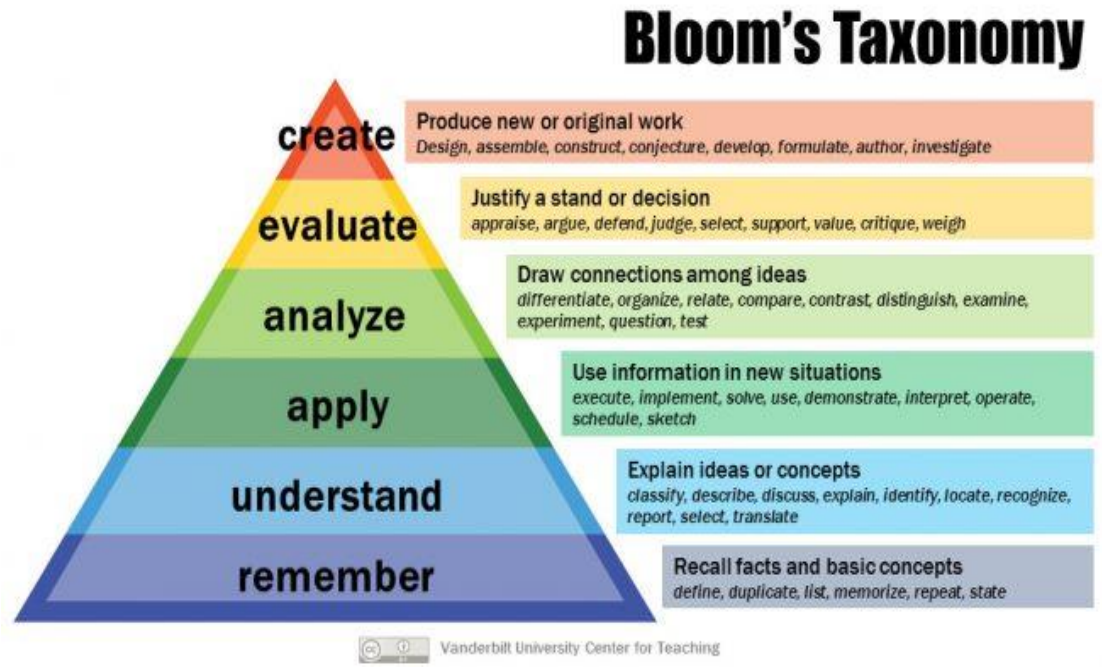
9. (Impacts) Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of 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.

PO NO	PROGRAMME OUTCOMES (POs)	
At the end of the programme, the students will be able to		
PO – 1	Demonstrate the knowledge and understanding of Science concepts and its relevant fields.	**Disciplinary Knowledge**
PO – 2	Identify, formulate, analyse complex problems and reach valid conclusions using the methodologies of Science.	**Problem Solving**
PO – 3	Employ critical and analytical thinking in understanding the concepts and apply them in various problems appearing in different branches of Science.	**Analytical Reasoning & Critical Thinking**
PO - 4	Communicate the known concepts effectively within the profession and with any forum	**Communication Skills**
PO - 5	Function successfully as a member/leader in any team and to apply ethics, accountability and equity in their life.	**Team Work and Moral/Ethical Awareness**
PO - 6	Use ICT tools in various learning situations, related information sources, suitable software to analyze data and furthermore participating in learning activities throughout life to meet the demands of work place through knowledge /up-skilling / re-skilling	**Digital Literacy & Life-long Learning**

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	General Physics Practical	3	-	-	-	-
6	21PPHCP2	Electronics Practical	3	-	-	-	-
		TOTAL	**30**	**16**	**100**	**300**	**400**
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	21PPHCP1	General Physics Practical	3	4	40	60	100
5	21PPHCP2	Electronics Practical	3	4	40	60	100
6	21PPHN21	Nanotechnology	6	6	25	75	100
		TOTAL	**30**	**26**	**180**	**420**	**600**

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					
	21PPHE33	Physics of Human body					
5		**Elective-II**					
	21PPHE34	Microprocessor and Microcontroller	6	6	25	75	100
	21PPHE35	Analytical Instrumentation					
	21PPHE36	Crystal Growth Methods & Characterization					
		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					
	21PPHE43	Advanced Optics					
5		**Elective-IV**					
	21PPHE44	Atomic and Molecular Spectroscopy	6	6	25	75	100
	21PPHE45	Bio-medical Instrumentation					
	21PPHE46	Computer Oriented Numerical methods					
		Total	**30**	**24**	**140**	**360**	**500**
		Grand Total	**120**	**90**	**560**	**1440**	**2000**


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:	EMPLOYABILITY	**SKILL ORIENTED** ✓	ENTREPRENEURSHIP		

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&
	Stokes theorem, another method of proving Stokes theorem	**7**	
	Gauss's theorem of divergence, deductions from gauss divergence	**7**	

	theorem, Helmholtz theorem.		Exercise
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 MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			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)	1 (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)	1 (K4)
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

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 %
CI A I	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CI A II	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

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

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No.	COs	K - Level	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 $\varphi \; such \; that \; \vec{F} = \delta\varphi$
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 $\int (2x - y)dx -$ $yz^2 dy - y^2 dz$ 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 $\int (x + y)\, dx + x^2 y\, dy$ (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)=$\frac{z^2}{(z-1)^2(z+2)}$ $and\ hence\ evaluate\ \int_c \frac{z^2\, dz}{(z-1)^2(z+2)}\ where\ c: \lvert z\rvert = 3$
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.	CO	K	Questions

No		Level	
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|=√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	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP		

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 transformation, Frequencies of free vibration and normal coordinates, Free vibrations of a linear	5	

	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 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	**K4**	2	K1&K2	2	K2	2(K3&K3)	1 (K4)
CI AII	**CO3**	**K2**	2	K1&K2	1	K2	2(K2&K2)	1(K2)
	CO4	**K4**	2	K1&K2	2	K2	2(K3&K3)	1 (K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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 %**
CI A I	**K1**	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100
CI A II	**K1**	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	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:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP

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 mathematical logics	K1
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, PPT
	Double side band with carrier- Single side band modulation	6	
	Angle modulation Tone modulated FM signal- Arbitrary modulated FM signal	7	
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** **MCQs**		**Section B** **Short Answers**		**Section C Either or Choice**	**Section D 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)	1(K4)
CI AII	**CO3**	**K2**	2	K1	1	K2	2 (K2&K2)	1(K2)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

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 %**
CI A I	**K1**	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100
CI A II	**K1**	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

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

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	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:	EMPLOYABILITY	**SKILL ORIENTED** ✓	ENTREPRENEURSHIP		

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 law in electrodynamics.	**6**	
	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**		**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	1	K1	2(K2&K2)	1(K2)
	CO2	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
CI AII	**CO3**	**K2**	2	K1	1	K2	2 (K2&K2)	1(K2)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

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 %**
CI A I	**K1**	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100
CI A II	**K1**	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

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

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	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	33
K4	-	-	-	20	10	8.33	8
K5	-	-	-	-	10	8.33	5
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	**GENERAL PHYSICS PRACTICAL**					
Course Code	**21PPHCP1**			**L**	**P**	**C**
Category	**Core**			-	3	-
Nature of the Course	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP		

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**

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

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

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

Course Name	**ELECTRONICS PRACTICAL**			
Course Code	**21PPHCP2**	**L**	**P**	**C**
Category	**Core**	-	3	-

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP

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**


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:	EMPLOYABILITY	**SKILLORIENTED**	✓	ENTREPRENEURSHIP

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& Exercise
	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	

	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)	1 (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)	1 (K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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 %**
CI A I	**K1**	2	2	-	-	4	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	20	40	80	
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CI A II	**K1**	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	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 K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
5	CO5	Up to K5	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	67
K4	-	-	-	-	-		-
K5	-	-	10	10	20	16.6	17
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	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 $(xy^2+ \lambda x^2y\, dx + (x+y)\, x^2dy = 0$ 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 $\int \text{xJo(x) dx} = x2\{j2 + j1(x)\} + c$

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**	✓	ENTREPRENEURSHIP

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 potential ,The Deuteron	6	
Unit-3	**REPRESENTATIONS, TRANSFORMATIONS AND**	6	Chalk &

	SYMMETRIES: Heisenberg Method,Matrix representation of wave function,Matrix representation of operator,properties of matrix elements, equation in matrix form		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** **MCQs**		**Section B** **Short Answers**		**Section C Either or Choice**	**Section D Open Choice**
			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)	1 (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)	1 (K4)
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

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	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	**K1**	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

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

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	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	K1&K2	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**	✓	ENTREPRENEURSHIP

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.

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 circuits	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, Controlled Inverter-Adder-Subtracter. Clocks: Clock wave forms-TTL clocks.	6	
	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	Types of registers: Serial in-serial out, serial in-parallel	6	Chalk

Registers and Counters	out, parallel in-serial out, parallel in-parallel out.		&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 MCQs No. of. Questions	Section A MCQs K - Level	Section B Short Answers No. of. Questions	Section B Short Answers K - Level	Section C Either or Choice	Section D Open Choice
CI AI	CO1	K2	2	K1&K2	1	K1	2(K2&K2)	1 (K2)
	CO2	K3	2	K1&K2	2	K2	2(K3&K3)	1 (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)	1 (K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	**K1**	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	**COs**	**K - Level**	**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	K1&K2	1	K1	2(K1&K1)	1(K2)
2	**CO 2**	**Up to 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: $F(A,B,C,D)=\Pi(0,1,2,5,8,9,10)$
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	**GENERAL PHYSICS PRACTICAL**				
Course Code	**21PPHCP1**		**L**	**P**	**C**
Category	**Core**		-	3	4
Nature of the Course	EMPLOYABILITY	**SKILL ORIENTED** ✓	ENTREPRENEURSHIP		

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**

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

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

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

Course Name	**ELECTRONICS PRACTICAL**			
Course Code	**21PPHCP2**	**L**	**P**	**C**
Category	**Core**	-	3	4

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP

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	**NANOTECHNOLOGY**				
Course Code	**21PPHN21**		**L**	**P**	**C**
Category	**NME**		6	-	6
Nature of course:	**EMPLOYABILITY**	✓ SKILL ORIENTED	ENTREPRENEURSHIP		

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


THIRD SEMESTER

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

Course Name	**SOLID STATE PHYSICS – I**				
Course Code	**21PPHC31**			**L**	**P**	**C**
Category	**Core**			6	-	4
Nature of course:	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP		

COURSE OBJECTIVES:

- To describe different types of crystal structures in terms of the crystal lattice and the basis of constituent atoms.
- To relate the crystal binding and elastic constants.
- To get the knowledge of vibrations of molecules and Fermi gas.
- To elaborate energy band and thermal properties of solids.
- To understand the classification of solids based on their band gap energies.
- To know about the use of band gap in semiconductors.

Unit: I	**Crystal Structure, Wave Diffraction and Reciprocal Lattice**	18 Hrs.

Crystal Structure: Periodic arrays of atoms - Lattice translation vectors - Basis and the crystal structure - Primitive lattice cell - Fundamental types of lattices - Two and three dimensional lattice types - Index system for crystal planes - Simple crystal structures - Sodium Chloride, Cesium Chloride, Hexagonal Close-Packed (hcp), Diamond and cubic Zinc Sulfide structures. Wave diffraction and the Reciprocal Lattice: Diffraction of waves by crystals - The Bragg law - Scattered wave amplitude - Fourier analysis - Reciprocal lattice vectors - Diffraction conditions - Laue equations - Brillouin zones - Reciprocal lattice to *sc*, *bcc* and *fcc* lattices - Fourier analysis of the basis - Structure factor of *bcc* and *fcc* lattices - Atomic form factor.

Unit: II	**Crystal Binding and Elastic Constants**	19 Hrs.

Crystals of inert gases - Van der Waals-London interaction - Repulsive interaction- Equilibrium lattice constants - Cohesive energy - Ionic crystals - Electrostatic or Madelung energy - Evaluation of the Madelung constant - Covalent crystals - Metals - Hydrogen bonds - Analysis of elastic strains - Dilation - Stress components - Elastic compliance and stiffness constants - Elastic energy density - Elastic stiffness constants of cubic crystals - Bulk modulus and compressibility - Elastic waves in cubic crystals – Waves in the *[100]* direction - Waves in the *[110]* direction.

Unit: III	**Crystal Vibrations and Thermal Properties**	16 Hrs.

Crystal Vibrations: Vibrations of crystals with monatomic basis - First Brillouin zone - Group velocity - Derivation of force constants from experiment - Two atoms per primitive basis - Quantization of elastic waves - Phonon momentum - Inelastic scattering by phonons. Thermal Properties: Phonon heat capacity - Density of states in one dimension - Density of states in three dimensions - Debye model for density of states - Debye T^3 law - Einstein model of the density of states - Anharmonic crystal interactions - Thermal expansion - Thermal conductivity - Thermal resistivity of phonon gas - Umklapp processes.

Unit: IV	**Free Electron Fermi Gas and Energy Bands**	18 Hrs.

Free Electron Fermi Gas: Energy levels in one dimension - Effect of temperature on the Fermi-Dirac distribution - Free electron gas in three dimensions - Heat capacity of the electron gas - Experimental heat capacity of metals - Electrical conductivity and Ohm's law - Experimental electrical resistivity of metals - Motion in magnetic fields - Hall Effect - Thermal conductivity

of metals - Ratio of thermal to electrical conductivity. Energy Bands: Nearly free electron model - Origin of the energy gap - Magnitude of the energy gap - Bloch Functions - Kronig-Penney Model - Wave equation of electron in a periodic potential - Restatement of the Bloch theorem - Crystal momentum of an electron - Solution of the central equation.		
Unit: V	**Semiconductor Crystals and Fermi Surfaces**	19 Hrs.
Semiconductor Crystals: Band gap - Equations of motion - Physical derivation of $\hbar\dot{k}$ = F - Holes - Effective mass - Physical interpretation of the effective mass - Intrinsic carrier concentration - Intrinsic mobility - Impurity conductivity - Donor states - Acceptor states - Thermal ionization of donors and acceptors. Fermi Surface and Metals: Reduced zone scheme - Periodic zone scheme - Construction of Fermi surfaces - Nearly free electrons - Electron orbits, Hole orbits and Open orbits - Calculation of energy bands - Tight Binding Method for energy bands - Wigner-Seitz Method - Cohesive energy - Experimental methods in Fermi surface studies - Quantization of orbits in a magnetic field - De Haas-van Alphen effect - Extremal orbits - Fermi surface of copper.		
	Total Lecture Hours	90

Books for Study:

C. Kittel, Introduction to Solid State Physics, 8th Edition, Wiley India Pvt. Ltd., New Delhi - 110 002. (2005) Reprint 2019.

Unit - I: Chapters 1 and 2
Unit - II: Chapter 3
Unit - III: Chapters 4 and 5
Unit - IV: Chapters 6 and 7
Unit - V: Chapters 8 and 9

Books for References:

1. S.L. Kakani and C. Hemarajani, Solid State Physics, Sultan Chand & Sons Educational Publishers, New Delhi - 2, Fourth Edition, 2005.
2. Neil W. Aschroft and N. David. Mermin, Solid State Physics, Cengage Learning Publishers, New Delhi, Fourteenth Indian reprint, 2014.
3. M.A. Wahab, Solid State Physics, Narosa Publishing House, Chennai, Third Edition, 2015, Sixth Reprint 2017.
4. M. Ali Omar, Elementary Solid State Physics - Principles and Applications, Addison Wesley, New Delhi, 2000.
5. A.O.E. Animalu, Intermediate Quantum Theory of the Crystalline Solid, Prentice Hall, New Delhi, 1977.
6. S.O. Pillai, Solid State Physics, New Age International Publishers, New Delhi, 1997.

Web Resources:

https://www.mooc-list.com/course/solid-state-devices-1-edx
https://nptel.ac.in/courses/115/105/115105099/
https://www.classcentral.com/course/swayam-solid-state-physics-14298

COURSE OUTCOME		**K Level**
On Completion of this course, the student will be able to		
CO1	Illustrate the theory of lattice vibrations (phonons) and use that to determine thermal properties of solids.	K4
CO2	Classify the different physical mechanisms involved in crystal binding	K4
CO3	Identify the vibrations of crystals and free electron gas	K3
CO4	Distinguish the physical properties of solids in terms of its band-structure with the understanding of thermal properties of solids.	K4
CO5	Justify the concepts of band gap in semiconductors and Fermi surface construction.	K5

CO & PO Mapping:

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

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

LESSON PLAN

Units	SOLID STATE PHYSICS-I	Hrs.	Mode
Unit - I Crystal structure, wave diffraction and reciprocal lattice	Periodic arrays of atoms, lattice translation vectors, Basis and crystal structure, primitive lattice cell, Fundamental types of lattices: Two and three dimensional lattice types.	5	Chalk &Talk, PPT, Seminar
	Index system for crystal planes: Miller indices of crystal planes. Simple crystal structures: Sodium chloride, Cesium chloride, Hexagonal close packed structure.	4	
	Diamond structure, Cubic zinc sulphide structure. Wave diffraction and the reciprocal Lattice: Diffraction of waves by crystals, Bragg's law. Scattered wave amplitude: Fourier analysis, Reciprocal lattice vectors.	4	
	Diffraction conditions, Laue equations, Brillouin Zones, Reciprocal lattice to sc, bcc and fcc lattices, Fourier analysis of the basis, structure factors of bcc and fcc lattices, Atomic form factor.	5	
Unit - II Crystal binding and elastic constants	Crystals of inert gases, Van der waals-London interaction, Repulsive interaction, Equilibrium lattice constants, Cohesive energy.	5	Chalk &Talk, PPT
	Ionic crystals: Electrostatic or Madelung energy, Evaluation of Madelung constant, Covalent crystals, metallic crystals, hydrogen bonds.	5	
	Analysis of elastic strains: Dilation, Stress components, Elastic compliance and stiffness constants: Elastic energy density.	4	
	Elastic stiffness constants of cubic crystal, Bulk modulus and compressibility - Elastic waves in cubic crystals, waves in the [1 0 0] & [1 1 0] directions.	5	
Unit - III Crystal vibrations & Thermal Properties	Vibrations of crystals with monatomic basis, First Brillouin zone, Group velocity, Derivation of force constants from experiment, Two atoms per primitive basis.	6	Chalk &Talk, Assignment
	Quantization of elastic waves, Phonon momentum,		

	Inelastic scattering by phonons. Thermal Properties: Phonon heat capacity, Density of states in one dimension, Density of states in three dimensions.	5	
	Debye model for density of states, Debye T^3 law, Einstein model of the density of states, Anharmonic crystal interactions, Thermal expansion, Thermal conductivity, Thermal resistivity of phonon gas, Umklapp processes.	5	
Unit - IV Free electron Fermi gas and Energy Bands	Free Electron Fermi Gas: Energy levels in one dimension, Effect of temperature on the Fermi-Dirac distribution, Free electron gas in three dimensions, Heat capacity of the electron gas, Experimental heat capacity of metals.	5	Chalk &Talk, Group discussion
	Electrical conductivity and Ohm's law, Experimental electrical resistivity of metals, Motion in magnetic fields, Hall Effect, Thermal conductivity of metals, Ratio of thermal to electrical conductivity.	5	
	Energy Bands: Nearly free electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch Functions, Kronig-Penney Model, Wave equation of electron in a periodic potential, Restatement of the Bloch theorem, Crystal momentum of an electron, Solution of the central equation.	8	
Unit - V Semiconductor crystals and Fermi surfaces	Semiconductor Crystals: Band gap, Equations of motion, Physical derivation of $\hbar\dot{k}$ = F, Holes, Effective mass, Physical interpretation of the effective mass.	5	Seminar, PPT, Chalk &Talk
	Intrinsic carrier concentration, Intrinsic mobility, Impurity conductivity, Donor states, Acceptor states, Thermal ionization of donors and acceptors.	4	
	Fermi Surface and Metals: Reduced zone scheme, Periodic zone scheme, Construction of Fermi surfaces, Nearly free electrons, Electron orbits, Hole orbits and Open orbits, Calculation of energy bands, Tight Binding Method for energy bands.	5	
	Wigner-Seitz Method, Cohesive energy, Experimental methods in Fermi surface studies, Quantization of orbits in a magnetic field, De Haas-van Alphen effect, Extremal orbits, Fermi surface of copper.	5	

Course Designed by: **Dr. S. Ramaswamy & Mr. N. Venkatesh Bharathi**

Learning Outcome Based Education & Assessment (LOBE)

Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	K4	2	K1	1	K1	2 (K3&K3)	1(K4)
	CO2	K4	2	K2	2	K2	2 (K3&K3)	1(K4)
CI AII	CO3	K3	2	K1	1	K1	2 (K3&K3)	1(K3)
	CO4	K4	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No.	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answer Questions)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either or Choice Questions)
Answer All Questions **(5x5=25 marks)**

Q. No	CO	K Level	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	

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	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
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Course Name	**QUANTUM MECHANICS – II**				
Course Code	**21PPHC32**		**L**	**P**	**C**
Category	Core		6	-	4
Nature of Course	EMPLOYABILITY	**SKILL ORIENTED** ✓	ENTREPRENEURSHIP		

Course Objectives:

- To describe the concepts of Spin and angular momentum in Quantum mechanics.
- To apply the ideas on Born approximation transformation and concepts of scattering theory.
- To analyze the principles of quantum mechanics in semi classical theory.
- To understand the difference between relativistic and non-relativistic equations and their solutions.
- To predict the Dirac matrices and gained knowledge about spin and magnetic movement of electron.

Unit: I	**ANGULAR MOMENTUM**	16 Hrs.

The Angular Momentum Operators – Angular Momentum Commutation Relations – Eigen values and Eigen functions of L^2 and L_z – General Angular Momentum – Eigenvalues of J^2 and J_z– Angular Momentum Matrices – Spin Angular momentum – Spin Vectors for Spin -(1/2) System – Addition of Angular momenta.

Unit: II	**SCATTERING THEORY**	19 Hrs.

Scattering Cross Section – Scattering Amplitude – Partial Waves – Scattering by a Central Potential: Partial Wave Analysis – Significant number of partial waves – Scattering by an Attractive Square-Well Potential – Briet-Wigner Formula – Scattering Length – Expression for Phase Shifts -Integral Equation –The Born Approximation – Scattering by a Screened Coulomb Potential – Validity of Born Approximation – Laboratory and Centre of mass Coordinate systems.

Unit: III	**IDENTICAL PARTICLES AND APPROXIMATION IN ATOMS STRUCTURE**	19 Hrs.

Identical particles: Physical meaning of identity – Symmetric and anti-symmetric wave functions – construction from un-symmetrized functions – Distinguishability of identical particles – The exclusion principle – connection with statistical mechanics – **Spin angular momentum:** connection between spin and statistics – spin matrices and Eigen functions – The Helium atom – **Approximation in atomic structure:** Central field approximation – periodic system of elements – Thomas-Fermi statistical fields – Evaluation of the potential – Hartree's self-consistent fields**.**

Unit: IV	**SEMI CLASSICAL THEORY OF RADIATION**	18 Hrs.

Absorption And Induced Emission: Maxwell's equations – Plane electromagnetic waves – Use of perturbation theory – Transition probability – Interpretation in terms of absorption and emission – Electric dipole transitions – Forbidden transitions. **Spontaneous Emission:** Classical radiation field – Asymptotic form – Radiated Energy – Dipole radiation – Angular momentum – Dipole case – Conversion from classical to quantum theory – Planck distribution formula – Line breadth.

Unit: V	**RELATIVISTIC WAVE EQUATIONS**	18 Hrs.

Schrodinger's relativistic Equations: Free particle-Electromagnetic potentials – separation of the equation – energy levels in a coulomb field – **Dirac's Relativistic equation**: Free particle equation – matrices of α and β-free particle solutions – charge and current densities – electromagnetic potentials. **Dirac equation for a central field**: Spin angular momentum, approximate reduction – spin-orbit energy – separation of the equation – The hydrogen atom – classification of energy levels

– negative energy states.	
Total Lecture Hours	**90**

Books for study:

1. G. Aruldhas, Quantum Mechanics, 2nd Edition, PHI Learning Private Limited, New Delhi-01, (2013).

Unit – I: Chapter 8

Unit – II: Chapter 14

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

Unit-III: Chapter 10 (Section 40 & 41) and Chapter 12 (Section 47)

Unit-IV: Chapter 11 (Section 44 & Section 45)

Unit-V: Chapter 13 (Sections 51,52 & 53)

Books for References:

1. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, Tata McGraw-Hill, New Delhi, 1976

2. V. Devanathan, Quantum Mechanics, Narosa Publishing House, New Delhi, 2005.

3. Gupta, Kumar & Sharma, Quantum Mechanics, 23rd edition,2004.

4. Sathya Prakash, Swathi Saluja, Quantum Mechanics, Kedar nath ram nath, Meerut,2019

5. Chatwal, Anand, Quantum Mechanics, Himalaya Publishing House, New Delhi, 2012.

6. G. Aruldhas, Quantum Mechanics: 500 Problems With Solutions, 2nd Edition, PHI Learning Private Limited, New Delhi-01, (2011)

Web Resources

https://swayam.gov.in/courses/3485-quantum-chemistry
https://nptel.ac.in/courses/115101107
https://youtu.be/iW-k3Hphbh4

Course Outcomes		**K Level**
On Completion of this course, the student will be able to		
CO1:	Demonstrate the concepts of Spin and angular momentum in Quantum mechanics.	**K2**
CO2:	Apply the ideas on Born approximation transformation and concepts of scattering theory.	**K3**
CO3:	Construct the principles of quantum mechanics in semi classical theory.	**K3**
CO4:	Analyze the difference between relativistic and non-relativistic equations and their solutions.	**K4**
CO5:	Deduct the Dirac matrices and gained knowledge about spin and magnetic movement of electron	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

Units	Quantum Mechanics-II	Hrs	Pedagogy
Unit-1 ANGULAR MOMENTUM	The Angular Momentum Operators, Angular Momentum Commutation Relations	6	**Chalk & Talk**
	Eigen values and Eigen functions of L^2 and L_z, General Angular Momentum, Eigenvalues of J^2 and J_z, Angular Momentum Matrices, Spin Angular momentum	5	
	Spin Vectors for Spin-(1/2) System, Addition of Angular momenta.	5	
Unit-2 SCATTERING THEORY	Scattering Cross Section, Scattering Amplitude, Partial Waves, Scattering by a Central Potential: Partial Wave Analysis	7	**Chalk & Talk, PPT, Test**
	Scattering by an Attractive Square Well Potential, Briet Wigner Formula, Scattering Length, Expression for Phase Shifts, Integral Equation	6	
	Born Approximation, Scattering by a Screened Coulomb Potential, Validity of Born Approximation, Laboratory and Centre of mass Coordinate systems.	6	
Unit-3 IDENTICAL PARTICLES AND APPROXIMATION IN ATOMIC STRUCTURE	Identical particles: Symmetric and anti-symmetric wave functions, construction from unsymmetrized functions, Distinguishability of identical particles, The exclusion principle, connection with statistical mechanics	6	**Chalk & Talk, Seminar**
	Spin angular momentum: connection between spin and statistics, spin matrices and Eigen functions, The Helium atom Approximation in atomic structure: Central field approximation, periodic system of elements	7	
	Thomas-Fermi statistical fields, Evaluation of the potential, Hartree's self-consistent fields**.**	6	
Unit-4 SEMI CLASSICAL THEORY OF RADIATION ABSORPTION AND INDUCED EMISSION	Maxwell's equations, Plane electromagnetic waves, Use of perturbation theory, Transition probability, Interpretation in terms of absorption and emission	7	**Chalk & Talk, Assignment**
	Electric dipole transitions, Forbidden transitions. Spontaneous Emission: Classical radiation field, Asymptotic form, Radiated Energy Dipole radiation	5	
	Angular momentum, Dipole case, Conversion from classical to quantum theory, Planck distribution formula, Line breadth.	6	
Unit-5 RELATIVISTIC WAVE EQUATIONS	Schrodinger's relativistic Equations: Free particle, Electromagnetic potentials, separation of the equation, energy levels in a coulomb field	6	**Chalk & Talk , Exercise**
	Dirac's Relativistic equation: Free particle equation, matrices of α and β-free particle solutions, charge and current densities, electromagnetic potentials, Dirac equation for a central field:	6	
	Spin angular momentum, appropriate reduction, spin-orbit energy, separation of the equation, The hydrogen atom, classification of energy levels, negative energy states.	6	

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

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	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	4	8	20
	K2	2	6	-	-	6	12	
	K3	-	-	10	10	20	40	40
	K4	-	-	10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No.	COs	K - Level	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 (K2&K2)	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	-	-	9	7.5	**50**
K2	5	6	30	10	51	42.5	
K3	-	-	20	20	40	33.34	**33**
K4	-	-	-	10	10	8.33	**8**
K5	-	-	-	10	10	8.33	**9**
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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answer Questions)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either or Choice Questions)
Answer All Questions **(5x5=25 marks)**

Q. No	CO	K Level	
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K2	
18) b	CO3	K2	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	

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**	
22	**CO2**	**K3**	
23	**CO3**	**K3**	
24	**CO4**	**K4**	
25	**CO5**	**K5**	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
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Course Name	**ADVANCED PHYSICS PRACTICAL**							
Course Code	**21PPHCP3**					**L**	**P**	**C**
Category	**Core**					-	3	-
Nature of Course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**			✓

COURSE OBJECTIVES:

- To give hands on training in the construction of simple electronics circuits.
- To develop the skills in handling instruments and make measurements.
- To get familiarization on advanced physics experiments.
- To make the students to understand practically the characteristics of filters, counters, registers and converters. To acquire knowledge of semiconductor devices and their applications.
- To understand the concepts of OPAMPS and their uses. To develop the skills in writing programs using microprocessors and microcontrollers.

ANY TWELVE EXPERIMENTS

1. Voltage Regulator using IC 723
2. Pulse Width Modulation Using IC 555 Timer
3. Amplitude Modulation using Transistor
4. Active Filters using OPAMPs
5. Analog Computation using OPAMPs
6. 4 Bit Shift Register using JK Flip Flops
7. 4 Bit D/A Converter
8. 4 Bit Binary Counter
9. Hall Effect Experiment
10. Quincke's Method – Susceptibility measurements
11. Four Probe Method – Band Energy gap
12. Interpretation of PXRD Photograph - indexing, calculating the lattice constant and Debye-Waller factor
13. Fraunhofer Diffraction using Laser
14. Refractive Index of liquids using Laser
15. Michelson's Interferometer
16. Microprocessor 8085 (Assembly Language Program)
17. Microprocessor 8085 (Interfacing I/O Operation)
18. Microcontroller 8051 based experiments

COURSE OUTCOMES	**K Level**
On Completion of this course, the students will be able to	
Understand the behavior of electronic components and perform analysis and design of electronic circuits.	K1
Set up testing strategies and select proper instruments to evaluate performance characteristics of electronic circuits.	K5
Choose the testing and experimental procedures on different types of electronic circuits and analyze their operation in different operating conditions.	K4
Gain knowledge of semiconductor devices and their applications.	K2
Build the skills in handling instruments and make measurements.	K3

CO & PO Mapping:

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

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

Course designed by: **Dr. S. Ramaswamy & Mr. N. Venkatesh Bharathi**

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

Course Name	**Project**							
Course Code	**21PPHPR1**					**L**	**P**	**C**
Category	**Core**					-	3	-
Nature of course:	EMPLOYABILITY	✓	SKILL ORIENTED	✓	ENTREPRENEURSHIP			✓

COURSE OBJECTIVES:

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

- Evaluation method for Project:

	Max. Marks		**Credit**
	Internal	**External**	
Project evaluation	**40**	**40**	**4**
Viva Voce	**-**	**20**	
Total	**100**		

- Internal examiners are the respective supervisors.
- Viva –voce examination to be evaluated by the external examiner.
- The report of the project must be in the prescribed form. It should be typed neatly in MS word with the equation editor or using Latex. The font size of the letter should be 12 with double space.
- The format of the project should have the following components.
  - First page should contain
  - Title of the project report
  - Name of the candidate
  - Register number
  - Name of the supervisor
  - Address of the institution
  - Month and year of submission

➢ Contents
➢ Declaration by candidate
➢ Certificate by supervisor
➢ Acknowledgement
➢ Preface
➢ Chapter-1-Preliminaries

- Other chapters
- References

  - ✓ The number of pages in the project may be 40 to 50
  - ✓ Each page should contain at least 18 lines
  - ✓ Three copies of the project report with binding should be submitted.

COURSE OUTCOME		K Level
On Completion of this course, the students will be able to		
CO1:	Familiarize various theories behind the instrumentation involved in the Characterizations techniques.	K1
CO2:	Get hands on experience on different instrumentation techniques to design a research problem and solve it using different research methods.	K2
CO3:	Organize and pursue a scientific and industrial research project and work effectively as an individual in multidisciplinary settings.	K3
CO4:	Analyze the theoretical problems and solve them using the knowledge of basic Physics ideas.	K4
CO5:	Have a comprehensive idea on research methods, methodology and ethics to communicate the research findings.	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	2	3	2	2	2	2
CO3	2	1	2	3	2	2
CO4	2	2	2	3	3	3
CO5	2	2	2	2	3	2

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

Course Designed by: **Dr. S. Ramaswamy & Mr. P. Dharmaraja**

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

Course Name	**THERMODYNAMICS AND STATISTICAL MECHANICS**					
Course Code	**21PPHE31**			**L**	**P**	**C**
Category	**Elective**			6	-	6
Nature of course	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP		

COURSE OBJECTIVES:

- To understand the basic concepts of thermodynamics parameters.
- To acquire knowledge about the density of states and internal energy of the systems.
- To study the micro and macroscopic properties of the mater through the statistical probability laws and distribution of particles.
- To know the classical and quantum distribution laws and their relations.
- To acquire the knowledge of various statistical distributions and their applications in Physics.

Unit: I	**Thermodynamics: Energy and the first law**	18 Hrs.

The translational between microscopic and macroscopic behavior: Thermodynamics – Quantum effects: Electrical charge – Wave nature particles – Uncertainty principle – Quantum states and phase space – Density of states. Internal energy: Potential energies – Solids, liquids and gases – Quantum effects: Rotations and vibrations – Degrees of freedom – Equipartition – Thermal Energy. Interaction between systems: Heat transfer – the thermal interactions – Work – the mechanical interaction – Particle transfer – the diffusive interaction - The first law of thermodynamics – Exact and inexact differentials - Dependent and independent variables.

Unit: II	**States and the second law**	17 Hrs.

Equilibrium - The fundamental postulate – The spacing of states – Density of states and the internal energy. The second law of thermodynamics – Definition and properties – Entropy and the second law: Interacting systems – Microscopic examples – Macroscopic examples – The second law of thermodynamics - Entropy.

Unit: III	**Statistical Mechanics: Classical Statistics**	17 Hrs.

Probabilities and microscopic behaviors: The ensembles – Probability that a system is in a certain state – Two approaches – Application of quantum statistics – Heat capacities – Closely spaced states – Equipartition. Kinetic theory and transport processes in gases: Probability distributions – Mean values – Particle flux – Collision frequency and mean free path – Transport processes. The partition function: Definitions – Calculations of mean values – Many subsystems and identical particles – The partition function of a gas.

Unit: IV	**Quantum statistics**	19 Hrs.

Introduction to quantum statistics: The occupation number – Comparison with classical statistics – The limits of classical statistics – The spectra of accessible states – The chemical potential. Quantum gases: The density of states – Distribution and mean values – Internal energy and the gas laws – Internal energy and the chemical potential. Blackbody radiation: Photons in an oven – Energy flux – Heat Shields – Entropy and adiabatic processes – Thermal noise and the Nyquist theorem.

Unit: V	**The thermal and electrical properties of materials**	19 Hrs.

The thermal properties of solids: Overview – Lattice vibrations – Conduction electrons – Heat capacities. The electrical properties of materials: Band structure – Conductors – Semiconductors –

p-n junctions. Low temperatures and degenerate systems: Low temperatures – Degenerate boson systems – Stellar collapse.

	Total Lecture Hours	90 Hrs.

Books for study:

1. K. Stowe, An Introduction to Thermodynamics and Statistical Mechanics, 2nd Edition, Cambridge University Press, UK, (2013).

Unit – I: Chapter 1 (1.A and 1.B.1 to 1.B.5), Chapter 4 and Chapter 5
Unit – II: Chapter 6, Chapter 7 and Chapter 8
Unit – III: Chapter 15, Chapter 16 and Chapter 18
Unit – IV: Chapter 19, Chapter 20 and Chapter 21
Unit – V: Chapter 22, Chapter 23 and Chapter 24

Books for References:

1. P.B. Pal, An Introductory Course of Statistical Mechanics, Narosa Publishing House, New Delhi, 2008.
2. K. Singh, S.P. Singh, Elements of Statistical Mechanics, S. Chand & Company, New Delhi, 2008.
3. P. Ansermet, S.D. Brechet, Principles of Thermodynamics and Statistical Mechanics, Cambridge University Press, UK, 2019.
4. S.L. Gupta, V. Kumar, Statistical Mechanics, Pragati Prakasan, Meerut, 2006.
5. B.K. Agarwal, M. Eisner, Statistical Mechanics, New Age International Pvt. Ltd., Kochi, 2013.
6. F. Reif, Fundamentals of Statistical and Thermal Physics, Waveland Press, USA, Reprint 2009.

Web Resources:

https://onlinecourses.nptel.ac.in/noc21_ph09/preview
https://onlinecourses.nptel.ac.in/noc19_ph10/preview
https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/video-lectures/lecture-1-thermodynamics-part-1/

Course outcomes		K Level
CO1:	Examine the different laws of thermodynamics to statistical mechanics.	K4
CO2:	Discovering the thermodynamic concepts, which are related to materials properties, various areas of research and development.	K4
CO3:	Identify the relation between microscopic and macroscopic particles and their properties.	K3
CO4:	Analyzing how to apply ensemble approach to solve classical and quantum thermodynamic systems.	K4
CO5:	Evaluate and check the knowledge from thermal properties of solids and electrical properties of materials.	K5

CO & PO Mapping:

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

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

LESSON PLAN

UNIT	THERMODYNAMICS AND STATISTICAL MECHANICS	Hrs	Mode
I Thermodynamics: Energy and the first law	The translational between microscopic and macroscopic behavior: Thermodynamics – Quantum effects: Electrical charge – Wave nature particles – Uncertainty principle – Quantum states and phase space – Density of states.	**6**	**Chalk, Talk & PPT**
	Internal energy: Potential energies – Solids, liquids and gases – Quantum effects: Rotations and vibrations – Degrees of freedom – Equipartition – Thermal Energy.	**6**	
	Interaction between systems: Heat transfer – the thermal interactions – Work – the mechanical interaction – Particle transfer – the diffusive interaction - The first law of thermodynamics – Exact and inexact differentials - Dependent and independent variables.	**6**	
II States and the second law	Equilibrium - The fundamental postulate – The spacing of states – Density of states and the internal energy.	**5**	**Chalk, Talk & Assignment**
	The second law of thermodynamics – Definition and properties – Entropy and the second law: Interacting systems.	**6**	
	Microscopic examples – Macroscopic examples – The second law of thermodynamics - Entropy.	**6**	
III Statistical Mechanics: Classical Statistics	Probabilities and microscopic behaviors: The ensembles – Probability that a system is in a certain state – Two approaches – Application of quantum statistics – Heat capacities – Closely spaced states – Equipartition.	**5**	**Chalk, Talk & PPT**
	Kinetic theory and transport processes in gases: Probability distributions – Mean values – Particle flux – Collision frequency and mean free path – Transport processes.	**6**	
	The partition function: Definitions – Calculations of mean values – Many subsystems and identical particles – The partition function of a gas.	**6**	
IV Quantum statistics	Introduction to quantum statistics: The occupation number – Comparison with classical statistics – The limits of classical statistics – The spectra of accessible states – The chemical potential.	**6**	**Chalk, Talk & Exercise**
	Quantum gases: The density of states – Distribution and mean values – Internal energy and the gas laws – Internal energy and the chemical potential.	**6**	
	Blackbody radiation: Photons in an oven – Energy flux – Heat Shields – Entropy and adiabatic processes – Thermal noise and the Nyquist theorem.	**7**	
V The thermal and electrical properties of materials	The thermal properties of solids: Overview – Lattice vibrations – Conduction electrons – Heat capacities.	**7**	**Chalk, Talk & Seminar**
	The electrical properties of materials: Band structure – Conductors – Semiconductors – p-n junctions.	**6**	
	Low temperatures and degenerate systems: Low temperatures – Degenerate boson systems – Stellar collapse.	**6**	

Course designed by: **Dr. P.P. Kannan & Dr. S. Ramaswamy**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**COs**	**K Level**	**Section A MCQs**		**Section B Short Answers**		**Section C Either or Choice**	**Section D Open Choice**
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**K3**	2	K1	1	K1	2 (K3&K3)	1(K3)
	CO2	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
CI AII	**CO3**	**K4**	2	K1	1	K2	2 (K3&K3)	1(K4)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answer Questions) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either or Choice Questions) **Answer All Questions**			**(5x5=25 marks)**
Q. No	**CO**	**K Level**	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher levelof K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**ENERGY PHYSICS**			
Course Code	**21PPHE32**	**L**	**P**	**C**
Category	**Elective**	6	-	6

Nature of course	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP

COURSE OBJECTIVES:

- To understand the various forms of conventional energy resources.
- To study the basic characteristics of solar energy and technologies for their utilization.
- To describe the principles that underlies the ability of wind energy to deliver usable energy.
- To analyze the fundamental concepts in bio-fuels and Geo thermal energy systems.
- To compare the different types of non-conventional sources in the power generation techniques.

Unit: I	**Fundamentals of energy and Energy conservation**	19 Hrs.

Energy, economy and social development – Oil crisis – Classification of energy resources – Consumption trend of primary energy resources – Importance of non-conventional energy resources – Energy chain – Common forms of energy – Advantages and disadvantages of conventional energy sources – Salient features of non-conventional energy sources – Energy densities (heating values) of various fuels – Environmental Aspects of energy. Energy conservation: Important Terms and Definitions – Important Aspects of Energy Conservation – Global Efforts, Achievements and Future Planning – Energy Conservation / Efficiency scenario in India.

Unit: II	**Solar energy**	19 Hrs.

The sun as a source of energy – The earth – Sun, earth radiation spectrum – Extraterrestrial and terrestrial radiations – Spectral power distribution of solar radiation – Depletion of solar radiation – Measurement of solar radiation. Solar Collectors – Solar Water Heater – Solar Passive Space Heating and Cooling System – Solar Industrial Heating System – Solar Refrigeration and Air Conditioning Systems – Solar cookers – Solar furnace – Solar greenhouse – Solar dryer – Solar distillation – Solar thermo mechanical system.

Unit: III	**Wind energy**	16 Hrs.

Origin of wind – Nature of winds – Wind turbine siting – Major applications of wind power – Basics of fluid mechanics - Wind energy conversion systems (WECS) – Wind-Diesel hybrid system – Effects of wind speed and grid condition (System integration) – Wind energy storage-Environmental aspects – Wind energy program in India.

Unit: IV	**Biomass and Geothermal Energy**	19 Hrs.

Photo synthesis process – Usable forms of biomass, their composition and fuel properties – Biomass resources – Biomass conversion technologies – Urban waste to energy conversion - Biomass gasification – Biomass liquefaction – Biomass to ethanol production. Geothermal Energy: Applications – Origin and Distribution of Geothermal Energy – Types of Geothermal Resources.

Unit: V	**Ocean energy and Emerging Technologies**	17 Hrs.

Tidal Energy: Origin and nature of tidal energy – Limitations – Tidal energy technology – Present status – Environmental impacts. Wave energy: Power in waves – Waves energy technology – Present status – Environmental impacts. Ocean thermal energy. Emerging Technologies: Introduction – Fuel Cell – Potential Applications – Classifications of Fuel Cells – Phosphoric Acid

Fuel Cell – Alkaline Fuel Cell.	
Total Lecture Hours	**90 Hrs.**

Book for study:

1. B.H. Khan, Non – Conventional Energy Resources, McGraw Hill Education Private limited, Third Edition, Chennai – 16, 2017.

Unit – I - Chapter 1 (Sections 1.1 to 1.12) , Chapter 2 (Sections 2.1 to 2.5)
Unit – II - Chapter 4 (4.1 and 4.8), Chapter 5 (5.1 – 5.12)
Unit – III - Chapter 7 (7.1 – 7.6, 7.10 – 7.14)
Unit – IV - Chapter 8 (8.1 – 8.9) , Chapter 9 (9.1 – 9.4)
Unit- V - Chapter 10, Chapter 12 (12.1, 12.2.1– 12.2.4)

Book for Reference:

1. G.D. Rai, Solar energy Utilization, Khanna Publishers, 5th Edition, New Delhi – 02, 2005.
2. R.L. Jaffe, The Physics of Energy, 1st Edition, Cambridge University Press, USA, 2018.
3. D.H. Perkins, Introduction to High Energy Physics, Cambridge University Press, USA, 2000.

Web Resources:

https://nptel.ac.in/courses/103/103/103103206/
https://onlinecourses.swayam2.ac.in/nou21_me03/preview
https://www.mooc-list.com/tags/energy

COURSE OUTCOMES		**K Level**
CO1:	Classify the present energy scenario and the need for energy conservation.	K4
CO2:	Separate the various energy resources in different environment.	K4
CO3:	Outline division aspects and utilization of renewable energy sources for both domestics and industrial applications.	K3
CO4:	Survey the concept of various forms of renewable and non-renewable energy resources.	K4
CO5:	Predict the aspects of ocean energy in human needs.	K5

CO & PO Mapping:

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

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

LESSON PLAN

UNIT	ENERGY PHYSICS	Hrs	Mode
I Fundamentals of energy and Energy conservation	Energy, economy and social development – Oil crisis – Classification of energy resources –Consumption trend of primary energy resources – Importance of non-conventional energy resources.	**6**	Chalk, Talk & PPT
	Energy chain – Common forms of energy – Advantages and disadvantages of conventional energy sources – Salient features of non-conventional energy sources – Energy densities (heating values) of various fuels – Environmental Aspects of energy.	**7**	
	Energy conservation: Important Terms and Definitions – Important Aspects of Energy Conservation – Global Efforts, Achievements and Future Planning – Energy Conservation / Efficiency scenario in India.	**6**	
II Solar energy	The sun as a source of energy – The earth – Sun, earth radiation spectrum – Extraterrestrial and terrestrial radiations – Spectral power distribution of solar radiation – Depletion of solar radiation – Measurement of solar radiation.	**7**	Chalk, Talk & Assignment
	Solar Collectors – Solar Water Heater – Solar Passive Space Heating and Cooling System – Solar Industrial Heating System – Solar Refrigeration and Air Conditioning Systems –	**6**	
	Solar cookers – Solar furnace – Solar greenhouse – Solar dryer – Solar distillation – Solar thermo mechanical system.	**6**	
III Wind energy	Origin of wind – Nature of winds – Wind turbine siting – Major applications of wind power – Basics of fluid mechanics.	**6**	Chalk, Talk & Seminar
	Wind energy conversion systems (WECS) – Wind-Diesel hybrid system – Effects of wind speed and grid condition (System integration)	**5**	
	Wind energy storage- Environmental aspects – Wind energy program in India.	**5**	
IV Biomass and Geothermal Energy	Photo synthesis process – Usable forms of biomass, their composition and fuel properties – Biomass resources – Biomass conversion technologies	**6**	Chalk, Talk & PPT
	Urban waste to energy conversion - Biomass gasification – Biomass liquefaction – Biomass to ethanol production.	**7**	
	Geothermal Energy: Applications – Origin and Distribution of Geothermal Energy – Types of Geothermal Resources.	**6**	
V Ocean energy and Emerging Technologies	Tidal Energy: Origin and nature of tidal energy – Limitations – Tidal energy technology – Present status – Environmental impacts.	**6**	Chalk, Talk & Exercise
	Wave energy: Power in waves – Waves energy technology – Present status – Environmental impacts. Ocean thermal energy.	**5**	
	Emerging Technologies: Introduction – Fuel Cell – Potential Applications – Classifications of Fuel Cells – Phosphoric Acid Fuel Cell – Alkaline Fuel Cell.	**6**	

Course designed by: **Mr. P. Dharmaraja & 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	**CO1**	**K3**	2	K1	1	K1	2 (K3&K3)	1(K3)
AI	**CO2**	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
CI	**CO3**	**K4**	2	K1	1	K2	2 (K3&K3)	1(K4)
AII	**CO4**	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answer Questions) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either or Choice Questions) **Answer All Questions**			**(5x5=25 marks)**
Q. No	**CO**	**K Level**	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher levelof K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**PHYSICS OF HUMAN BODY**			
Course Code	**21PPHE33**	**L**	**P**	**C**
Category	**Elective**	**6**	**-**	**6**

Nature of course:	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP

Course Objectives:

- To visualize the dynamics of fluid in human body
- To explain the physics of circulation system in cardiovascular system
- To understand breathing technique in a effective way
- To differentiate various sounds from sources
- To describe various visual impairments and their corrective measures

Unit: I	**Fluid Flow and its Motion in Body**	18 Hrs.

Characteristic Pressures in the Body - Definition and Units - Measuring Pressure - Basic Physics of Pressure and Flow of Fluids - Law of Laplace - Fluids in Motion - Equation of Continuity - Bernoulli's Equation - Interactions among the Flow Parameters - Viscous Flow and Poiseuille's Law - Diffusion (Advanced Topic) - Pressure and Flow in the Body - Motion of Humans in Fluids - Swimming - Human Flight.

Unit: II	**Cardiovascular System**	18 Hrs.

Overview of the Circulatory System and Cardiac Cycle - Circulation - Cardiac Cycle - Valves - Physics of the Circulation System - Properties of Blood - Blood Pressure and Flow in Vessels - Capillaries and Osmotic Pressure - Blood Flow Rates and Speeds - Consequences of Clogged Arteries - Work Done by the Heart and the Metabolic Needs of the Heart - Strokes and Aneurysms - Arterial Bifurcations and Saccular Aneurysms - Stenosis and Ischemic Strokes - Equation of Motion of Arteries and Aneurysms during Pulsatile Flow (Advanced Topic) - Modelling the Circulatory System and the Heart - Model of the Heart - Model of the Overall Flow in the Circulatory System - The Arterial Pulse- Windkessel Model - Modelling the Malfunctioning Heart.

Unit: III	**Lungs and Breathing**	18 Hrs.

Structure of the Lungs - The Physics of the Alveoli - Physics of Breathing - Volume of the Lungs - Breathing Under Usual and Unusual Conditions - Flow of Air During Breathing- Mechanical Model of Breathing and Model Parameters - Inspiration/Expiration Cycle - Breathing with a Diseased Lung - Breathing at Higher Elevations - Work Needed to Breathe

Unit: IV	**Sound, Speech, and Hearing**	18 Hrs.

The Physics of Sound Waves - The Speed and Properties of Sound Waves - Intensity of Sound Waves - What Happens when Sound Travels from One Medium to An- Resonant Cavities - Speech Production - Types of Sounds - Systems in Speech Production - Parameters of the Human Voice - The Energetic of Speaking – Hearing- Auditory Sensitivity - Connections to Hearing Perception - Other Vibrations in the Body - Cardiac and Other Sources of Sounds

Unit: V	**Light, Eyes and Vision**	18 Hrs.

Structure of the Eye - Focusing and Imaging with Lenses - Image Formation- Scientific Basis for Imaging - Combinations of Lenses or Refractive Surfaces - Imaging and Detection by the Eye - Transmission of Light in the Eye - The Eye as a Compound Lens – Accommodation -Field of View and Binocular Vision - Adjustments of Light Levels - Limitations to Visual Acuity - Imperfect Human Vision - Correction of Vision by Eyeglasses, Contact Lenses and Other Means - Types of Vision Impairment - Connections to Visual Perception.

	Total Lecture Hours	90 Hrs.

Books for Study:

Irving P. Herman, Physics of Human body, Springer-Verlag Berlin Heidelberg, (2008).
Unit I : Chapter 7
Unit II :Chapter 8
Unit III: Chapter 9
Unit IV :Chapter 10
Unit V :Chapter 11

Books for References:

1. P. Davidovits, Physics in Biology & Medicine, 5th Edition, Academic Press, USA, Reprint 2018.

Web Resources:

1. **https://openregon.pressbooks.pub/bodyphysics/chapter/human-metabolism/**
2. **https://en.m.wikipedia.org/wiki/Composition_of_the_human_body**
3. **https://en.m.wikipedia.org/wiki/Human_body**

Course Outcomes		**K Level**
CO1:	Infer the dynamics of fluid in human body	**K4**
CO2:	Focus the physics of circulation system such as blood pressure, osmotic pressure, metabolic needs, etc.,	**K4**
CO3:	Apply breathing technique in a effective way which resulted from the understanding of detailed theory behind breathing	**K3**
CO4:	Distinguish various sources of sound	**K4**
CO5:	Justify the various visual impairments and about their corrective measures	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

UNIT	PHYSICS OF HUMAN BODY	Hrs	Mode
I Fluid Flow and its Motion in Body	Characteristic Pressures in the Body, Definition and Units, Measuring Pressure, Basic Physics of Pressure and Flow of Fluids	**6**	Chalk & Talk and Assignment
	Law of Laplace, Fluids in Motion, Equation of Continuity, Bernoulli's Equation	**6**	
	Interactions among the Flow Parameters, Viscous Flow and Poiseuille's Law, Diffusion (Advanced Topic), Pressure and Flow in the Body, Motion of Humans in Fluids, Swimming, Human Flight.	**6**	
II Cardiovascular System	Overview of the Circulatory System and Cardiac Cycle, Circulation, Cardiac Cycle, Valves, Physics of the Circulation System, Properties of Blood, Blood Pressure and Flow in Vessels, Capillaries and Osmotic Pressure, Blood Flow Rates and Speeds, Consequences of Clogged Arteries	6	Chalk & Talk and PPT
	Work Done by the Heart and the Metabolic Needs of the Heart, Strokes and Aneurysms, Arterial Bifurcations and Saccular Aneurysms, Stenosis and Ischemic Strokes	**6**	
	Equation of Motion of Arteries and Aneurysms during Pulsatile Flow (Advanced Topic), Modelling the Circulatory System and the Heart, Model of the Heart, Model of the Overall Flow in the Circulatory System, The Arterial Pulse, Windkessel Model , Modelling the Malfunctioning Heart.	**6**	
III Lungs and Breathing	Structure of the Lungs, The Physics of the Alveoli, Physics of Breathing, Volume of the Lungs, Breathing Under Usual and Unusual Conditions,	**6**	Chalk, Talk& class test
	Flow of Air During Breathing, Mechanical Model of Breathing and Model Parameters, Inspiration/Expiration Cycle,	**6**	
	Breathing with a Diseased Lung, Breathing at Higher Elevations, Work Needed to Breathe	**6**	
IV Sound, Speech and Hearing	The Physics of Sound Waves, The Speed and Properties of Sound Waves, Intensity of Sound Waves, Sound Travels from One Medium to other	**6**	Chalk & Talk, PPT
	Resonant Cavities, Speech Production, Types of Sounds, Systems in Speech Production, Parameters of the Human Voice,	**6**	
	The Energetic of Speaking, Hearing, Auditory Sensitivity, Connections to Hearing Perception, Other Vibrations in the Body, Cardiac and Other Sources of Sounds	**6**	
V Light, eye and Vision	Structure of the Eye, Focusing and Imaging with Lenses, Image Formation, Scientific Basis for Imaging, Combinations of Lenses or Refractive Surface ,	**6**	Chalk, Talk& Seminar
	Imaging and Detection by the Eye , Transmission of Light in the Eye, The Eye as a Compound Lens, Accommodation, Field of View and Binocular Vision, Adjustments of Light Levels	**6**	
	Limitations to Visual Acuity, Imperfect Human Vision,	**6**	

	Correction of Vision by Eyeglasses, Contact Lenses and Other Means, Types of Vision Impairment, Connections to Visual Perception, Vision in Other Animals.		

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

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answer Questions)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either or Choice Questions)
Answer All Questions **(5x5=25 marks)**

Q. No	CO	K Level	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	

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

Section D (Open Choice)
Answer Any Three questions **(3x10=30 marks)**

Q. No	CO	K Level	Questions
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**MICROPROCESSOR AND MICROCONTROLLER**							
Course Code	**21PPHE34**					**L**	**P**	**C**
Category	**Elective**					**6**	**-**	**6**
Nature of course	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP			

COURSE OBJECTIVES:

- To understand the architecture and instruction set of INTEL 8085 in Microprocessor.
- To create assembly language programs by studying some examples in Microprocessor Programs.
- To familiarize different programmable device and methods to interface them.
- To understand the working of a microcontroller.
- To use a microcontroller for various applications.

Unit: I	**Introduction to 8085 assembly language programming**	17 Hrs.

The 8085 programming model – Instruction classification – Instruction, data format, and storage – How to write, assemble, and execute a simple program. Data transfer (copy) operations – Arithmetic operations – Logic operations – Branch operations – Writing assembly language programs – Debugging a program.

Unit: II	**Counters and time delays**	18 Hrs.

Counters and time delays – Illustrative programs: Hexadecimal counters – zero to nine (Modulo Ten) counters – Generating pulse waveforms – Debugging counters and time delay programs. Stack and subroutines: Stack – Subroutine – Restart, conditional call, and return instructions – Advanced subroutine concepts.

Unit: III	**Code conversion, BCD arithmetic and 16 bit data operations and Interfacing data converters**	17 Hrs.

BCD to binary conversion – Binary to BCD conversion – BCD to seven segment LED code conversion – Binary to ASCII and ASCII to binary code conversion – BCD addition and subtraction – Introduction to advanced instructions and applications – Multiplications – Subtraction with carry. Interfacing Data Converters: Digital to analog (D/A) converters– Analog to digital (A/D) converters.

Unit: IV	**Microcontrollers: 8051 Assembly Language Programming & Jump, loop and call instructions**	19 Hrs.

Inside the 8051 – Introduction to 8051 Assembly programming – Assembling and running an 8051 program – The program counter and ROM space in the 8051 – 8051 data types and derivatives – 8051 flag bits and the PSW register. Loop and jump instructions – Call instructions – Time delay for various 8051 chips.

Unit: V	**I/O Port Programming & 8051 Addressing modes**	19 Hrs.

8051 I/O Programming – I/O bit manipulation programming. Immediate and register addressing modes – Assessing memory using various addressing modes. Bit addresses for I/O and RAM – Extra 128-byte on-chip RAM in 8052.

	Total Lecture Hours	**90 Hrs.**

Book for study:

1. Ramesh S. Gaonkar, Microprocessor/ Architecture, Programming and Application with 8085 5th Edition, Prentice Hall Pearson Education, New Jersey, 2002.

Unit I: Chapter 2 (2.1-2.4), Chapter 6 (6.1-6.6)

Unit II: Chapter 8 and Chapter 9
Unit III: Chapter 10 and Chapter 13

2. Muhammed Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2nd Edition, Pearson Education, Inc., New Delhi, 2005.

Unit IV: Chapter 2 and 3
Unit V: Chapter 4 and 5

Books for References:

1. Krishnakanth, Microprocessor and Microcontrollers, PHI Learning Pvt. Ltd., First Edition, New Delhi, 2007.
2. R. Latha and S. Sakthivel, 8085,8086, Microprocessor and 8051 Microcontrollers Hardware, Applications and Interfacing, , First Edition, Anuradha Publication, Kumbakonam,2006.
3. A. NagoorKani, Microprocessor and it's applications, 3rd Edition, McGraw Hill India Pvt Ltd, New Delhi, 2017.
4. A.P. Mathur, Introduction to Microprocessor, 3rd Edition, McGraw Hill India Pvt Ltd, New Delhi, Reprint 2006.

Web Resources:

https://www.mooc-list.com/tags/microprocessors
https://nptel.ac.in/courses/108/105/108105102/
https://www.classcentral.com/course/swayam-microprocessors-and-interfacing-17694

COURSE OUTCOMES		**K Level**
CO1:	Discover an assembly language programming (ALP) in 8085 microprocessor for the given specification	**K4**
CO2:	Organize the architecture and functional block of 8051 microcontroller	**K4**
CO3:	Construct an embedded C and ALP in 8051 microcontroller using the internal functional blocks for the given specification	**K3**
CO4:	Differentiate various peripherals devices such as 8051, 8085 and 8052	**K4**
CO5:	Reframe electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

UNIT	MICROPROCESSOR AND MICROCONTROLLER	Hrs	Mode
I Introduction to 8085 assembly language programming	The 8085 programming model – Instruction classification – Instruction, data format, and storage	**5**	Chalk, Talk & PPT
	How to write, assemble, and execute a simple program. Data transfer (copy) operations	**6**	
	Arithmetic operations – Logic operations – Branch operations – Writing assembly language programs – Debugging a program.	**6**	
II Counters and time delays	Counters and time delays – Illustrative programs: Hexadecimal counters – zero to nine (Modulo Ten) counters	**6**	Chalk, Talk &Assignment
	Generating pulse waveforms – Debugging counters and time delay programs. Stack and subroutines: Stack – Subroutine	**6**	
	Restart, conditional call, and return instructions – Advanced subroutine concepts.	**6**	
III Code conversion, BCD arithmetic and 16 bit data operations and Interfacing data converters	BCD to binary conversion – Binary to BCD conversion – BCD to seven segment LED code conversion – Binary to ASCII and ASCII to binary code conversion	**5**	Chalk, Talk & Seminar
	BCD addition and subtraction – Introduction to advanced instructions and applications – Multiplications – Subtraction with carry.	**7**	
	Interfacing Data Converters: Digital to analog (D/A) converters– Analog to digital (A/D) converters.	**5**	
IV Microcontrollers: 8051 Assembly Language Programming & Jump, loop and call instructions	Inside the 8051 – Introduction to 8051 Assembly programming – Assembling and running an 8051 program	**7**	Chalk, Talk & PPT
	The program counter and ROM space in the 8051 – 8051 data types and derivatives – 8051 flag bits and the PSW register.	**7**	
	Loop and jump instructions – Call instructions – Time delay for various 8051 chips.	**5**	
V I/O Port Programming & 8051 Addressing modes	8051 I/O Programming – I/O bit manipulation programming.	**7**	Chalk, Talk &Exercise
	Immediate and register addressing modes – Assessing memory using various addressing modes.	**7**	
	Bit addresses for I/O and RAM – Extra 128-byte on-chip RAM in 8052.	**5**	

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

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answer Questions) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either or Choice Questions) **Answer All Questions**			**(5x5=25 marks)**
Q. No	**CO**	**K Level**	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher levelof K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**ANALYTICAL INSTRUMENTATION**							
Course Code	**21PPHE35**					**L**	**P**	**C**
Category	**Elective**					**6**	**-**	**6**
Nature of course	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP			

COURSE OBJECTIVES:

- To introduce the principles and theory of instrument analysis.
- To acquire knowledge about the widely used analytical instruments.
- To learn specific technique employed for monitoring different pollutants in air and water.
- To describe the calibration methods for various analytical instruments.
- To compare different techniques of instrumentation with their efficiency and uses.

Unit: I	**Ultraviolet and visible spectrometry**	18 Hrs.

Radiation sources – Wavelength selection – Cells and sampling devices – Detectors – Readout Modules – Instruments for absorption photometry.

Unit: II	**Infrared spectrometry and Raman spectroscopy**	19 Hrs.

Correlation of infrared spectra with molecular structure – Instrumentation – Sample handling – Quantitative analysis. Raman spectroscopy: Theory – Instrumentation - Sample handling and illumination – Structural analysis – Polarization measurements – Quantitative analysis – Comparison of Raman with infrared spectroscopy.

Unit: III	**X-ray Methods**	17 Hrs.

Production of X-rays and X-ray spectra – Instrumentation – Direct X-ray Methods – X-ray absorption methods – X-ray fluorescence method – X-ray diffraction – Auger Emission Spectroscopy (AES) – Electron spectroscopy for chemical analysis (ESCA).

Unit: IV	**Nuclear Magnetic Resonance Spectroscopy**	17 Hrs.

Basic principles – Continuous wave NMR spectrometers – Pulsed Fourier Transform NMR spectrometer – Spectra and molecular structure – Elucidation of NMR spectra – Quantitative analysis and integration – NMR imaging in medicine.

Unit: V	**Mass spectrometry**	19 Hrs.

Sample flow in a Mass spectrometer – Inlet Sample system – Ionization methods in mass spectrometry – Mass analyzers – Ion-collection systems – Vacuum system – Data handling – Isotope-Ratio spectrometry – Correlation of mass spectra with molecular structure – Quantitative analysis of mixtures.

	Total Lecture Hours	90 Hrs.

Book for study:

1. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, Instrumental Methods of Analysis, 7th Edition, CBS Pub & Co, New Delhi, (1986).

Unit – I: Chapter 6
Unit – II: Chapters 11 & 12
Unit – III: Chapter 13
Unit – IV: Chapter 15
Unit- V: Chapter 16 (16.1 – 16.10)

Books for References:

1. R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw-Hill Publications, New Delhi, 2006.
2. G. McMahon, Analytical Instrumentation: A Guide to Laboratory, Portable and Miniaturized Instruments, John Wiley & Sons, Ltd., New York, 2007.
3. J. Cazes, Analytical Instrumentation Handbook, CRC Press, 2004.

Web Resources:
https://www.mooc-list.com/course/analytical-chemistry-instrumental-analysis-coursera
https://nptel.ac.in/courses/103/108/103108100/
https://onlinecourses.swayam2.ac.in/cec20_bt22/preview

COURSE OUTCOMES		**K Level**
CO1:	Categorize the required instruments for spectroscopic analysis.	**K4**
CO2:	Analyze the effects of different constituent in a process outcome and the performance of various instruments.	**K4**
CO3:	Compute the working of X- ray diffractometer and scanning electron microscope.	**K3**
CO4:	Classify the frequency selection of the substance from spectrum analysis.	**K4**
CO5:	Interpret the experimental analysis for analyzing the real samples using instruments.	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

UNIT	ANALYTICAL INSTRUMENTATION	Hrs	Mode
I Ultraviolet and visible spectrometry	Radiation sources, Wavelength selection	**6**	Chalk, Talk & PPT
	Cells and sampling devices, Detectors	**6**	
	Readout Modules, Instruments for absorption photometry	**6**	
II Infrared spectrometry and Raman spectroscopy	Correlation of infrared spectra with molecular structure, Instrumentation	**7**	Chalk, Talk &Exercise
	Sample handling, Quantitative analysis. Raman spectroscopy: Theory, Instrumentation	**6**	
	Sample handling and illumination, Structural analysis, Comparison of infrared and Raman spectroscopy	**6**	
III X-ray Methods	Production of X-rays and X-ray spectra, Instrumentation	**5**	Chalk, Talk &Assignment
	Direct X-ray Methods, X-ray absorption methods, X-ray fluorescence method	**6**	
	X-ray diffraction, Auger Emission Spectroscopy (AES).	**6**	
IV NMR spectroscopy	NMR basic principles, Continuous wave NMR spectrometers	**5**	Chalk, Talk & Seminar
	Pulsed Fourier Transform NMR spectrometer , Spectra and molecular structure	**5**	
	Elucidation of NMR spectra, quantitative analysis and integration, NMR imaging in medicine	**7**	
V Mass spectrometry	Sample flow in a Mass spectrometer, Inlet Sample system, Ionization methods in mass spectrometry	**7**	Chalk, Talk & PPT
	Mass analyzers, Ion-collection systems, Vacuum system, Data handling, Isotope-Ratio spectrometry	**7**	
	Correlation of mass spectra with molecular structure , Quantitative analysis of mixtures	**5**	

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

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answer Questions) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either or Choice Questions) **Answer All Questions**			**(5x5=25 marks)**
Q. No	**CO**	**K Level**	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher levelof K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**CRYSTAL GROWTH AND CHARACTERIZATION TECHNIQUES**					
Course Code	**21PPHE36**			**L**	**P**	**C**
Category	**Elective**			6	-	6
Nature of course:	EMPLOYABILITY	**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**		✓

COURSE OBJECTIVES:

- To understand the theories involved in crystal growth nucleation process.
- To realize the extended knowledge on advanced condensed matter topics like crystal growth from solution method.
- To familiarize the melt growth procedure for single crystals.
- To know the vapour growth techniques and characterization tools.
- To demonstrate the crystal characterization methods.

Unit: I	**Nucleation theory**	18 Hrs.

Importance of crystal growth – Classification of crystal growth methods – Nucleation Theory - Kinds of nucleation – Homogeneous nucleation - Heterogeneous nucleation - secondary nucleation - Classical theory of nucleation: Gibbs Thomson equations for vapour and solution – Kinetic theory of nucleation – Energy of formation of a spherical nucleus and cylindrical nucleus.

Unit: II	**Solution Growth Techniques**	19 Hrs.

Growth from low temperature solutions: Selection of solvents and solubility – Meir's solubility diagram – Saturation and super saturation – Metastable zone width – Growth by restricted evaporation of solvent, slow cooling of solution and temperature gradient methods - **Gel Growth Technique:** Principle – Various types – Structure of gel – Importance of gel – Experimental procedure – Chemical reaction method – Single and double diffusion method – Chemical reduction method – Complex and decomplexion method – Advantages of gel method. **Growth from high temperature solutions**: Flux growth – Hydrothermal growth method.

Unit: III	**Melt Growth Techniques**	17 Hrs.

Basics of melt growth - Bridgman method – Growth apparatus: Crucibles, Heater, measurement and control of temperature – growth process – Applications of Bridgman method; Czochralski technique – Growth apparatus – seed preparation – pulling rate – shape of crystal melt interface – Growth process.

Unit: IV	**Vapour Growth Techniques**	19 Hrs.

Physical Vapour Transport (PVT) – Processes of sublimation and condensation – principle – crystal growth in closed and semi-open ampoules – Chemical Vapour Transport – Criteria for the choice of transport reaction – Transported materials and transporting agents – Temperature variation method for crystal growth: Stationary temperature profile, Linearly time varying temperature profile and Oscillatory temperature profile.

Unit: V	**Characterization Techniques**	17 Hrs.

X-Ray Diffraction (XRD) – Powder and single crystal – Fourier transform Infrared (FT-IR) – Raman analysis – TG-DTA /DSC – UV-Visible spectrometer – Vickers Micro hardness – Chemical Etching.

	Total Lecture Hours	90

Books for Study:

1. J. C. Brice, Crystal Growth Processes, John Wiley and Sons, New York, 1986.

2. P. Santhana Ragavan and P. Ramasamy, Crystal Growth Processes and Methods, KRU Publications, Kumbakonam, 2001.

Books for References:

1. Govindhan Dhanaraj, Kullaiah Byrappa, Vishwanath Prasad, Michael Dudley (Eds.), Hand book of Crystal Growth, Springer Heidelberg Dordrecht, New York, 2010.
2. H.L. Bhat, Introduction to Crystal Growth Principles and Practice, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2015.
3. Sam Zhang, Lin Ki, Ashok Kumar, Materials Characterization Techniques, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009.
4. G. R. Desiraju, J. J. Vittal, A. Ramanan, Crystal Engineering A Text book, World Scientific, Singapore, 2011.

Web Resources:

https://www.mooc-list.com/tags/x-rays
https://nptel.ac.in/courses/113/106/113106069/
https://onlinecourses.swayam2.ac.in/arp20_ap42/preview

COURSE OUTCOME On Completion of this course, the student will be able to		**K Level**
CO1:	Analyze the theory of nucleation for crystal growth.	**K4**
CO2:	Assume the detailed description on solution and gel growth techniques	**K4**
CO3:	Experiment with the melt and vapour growth techniques easily	**K3**
CO4:	Examine the preparation of crystals using vapour deposition method	**K4**
CO5:	Importance on different characterization techniques	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

Units	CRYSTAL GROWTH AND CHARACTERIZATION TECHNIQUES	Hrs	Mode
I Nucleation theory	Importance of crystal growth, Classification of crystal growth methods, Nucleation Theory, Kinds of nucleation	**4**	**Chalk &Talk, PPT**
	Homogeneous nucleation, Heterogeneous nucleation, secondary nucleation	**4**	
	Classical theory of nucleation: Gibbs Thomson equations for vapour and solution	**5**	
	Kinetic theory of nucleation, Energy of formation of a spherical nucleus and cylindrical nucleus.	**5**	
II Solution Growth Techniques	**Growth from low temperature solutions:** Selection of solvents and solubility, Meir's solubility diagram, Saturation and supersaturation, Metastable zone width Growth by restricted evaporation of solvent, slow cooling of solution and temperature gradient methods.	**5**	**Chalk &Talk, PPT, Assignment**
	Growth Technique: Principle, Various types, Structure of gel, Importance of gel, Experimental procedure	**5**	
	Chemical reaction method, Single and double diffusion method, Chemical reduction method, Complex and decomplexion method, Advantages of gel method.	**5**	
	Growth from high temperature solutions: Flux growth – Hydrothermal growth method.	**4**	
III Melt Growth Techniques	Basics of melt growth, Bridgman method, Growth apparatus: Crucibles, Heater, measurement and control of temperature	**6**	**Chalk &Talk**
	growth process, Applications of Bridgman method; Czochralski technique, Growth apparatus	**5**	
	seedpreparation, pulling rate, shape of crystal melt interface, Growth process.	**6**	
IV Vapour Growth Techniques	Physical Vapour Transport (PVT), Processes of sublimation and condensation, principle, crystal growth in closed and semi-open ampoules.	**6**	**Chalk &Talk, Class Test**
	Chemical Vapour Transport, Criteria for the choice of transport reaction. Transported materials and transporting agents.	**6**	
	Temperature variation method for crystal growth: Stationary temperature profile, Linearly time varying temperature profile and Oscillatory temperature profile.	**6**	
V Characterization Techniques	X-Ray Diffraction (XRD), Powder and single crystal.	**6**	**Seminar, Chalk &Talk, PPT**
	Fourier transform Infrared (FT-IR), Raman analysis.	**6**	
	TG-DTA / DSC, UV-Visible spectrometer, Vickers Micro hardness, Chemical Etching.	**6**	

Course Designed by: **Dr. S. Ramaswamy & Mr. N. Venkatesh Bharathi**

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**	**K4**	2	K1	1	K1	2 (K3&K3)	1(K4)
	CO2	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
CI AII	**CO3**	**K3**	2	K1	1	K1	2 (K3&K3)	1(K3)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	**K1**	2	2	-	-	4	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

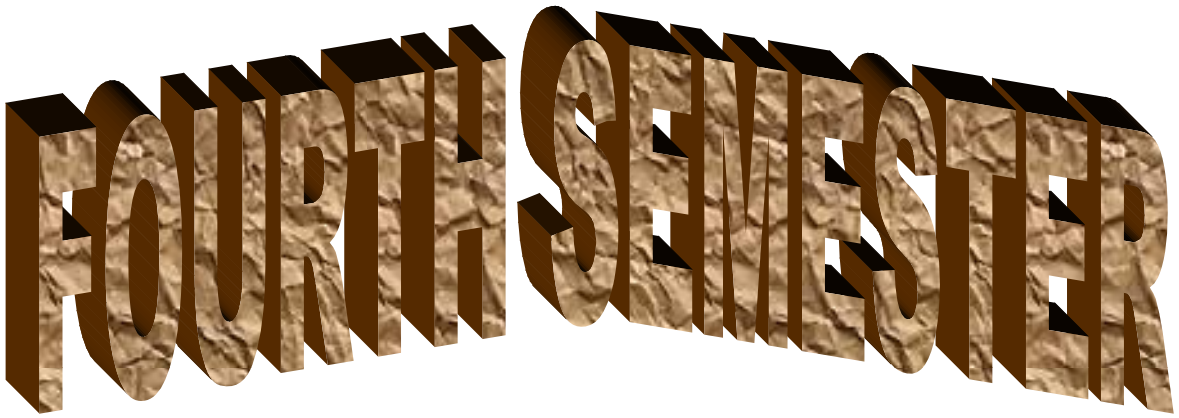
CO5 will be allotted for individual Assignment which carries five marks as a part of CIA component.

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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answer Questions) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either or Choice Questions) **Answer All Questions**			**(5x5=25 marks)**
Q. No	**CO**	**K Level**	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
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	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	


FOURTH SEMESTER

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

Course Name	**SOLID STATE PHYSICS - II**				
Course Code	**21PPHC41**			**L**	**P**	**C**
Category	**Core**			6	-	4
Nature of course:	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENURSHIP		

COURSE OBJECTIVES:

- To recognize the occurrence of superconductivity and different theories about it.
- To understand the properties of para, dia and ferro magnetic materials.
- To study the importance of the Dielectric and ferroelectric solid systems and its potential applications.
- To get knowledge of plasmons, polaritons, polarons an exitons.
- To elucidate the electrical and optical properties of crystalline solids.
- To familiarize about various defects in solids and concepts of alloys.

Unit: I	**Superconductivity**	18 Hrs.

Experimental survey - Occurrence of superconductivity - Destruction of superconductivity by magnetic fields - Meissner effect - Heat capacity - Energy gap – Microwave and infrared properties - Isotope effect - London equation - Coherence length - BCS theory of superconductivity - BCS ground state - Flux quantization in a superconducting ring - Duration of persistent currents - Type II superconductors - Vortex state - Estimation of H_{c1} and H_{c2} - Single particle tunneling - Josephson superconductor tunneling – DC Josephson effect - AC Josephson effect - Macroscopic quantum interference.

Unit: II	**Magnetic Properties of Materials**	19 Hrs.

Diamagnetism and paramagnetism: Langevin diamagnetism equation - Quantum theory of diamagnetism of mononuclear systems - Paramagnetism - Quantum theory of paramagnetism - Hund rules - Crystal field splitting - Spectroscopic splitting factor - Van Vleck temperature-independent paramagnetism. Ferromegnetism and antiferromegnetism: Ferromagnetic order - Curie point and the exchange integral - Temperature dependence of the saturation magnetization - Magnons - Quantization of spin waves - Thermal excitation of magnons - Ferrimagnetic order - Curie temperature and susceptibility of ferrimagnets - Antiferromagnetic order - Susceptibility below the Neel temperature - Ferromagnetic domains - Anisotropy energy - Transition region between domains - Origin of domains.

Unit: III	**Plasmons, Polaritons, Polarons and Excitons**	19 Hrs.

Plasmons, Polaritons and Polarons: Dielectric function of the electron gas - Definitions - Plasma optics - dispersion relation for electromagnetic waves - transverse optical modes in a plasma - Transparency of metals in the ultraviolet - Longitudinal plasma oscillations - Plasmons - Electrostatic screening - Screened coulomb potential - Polaritons - LST Relation - Electron-Electron interaction - Fermi liquid - Electron-Electron collisions - Electron-Phonon interaction: Polarons - Optical processes and excitons: Optical reflectance - Kramers-Kronig relations - Excitons - Frenkel excitons - Alkali halides - Molecular crystals - Weakly bound (Mott-Wannier) excitons - Exciton condensation into electron-hole drops (EHD) - Raman effect in crystals.

Unit: IV	**Dielectrics and Ferroelectrics**	18 Hrs.

Dielectrics and Ferroelectrics: Maxwell equations - Polarization - Macroscopic electric field - Depolarization field - Local electric field at an atom - Lorentz field - Field of dipoles inside cavity -

Dielectric constant and polarizability- Electronic polarizability - Classical theory of electronic polarizability - Ferroelectric crystals - Classification of ferroelectric crystals - Displacive transitions - Soft optical phonons - Landau theory of the phase transition - Second-order transition - First-order transition - Antiferroelectricity - Ferroelectric domains - Piezoelectricity.		
Unit: V	**Defects in Solids and Alloys**	16 Hrs.
Point defects: Lattice vacancies - Color centers - F centers - Other centers in alkali halides. Dislocations: slip - dislocations - Burgers vectors - Stress fields of dislocations - Dislocation densities - Dislocations and crystal growth - Whiskers - Hardness of materials. Alloys: substitutional solid solutions - Hume-Rothery rules - Order-Disorder transformation - Elementary theory of order - Kondo effect.		
	Total Lecture Hours	90 Hrs.

Books for Study:

1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Wiley India Pvt. Ltd., New Delhi - 110 002. (2005) Reprint 2019.
   - Unit - I: Chapters 10
   - Unit - II: Chapter 11 and 12
   - Unit - III: Chapter 14 and 15
   - Unit - IV: Chapters 16
   - Unit - V: Chapters 20, 21 and 22

Books for References:

1. S.L. Kakani and C. Hemarajani, Solid State Physics, Sultan Chand & Sons Educational Publishers, New Delhi - 2, Fourth Edition, 2005.
2. Neil W. Aschroft and N. David. Mermin, Solid State Physics, Cengage Learning Publishers, New Delhi, Fourteenth Indian reprint, 2014.
3. M.A. Wahab, Solid State Physics, Narosa Publishing House, Chennai, Third Edition, 2015, Sixth Reprint 2017.
4. M. Ali Omar, Elementary Solid State Physics - Principles and Applications, Addison Wesley, New Delhi, 2000.
5. A.O.E. Animalu, Intermedite Quantum Theory of the Crystalline Solid, Prentice Hall, New Delhi, 1977.
6. S.O. Pillai, Solid State Physics, New Age International Publishers, New Delhi, 1997.

Web Resources:

https://www.mooc-list.com/course/solid-state-devices-1-edx
https://nptel.ac.in/courses/115/105/115105099/
https://www.classcentral.com/course/swayam-solid-state-physics-14298

COURSE OUTCOME		**K Level**
On Completion of this course, the student will be able to		
CO1:	Analyze the basic concepts of the occurrence of Super Conductivity and to study the characteristic properties, types and applications of superconductors.	**K4**
CO2:	Categorize about properties and phase change phenomena in Magnetic materials.	**K4**
CO3:	Apply the concepts of electron, phonon and excitons with their optical properties in crystals.	**K3**
CO4:	Relate and differentiate the basic theories to explain the behaviors of various materials like dielectric, ferroelectric materials.	**K4**
CO5:	Make use of the concepts of defects and dislocations in crystals for higher studies	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

Units	SOLID STATE PHYSICS - II	Hrs.	Mode
I Superconductivity	Experimental survey, Occurrence of superconductivity, Destruction of superconductivity by magnetic fields, Meissner effect, Heat capacity.	**4**	**Chalk &Talk, PPT**
	Energy gap, Microwave and infrared properties, Isotope effect, London equation, Coherence length.	**4**	
	BCS theory of superconductivity, BCS ground state, Flux quantization in a superconducting ring, Duration of persistent currents, Type II superconductors, Vortex state, Estimation of H_{c1} and H_{c2}.	**5**	
	Single particle tunneling, Josephson superconductor tunneling, DC Josephson effect, AC Josephson effect, Macroscopic quantum interference.	**5**	
II Magnetic properties of materials	Diamagnetism and paramagnetism: Langevin diamagnetism equation, Quantum theory of diamagnetism of mononuclear systems, Paramagnetism, Quantum theory of paramagnetism.	**5**	**Chalk &Talk, PPT, Quiz**
	Hund rules, Crystal field splitting, Spectroscopic splitting factor, Van Vleck temperature-independent paramagnetism.	**4**	
	Ferromegnetism and antiferromegnetism: Ferromagnetic order, Curie point and the exchange integral, Temperature dependence of the saturation magnetization, Magnons, Quantization of spin waves, Thermal excitation of magnons.	**5**	
	Ferrimagnetic order, Curie temperature and susceptibility of ferrimagnets, Antiferromagnetic order, Susceptibility below the Neel temperature, Ferromagnetic domains, Anisotropy energy, Transition region between domains, Origin of domains.	**5**	
III Plasmons, Polaritons,	Plasmons, Polaritons, and Polarons: Dielectric function of the electron gas, Definitions, Plasma optics, dispersion relation for electromagnetic waves, transverse optical modes	**7**	**PPT, Chalk &Talk,**

Polarons & Excitons	in a plasma, Transparency of metals in the ultraviolet, Longitudinal plasma oscillations, Plasmons, Electrostatic screening, Screened coulomb potential.		**Assignment**
	Polaritons - LST Relation - Electron-Electron interaction - Fermi liquid - Electron-Electron collisions - Electron-Phonon interaction: Polarons.	**6**	
	Optical processes and excitons: Optical reflectance - Kramers-Kronig relations - Excitons - Frenkel excitons - Alkali halides - Molecular crystals - Weakly bound (Mott-Wannier) excitons - Exciton condensation into electron-hole drops (EHD) - Raman effect in crystals.	**6**	
IV Dielectrics and Ferro-electrics	Dielectrics and Ferroelectrics: Maxwell's equations, Polarization, Macroscopic electric field (E), Depolarization field (E_1), local electric field at an atom, Lorentz field (E_2), Field of dipoles inside cavity (E_3).	**6**	**Chalk &Talk, PPT, Assignment**
	Dielectric constant and polarizability, Electronic polarizability, Classical theory of electronic polarizability, Ferroelectric crystals, Classification of ferroelectric crystals, Displacive transitions.	**6**	
	Soft optical phonons, Landau theory of the phase transition, Second-order transition, First-order transition, Antiferroelectricity, Ferroelectric domains, Piezoelectricity.	**6**	
V Defects in Solids and Alloys	Point defects: Lattice vacancies, Color centers, F centers, Other centers in alkali halides.	**4**	**Seminar, PPT, Chalk &Talk**
	Dislocations: slip, dislocations, Burgers vectors, Stress fields of dislocations, Dislocation densities, Dislocations and crystal growth, Whiskers,Hardness of materials.	**6**	
	Alloys: substitutional solid solutions, Hume-Rothery rules, Order-Disorder transformation, Elementary theory of order, Kondo effect.	**6**	

Course Designed by: **Dr. S. Ramaswamy & Mr. N. Venkatesh Bharathi**

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**	**K4**	2	K1	1	K1	2 (K3&K3)	1(K4)
	CO2	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
CI AII	**CO3**	**K3**	2	K1	1	K1	2 (K3&K3)	1(K3)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	**K1**	2	2	-	-	4	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answer Questions) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either or Choice Questions) **Answer All Questions**			**(5x5=25 marks)**
Q. No	**CO**	**K Level**	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
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	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**MOLECULAR SPECTROSCOPY**				
Course Code	**21PPHC42**		**L**	**P**	**C**
Category	**Core**		**6**	**-**	**4**
Nature of course:	EMPLOYABILITY	**SKILL ORIENTED** ✓	ENTREPRENEURSHIP		

Course Objectives:

- To describe the spectra of atom in detail
- To discuss the rotational spectra of various molecules in detail
- To gain knowledge from the vibrational spectra of polyatomic molecules.
- To distinguish the Raman spectra of different molecules
- To gain understanding on the importance of electronic spectra of molecules

Unit: I	**Spectra of atoms**	18 Hrs.

Early atomic spectra – Hydrogen spectrum – Angular momentum – Larmor precession – Energy of a magnetic moment in a magnetic field – The vector atom model – Spin orbit interaction – Spectra of alkali atom – Angular momentum of many electron atoms – Energy levels and spectral transitions of helium – Spectral terms of equivalent electrons – Normal Zeeman effect – Anomalous Zeeman effect – Paschen-Bach effect – Influence of nuclear-spin hyperfine structure – Stark effect – Rydberg atom – Lamb shift – Characteristic x-ray spectra – Moseley's law.

Unit: II	**Rotation of molecules**	18 Hrs.

Classification of molecules – Interaction of radiation with rotating molecule – Rotational spectra of rigid diatomic molecules – Isotope effect in rotational spectra – Intensity of rotational lines – Non-rigid rotator – Vibrational Excitation Effect – Linear polyatomic molecules – Symmetric top molecules – Asymmetric top molecules – Stark effect – Quadrupole hyperfine interaction – Interstellar molecules – Microwave Spectrometer – Information derived from rotational spectra.

Unit: III	**Infrared spectroscopy**	18 Hrs.

Vibration energy of a diatomic molecule – Infrared Spectra-Preliminaries – Infrared selection rules – Vibrating diatomic molecule – Diatomic vibrating rotator – Asymmetry of rotation-vibration band – Vibrations of polyatomic molecules – More about anharmonicity – Fermi Resonance – Hydrogen bonding – Rotation-Vibration spectra of polyatomic molecules – IR Spectrophotometer – Instrumentation – Sample handling technique – FTIR Spectroscopy – Applications.

Unit: IV	**Raman spectroscopy**	18 Hrs.

Theory of Raman scattering – Rotational Raman spectra – Vibrational Raman spectra – Mutual Exclusion Principle – Raman spectrometer – Sample handling techniques – Fiber Coupled Raman Spectrometer – Fourier transform Raman spectrometer – Polarization of Raman Scattered light – Single Crystal Raman spectra - Structure determination using IR and Raman spectroscopy – Raman Investigation of Phase transitions – Proton conduction in solids-Raman Spectral study – Industrial applications – Resonance Raman scattering – Raman microscopy.

Unit: V	**Electronic spectra of molecules**	18 Hrs.

Vibrational coarse structure – Vibrational analysis of band systems – Progressions and sequences – Information derived from vibrational analysis – Franck-Condon Principle – Intensity of vibrational electronic spectra – Rotational fine structure of Electronic-Vibration spectra – The Fortrat Parabolae – dissociation – Pre-dissociation. Spin – resonance spectroscopy: Nuclear Magnetic Resonance: Magnetic properties of nuclei – Resonance condition – NMR Instrumentation –

Electron Spin Resonance: Principle of ESR – ESR Spectrometer – Hyperfine structure.	
Total Lecture Hours	**90 Hrs.**

Books for Study:

1. G. Aruldhas, Molecular Structure and Spectroscopy, II Edition, PHI Learning Pvt. Limited, New Delhi, 2011.

Unit – I Chapter 3
Unit – II Chapter 6
Unit – III Chapter 7 (Section 7.1 to 7.11, 7.16 to 7.19)
Unit – IV Chapter 8
Unit – V Chapter 9 (Section 9.1 to 9.12).
Chapter 10(Section10.1 to 10.3)
Chapter 11 (Section 11.1 to 11.3, 11.5)

Books for References:

1. H. J. Michael, Modern Spectroscopy, 4th Edition, Wiley India Pvt. Ltd., New Delhi,2014
2. M. S. Yadev, A text book of Spectroscopy, 2nd Edition, Anmol Publications Pvt. Ltd., New Delhi, 2008
3. P. S. Sindhu, Molecular spectroscopy, 1st Edition, PMH New Delhi, 1988.
4. C.N. Banwell, Fundamentals of Molecular Spectroscopy, 4th Edition, Mc-Graw Hill International Ltd., United Kingdom, Reprint 207.

Web Resources:

1. http://www.freebookcentre.net/Chemistry/Spectroscopy-Books-Download.html
2. http://chemistry.du.ac.in/study_material/202-A/MSc%20Teaching-May%2011,%202020.pdf
3. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5

Course Outcomes		**K Level**
CO1:	Illustrate the spectra's of atom and discuss about the influences of external fields such as electric and magnetic field on matter.	**K4**
CO2:	Elaborate the rotational spectra for various molecules in detail.	**K4**
CO3:	Develop the information on the vibrational spectra of molecules in various forms such as diatomic molecules and poly atomic molecules.	**K3**
CO4:	Analyze Raman spectra of different molecules by its instrumentation	**K4**
CO5:	Measure the electronic spectra of molecules from the detailed understanding from rotational – vibrational spectra	**K5**

CO & PO Mapping:

CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**2**	**2**	**2**
CO 2	**3**	**2**	**3**	**2**	**3**	**3**
CO 3	**2**	**3**	**3**	**3**	**2**	**2**
CO 4	**2**	**2**	**2**	**2**	**3**	**3**
CO 5	**3**	**3**	**1**	**3**	**2**	**2**

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

LESSON PLAN

Unit	MOLECULAR SPECTROSCOPY	Hrs	Mode
I Spectra of atoms	Early atomic spectra, hydrogen spectrum, angular momentum, Larmor precession, energy of a magnetic moment in a magnetic field.	**6**	Chalk & Talk, PPT
	the vector atom model, spin orbit interaction spectra of alkali atom, angular momentum of many electron atom, energy levels and spectral transition of helium, spectral terms of equivalent electrons.	**6**	
	Normal Zeeman effect – Anamolous Zeeman effect – Paschen, Bach effect – influence of nuclear – spin hyperfine structure – Stark effect – Rydberg atom – lamb shift – characteristic x-ray spectra – Moseley's law.	**6**	
II Rotation of molecules	Classification of molecules, interaction of radiation with rotating molecule, rotational spectra of rigid diatomic molecule, isotope effect in rotational spectra, intensity of rotational lines ,	**6**	Chalk, Talk& Assignment
	Non-rigid rotator, Vibrational Excitation Effect, Linear polyatomic molecules, Symmetric top molecules, Asymmetric top molecules	**6**	
	Stark effect, Quadrupole hyperfine interaction, Interstellar molecules, Microwave Spectrometer, Information derived from rotational spectra.	**6**	
III Infrared spectroscopy	Vibration energy of a diatomic molecule Infrared Spectra Preliminaries, Infrared selection rules, Vibrating diatomic molecule, Diatomic vibrating rotator.	**6**	Chalk, Talk& class test
	Asymmetry of rotational - vibrational band, Vibrations of polyatomic molecules, More about anharmonicity, Fermi Resonance, Hydrogen bonding, Rotation – Vibration spectra of polyatomic molecules.	**6**	
	IR Spectrometer, Sample handling technique, FTIR Spectroscopy.	**6**	
IV Raman spectroscopy	Theory of Raman scattering, Rotational Raman spectra, Vibrational Raman spectra, Mutual Exclusion Principle.	**6**	Chalk & Talk, PPT
	Raman spectrometer, Sample handling techniques, Fibre Coupled Raman Spectrometer, Fourier transform Raman spectrometer, Polarization of Raman Scattered light, Single Crystal Raman spectra, Structure determination using IR and Raman spectroscopy.	**6**	
	Raman Investigation of Phase transition, Proton conduction in solids, Raman Spectral studies, Industrial applications, Resonance Raman scattering, Raman microscopy.	**6**	
V Electronic spectra of molecules	Vibrational coarse structure, Vibrational analysis of band systems, Progressions and sequences, Information derived from vibrational analysis.	**6**	Chalk, Talk& Seminar
	Franck - Condon Principle, Rotational fine structure of Electronic Vibration spectra, The FortratParabolae, Dissociation, Pre-dissociation.	**6**	
	Spin – resonance spectroscopy: Nuclear Magnetic Resonance: Magnetic properties of nuclei, Resonance condition, NMR Instrumentation, Electron Spin Resonance: Principle of ESR, ESR	**6**	

	Spectrometer – Hyperfine structure**.**		

Course Designed by: **Mr. N. Venkatesh Bharathi & 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	**CO1**	**K4**	2	K1	1	K1	2 (K3&K3)	1(K4)
AI	**CO2**	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
CI	**CO3**	**K3**	2	K1	1	K1	2 (K3&K3)	1(K3)
AII	**CO4**	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	**K1**	2	2	-	-	4	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answer Questions)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either or Choice Questions)
Answer All Questions **(5x5=25 marks)**

Q. No	CO	K Level	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	

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	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**ADVANCED PHYSICS PRACTICAL**							
Course Code	**21PPHCP3**					**L**	**P**	**C**
Category	**Core**					-	3	4
Nature of Course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**			✓

COURSE OBJECTIVES:

- To give hands on training in the construction of simple electronics circuits.
- To develop the skills in handling instruments and make measurements.
- To get familiarization on advanced physics experiments.
- To make the students to understand practically the characteristics of filters, counters, registers and converters. To acquire knowledge of semiconductor devices and their applications.
- To understand the concepts of OPAMPS and their uses. To develop the skills in writing programs using microprocessors and microcontrollers.

ANY TWELVE EXPERIMENTS

1. Voltage Regulator using IC 723
2. Pulse Width Modulation Using IC 555 Timer
3. Amplitude Modulation using Transistor
4. Active Filters using OPAMPs
5. Analog Computation using OPAMPs
6. 4 Bit Shift Register using JK Flip Flops
7. 4 Bit D/A Converter
8. 4 Bit Binary Counter
9. Hall Effect Experiment
10. Quincke's Method – Susceptibility measurements
11. Four Probe Method – Band Energy gap
12. Interpretation of PXRD Photograph - indexing, calculating the lattice constant and Debye-Waller factor
13. Fraunhofer Diffraction using Laser
14. Refractive Index of liquids using Laser
15. Michelson's Interferometer
16. Microprocessor 8085 (Assembly Language Program)
17. Microprocessor 8085 (Interfacing I/O Operation)
18. Microcontroller 8051 based experiments

COURSE OUTCOMES	**K Level**
On Completion of this course, the students will be able to	
Understand the behavior of electronic components and perform analysis and design of electronic circuits.	**K1**
Set up testing strategies and select proper instruments to evaluate performance characteristics of electronic circuits.	**K5**
Choose the testing and experimental procedures on different types of electronic circuits and analyze their operation in different operating conditions.	**K4**
Gain knowledge of semiconductor devices and their applications.	**K2**
Build the skills in handling instruments and make measurements.	**K3**

CO & PO Mapping:

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

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

Course designed by: **Dr. S. Ramaswamy & Mr. N. Venkatesh Bharathi**

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

Course Name	**Project**							
Course Code	**21PPHPR1**					**L**	**P**	**C**
Category	**Core**					-	3	-
Nature of course:	EMPLOYABILITY	✓	SKILL ORIENTED	✓	ENTREPRENEURSHIP			✓

COURSE OBJECTIVES:

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

- Evaluation method for Project:

	Max. Marks		**Credit**
	Internal	**External**	
Project evaluation	**40**	**40**	**4**
Viva Voce	**-**	**20**	
Total	**100**		

- Internal examiners are the respective supervisors.
- Viva –voce examination to be evaluated by the external examiner.
- The report of the project must be in the prescribed form. It should be typed neatly in MS word with the equation editor or using Latex. The font size of the letter should be 12 with double space.
- The format of the project should have the following components.
    - First page should contain
    - Title of the project report
    - Name of the candidate
    - Register number
    - Name of the supervisor
    - Address of the institution
    - Month and year of submission

➢ Contents
➢ Declaration by candidate
➢ Certificate by supervisor
➢ Acknowledgement
➢ Preface

- Chapter-1-Preliminaries
- Other chapters
- References

  - ✓ The number of pages in the project may be 40 to 50
  - ✓ Each page should contain at least 18 lines
  - ✓ Three copies of the project report with binding should be submitted.

COURSE OUTCOME		**K Level**
On Completion of this course, the students will be able to		
CO1:	Familiarize various theories behind the instrumentation involved in the Characterizations techniques.	**K1**
CO2:	Get hands on experience on different instrumentation techniques to design a research problem and solve it using different research methods.	**K2**
CO3:	Organize and pursue a scientific and industrial research project and work effectively as an individual in multidisciplinary settings.	**K3**
CO4:	Analyze the theoretical problems and solve them using the knowledge of basic Physics ideas.	**K4**
CO5:	Have a comprehensive idea on research methods, methodology and ethics to communicate the research findings.	**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	2	3	2	2	2	2
CO3	2	1	2	3	2	2
CO4	2	2	2	3	3	3
CO5	2	2	2	2	3	2

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

Course Designed by: **Dr. S. Ramaswamy & Mr. P. Dharmaraja**

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

Course Name	**NUCLEAR AND PARTICLE PHYSICS**				
Course Code	**21PPHE41**		**L**	**P**	**C**
Core	**Elective**		6	-	6
Nature of course	EMPLOYABILITY	**SKILL ORIENTED** ✓	ENTREPRENEURSHIP		

Course Objectives

- To describe the properties of Nucleus and Deuteron.
- To illustrate the characteristics of radioactivity and their detectors.
- To outline the various nuclear models and nuclear accelerators.
- To determine the energy values in nuclear reactions.
- To classify the elementary particles and their interactions.

Unit: I	**GENERAL PROPERTIES OF ATOMIC NUCLEI AND NUCLEAR FORCES**	19 Hrs.

General Properties Of Atomic Nuclei – Nuclear spin – Pauli's spin – parity of Nuclei – Nuclear size – Nuclear mass and mass spectroscopy – double focusing spectrometer – Nier's mass spectrograph – Nuclear stability, binding energy, mass defect and packing fraction – Semi-empirical mass formula – The Deuteron – Magnetic moment of the Deuteron – The meson theory of nuclear forces – Charge independence of nuclear Forces**.**

Unit: II	**RADIOACTIVITY AND NUCLEAR DETECTORS**	20 Hrs.

Alpha Ray Emission: Properties of Alpha-particles – velocity and energy of alpha-particles – Scattering of alpha particles – Alpha-decay and barrier penetration – Gamow's theory of alpha decay. Beta Decay: General Features of β-Ray spectrum – Fermi's theory of β-decay-forms of interaction and selection rules – parity in beta decay. Gamma-Rays: Absorption of γ-rays by matter-interaction of γ-rays with matter – multipole radiations – nuclear isomerism. Nuclear Detectors: Ionization Chamber – Proportional counter – Geiger-Muller counter – Scintillation counter – Semiconductor counter – Cloud and the bubble chamber.

Unit: III	**NUCLEAR MODELS AND PARTICLE ACCELERATORS**	16 Hrs.

Nuclear Model: The degenerate gas model – Quantum mechanical treatment – The liquid drop model – The alpha-particle model – The shell model – Collective model – vibrational state – rotational states – Unified model – Optical model. Particle Accelerators: Van de Graff Electrostatic Generators – The Cyclotron – Betatron – The Synchro-cyclotron – The Electron synchrotron.

Unit: IV	**NUCLEAR REACTIONS AND NUCLEAR ENERGY**	17 Hrs.

Nuclear Reactions: Conservation laws for Nuclear Reactions – Nuclear reaction cross sections – Theories of Nuclear Reactions – The compound nucleus – Direct reactions – Theory of Stripping and Pick up reactions. Nuclear Energy: Mass and energy distribution of fission fragments – Neutron emission in fission process – prompt and delayed neutrons – Theory of nuclear fission and the Liquid drop model – The nuclear chain reaction – controlled fission-nuclear reactors – Transuranic elements – The fusion reaction – Thermo-nuclear reactions as source of stellar energy Controlled Thermonuclear reactions – The possibility of fusion reactor.

Unit: V	**ELEMENTARY PARTICLES**	18 Hrs.

Classification of elementary particles – Fundamental interactions (Gravitational, electromagnetic, strong, weak) – Conservation laws – Invariance under charge, parity , C.P., time and CPT – Electron and positron – Proton and anti- proton – Neutron and anti- neutron – Neutrino and anti-

neutrino Photon and Gluon – Meson: muons, Tauons, Pions, K- meson ,η - mesons, Hyperons : Λ -, Ξ, ∑, Ω- hyperons. Quarks.		
	Total Lecture Hours	90

Books for study:

1. M.L. Pandya, R.P.S. Yadav and A. Dash, Elements of Nuclear Physics, 8th Edition, Kedar Nath Ram Nath Publications, Meerut, 2019.

Unit – I Chapter 1 (Section 1.1 to 1.4, 1.10-1.13, 1.16 & 1.18)
Chapter 2 (Section 2.1, 2.2,2.5 & 2.16)
Unit – II Chapter 5 (Section 5.1-5.5)
Chapter 6 (Section 6.4 - 6.7)
Chapter 7 (Section 7.1 to 7.3, 7.6, 7.8 & 7.10)
Chapter 8(Section 8.1-8.5, 8.7 & 8.9)
Unit – III Chapter 3 (Section 3.1 - 3.6)
Chapter 9 (Section 9.9, 9.11, 9.12, 9.14 & 9.15)
Unit – IV Chapter 11(Section11.1,11.8-11.12)
Chapter 12 (Section 12.1 -12.3,12.7, 12.9-12.14)

2. D .C. Tayal, Nuclear Physics, Revised and Enlarged Edition, Himalaya Publishing House, New Delhi, 2008.

Unit – V Chapter 18 (Section 18.1 to 18.15 & 18.19).

Reference:

1. R.R Roy and B.P. Nigam, Nuclear Physics (Theory and experiment), 3rd Edition, Wiley Eastern Ltd, New Delhi,2006.
2. V. Devanathan, Nuclear Physics, 2nd Edition, Narosa Publishing House Private Limited, New Delhi,2011.
3. Dr.S.N.Ghoshal, Nuclear Physics, S. Chand & Company Pvt. Ltd.,2006
4. A.B.Gupta and H.Roy, Physics of the Nucleus, Books and Allied (P), 2008
5. Sathya Prakash, Nuclear Physics & Particle Physics, Sultan Chand & Sons, New Delhi, 2005.
6. I. Kaplan, Nuclear Physics, 2nd Edition, Addison-Wesley Publishing Company, United Kingdom, 1977.

Web resources

https://nptel.ac.in/courses/115/104/115104043/

Course Outcomes		**K Level**
On Completion of this course, the student will be able to		
CO1:	Describe the basic nuclear properties and the concept of nuclear forces	**K2**
CO2:	Build the knowledge of radioactivity and the essential instrumentation for detection	**K3**
CO3:	Compute the nuclear models and particle accelerators.	**K3**
CO4:	Analyze the energy values in kinematics of nuclear reactions, fission and fusion reactions	**K4**
CO5:	Evaluate the properties of elementary particles and their associated symmetries, conservation laws	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

Units	NUCLEAR AND PARTICLE PHYSICS	Hrs	Mode
I Basic Nuclear Properties and Nuclear Forces	Basic Nuclear Properties and Nuclear Forces: Nuclear spin, Pauli's spin, parity of Nuclei, Nuclear size, Nuclear mass and mass spectroscopy, double focusing spectrometer	**6**	**Chalk & Talk**
	Nier's mass spectrograph, Nuclear stability, binding energy, mass defect and packing fraction, Semi-empirical mass formula, Nuclear Forces: Concept of Nuclear forces	**6**	
	The Deuteron, Magnetic moment of Deuteron, The meson theory of nuclear forces, Charge independence of nuclear Forces	**7**	
II Radioactivity and nuclear detectors	Alpha Ray Emission: Properties of Alpha particles, velocity and energy of alpha-particles, Scattering of alpha particles, Alpha-decay and barrier penetration, Gamow's theory of alpha decay	**7**	**Chalk & Talk, PPT, seminar**
	Beta Decay: General Features of β-Ray spectrum, Fermi's theory of β-decay, form of interaction and selection rules-non conservation of parity in beta decay. Gamma-Rays: Absorption of γ-rays by matter, interaction of γ-rays with matter, multipole radiations, nuclear isomerism	**6**	
	Nuclear Detectors: Ionization chamber, Proportional counter, Geiger counter, Scintillation counter, Semiconductor counter, Cloud and bubble chambers	**6**	
III Nuclear models and particle accelerators	Nuclear Model: The degenerate gas model, Quantum mechanical treatment, The liquid drop model, The alpha-particle model	**6**	**Chalk & Talk, exercise**
	The shell model, Collective model, vibrational states, rotational states, Unified model, Optical model	**5**	

	Particle Accelerators: Van de Graff Electrostatic Generators, The Cyclotron, Betatron, Synchro-cyclotron, Electron synchrotron.	**5**	
IV Nuclear Reactions	Conservation laws for Nuclear Reactions, Nuclear reaction cross sections, Theories of Nuclear Reactions, The compound nucleus, Direct reactions	**6**	**Chalk & Talk, Assignment**
	Theory of Stripping and Pick up reactions. Nuclear Energy: Mass energy distribution of fission fragments, Neutron emission in fission process-prompt and delayed neutrons, Theory of nuclear fission	**5**	
	Liquid drop model, The nuclear chain reaction, controlled fission, nuclear reactors, Transuranic elements, fusion reaction, Thermo-nuclear reactions as source of stellar energy, The possibility of fusion reactor.	**6**	
V Elementary particles	Classification of elementary particles, Particle interactions (Gravitational, electromagnetic, strong, weak), Conservation laws	**6**	**Chalk & Talk , Exercise**
	Invariance under charge, parity, C.P, C.P.T, Electrons and positrons, Protons and anti- protons, Neutrons and anti- neutrons	**6**	
	Neutrinos and anti- neutrinos, Meson: muons, Pions, K- meson, η - mesons, Hyperons: Λ -, Ξ, $\sum$, Ω- hyperons. Quarks	**6**	

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 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	1	K1	2 (K2&K2)	1(K2)
	CO2	**K3**	2	K2	2	K2	2 (K3&K3)	1(K3)
CI AII	**CO3**	**K3**	2	K1	1	K2	2 (K3&K3)	1(K3)
	CO4	**K4**	2	K2	2	K2	2 (K4&K4)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	4	8	20
	K2	2	6	-	-	6	12	
	K3	-	-	10	10	20	40	40
	K4	-	-	10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as a 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	K2	2	K1&K2	1	K1	2 (K2&K2)	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	-	-	9	7.5	50
K2	5	6	30	10	51	42.5	
K3	-	-	20	20	40	33.34	33
K4	-	-	-	10	10	8.33	8
K5	-	-	-	10	10	8.33	9
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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answer Questions)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either or Choice Questions)
Answer All Questions **(5x5=25 marks)**

Q. No	CO	K Level	
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K2	
18) b	CO3	K2	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	

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

Section D (Open Choice)
Answer Any Three questions **(3x10=30 marks)**

Q. No	CO	K Level	Questions
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**ELECTRONIC COMMUNICATIONS**				
Course Code	**21PPHE42**		**L**	**P**	**C**
Category	**Elective**		**6**	**-**	**6**
Nature of course:	EMPLOYABILITY	**SKILL ORIENTED** ✓	ENTREPRENEURSHIP		

Course Objectives:

- To discuss about the digital communication system and its associated devices in detail
- To elaborate on the propagation of radio waves through various layers of atmosphere
- To develop understanding about antenna characteristics such as power gain, effective area, effective length.
- To correlate the details of satellite orbit, positioning and station keeping
- To describe the light propagation in fiber optic cables

Unit: I	**Digital Communication**	**18 Hrs.**

Synchronization – Asynchronous transmission – Probability of Bit error in baseband transmission – Matched filter – Optimum terminal filters – Bit timing recovery – Eye diagrams – Digital carrier systems : Frequency shift keying, Phase shift keying – Carrier recovery circuits – Differential phase shift keying – Hard and soft decision decoders – Error control coding: Block codes.

Unit: II	**Radio wave propagation**	**18 Hrs.**

Propagation in free space: Mode of propagation, Microwave systems – Tropospheric propagation: Mode of propagation, Radio horizon, Contour maps, Super and subrefractions, Attenuation in the atmosphere, VHF/UHF radio systems – Ionospheric propagation – Surface wave – Low frequency propagation and very low frequency – Extremely low frequency propagation.

Unit: III	**Antennas**	**18 Hrs.**

Antenna equivalent circuits – Coordinate system – Radiation fields – Polarization – Isotrophic radiator – Power gain of an antenna – Effective area of an antenna – Effective length of an antenna – Hertzian dipole – Half wave dipole – Vertical antennas – Folded elements – Loop and ferrite rod receiving antennas – Nonresonant antennas – Driven arrays – Parasitic arrays.

Unit: IV	**Satellite communication**	**18 Hrs.**

Kepler's First law – Kepler's second law – Kepler's third law – Orbits – Geostationary orbit – Power systems – Attitude control – satellite station keeping – Antenna look angles – Limits of visibility – Frequency plans and polarization – Transponders – Uplink power budget calculations – Downlink power budget calculations – Overall link budget calculation

Unit: V	**Fiber optic communication**	**18 Hrs.**

Principles of light transmission in a fiber: Propagation within a fiber, Fiber index profiles, Mode of propagation, Number of propagated modes in step index fibers – Losses in fibers – Dispersion – Light sources for fiber optics – Photodetectors – Connectors and splices – Fiber-optic communication link.

	Total Lecture Hours	**90 Hrs.**

Books for Study:

1. D. Roddy and J. Coolen, Electronic Communication, 4th Edition, PHI Private Ltd., (1999).

Unit I - Chapter 12
Unit II - Chapter 15
Unit III - Chapter 16 (Section 16.1 to 16.17)

Unit IV - Chapter 19 (Section 19.1 to 19.16) Unit V - Chapter 20
Books for References:
1. Sanjeev Gupta, Electronic Communication Systems (Khanna Publications, New Delhi, 1995). 2. N.D. Deshandae, P.K. Rangole, Communication Electronics, Tata McGraw Hill Pvt. Ltd., 1998. 3. M. Arumugam, Optical Fiber Communication and Sensors, Anuradha Agencies, Kumbakonam, 2002. 4. G. Kennedy and Davis, Electronic Communication system, TMH, New Delhi, 1999. 5. Gerd Keiser, Optical Fiber Communication, Third Edition, McGraw – Hill, Singapore, 2000. 6. Raj Pandya, Mobile and Personal Communication Services and Systems, Prentice Hall of India Private Ltd., New Delhi, 2003.
Web Resources:
1. https://www.coursera.org/courses?query=vector%20calculus **2. https://nptel.ac.in/courses/111/105/111105122/** **3. https://nptel.ac.in/courses/111/106/111106100**

Course Outcomes		**K Level**
On Completion of this course, the student will be able to		
CO1:	Classify the digital communication system and about its various components	**K4**
CO2:	Correlate the radio wave propagation through various atmospheric layer such as in trophospheric, ionospheric, surface and at ground zones	**K4**
CO3:	Collect depth knowledge on antenna in terms of power gain, effective area and effective length, etc.,	**K3**
CO4:	Analyze satellite communication in terms of its orbit, positioning and station keeping	**K4**
CO5:	Predict the theory behind light transmission that occurs in fiber optics	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

Unit	ELECTRONIC COMMUNICATIONS	Hrs	Mode
I Digital Communications	Synchronization, Asynchronous transmission, probability of Bit error in baseband transmission, the matched filter, optimum terminal filters, bit timing Recovery, eye diagrams.	**6**	**Chalk & Talk, PPT**
	Digital carrier systems: frequency shift keying, phase shift keying, carrier recovery circuits, differential phase shift keying.	**6**	
	Hard and soft decision decoders, error control coding: block codes.	**6**	
II Radio wave propagation	Propagation in free space: mode of propagation , microwave systems,	**6**	**Chalk, Talk &Assignment**
	tropospheric propagation: mode of propagation, radio horizon, contour maps, super and sub refractions, attenuation in the atmosphere, VHF/UHF radio systems,	**6**	
	ionospheric propagation, surface wave, low frequency propagation and very low frequency, extremely low frequency propagation	**6**	
III Antennas	Antenna equivalent circuits, coordinate system, radiation fields, polarization, isotrophic radiator	**6**	**Chalk, Talk& Exercise**
	power gain of an antenna, effective area of an antenna, effective length of an antenna, Hertzian dipole, half wave dipole	**6**	
	vertical antennas, folded elements, loop and ferrite rod receiving antennas non resonant antennas, driven arrays, parasitic arrays.	**6**	
IV Satellite communication	Kepler's First law , Kepler's second law , Kepler's third law, orbits , Geostationary orbit, power systems, Attitude control	**6**	**Chalk & Talk, PPT**
	satellite station keeping, Antenna look angles, limits of visibility, frequency plan and polarization, transponders,	**6**	
	uplink power budget calculations, downlink power budget calculations, overall link budget calculation	**6**	
V Fiber optic communication	Principles of light, principles of light transmission in a fiber: propagation within a fiber,	**6**	**Chalk, Talk& Seminar**
	Fiber index profiles, mode of propagation, number of propagated modes in step index fibers, losses in fibers, dispersion	**6**	
	light sources for optic fibers, photodetectors, connectors and splices, fiber optic communication link.	**6**	

Course Designed by: **Mr. N. Venkatesh Bharathi & 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**	**K4**	2	K1	1	K1	2 (K3&K3)	1(K4)
	CO2	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
CI AII	**CO3**	**K3**	2	K1	1	K1	2 (K3&K3)	1(K3)
	CO4	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	**K1**	2	2	-	-	4	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answer Questions)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either or Choice Questions)
Answer All Questions **(5x5=25 marks)**

Q. No	CO	K Level	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	

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	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**ADVANCED OPTICS**					
Course Code	**21PPHE43**			**L**	**P**	**C**
Category	**Elective**			**6**	**-**	**6**
Nature of course	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP		

COURSE OBJECTIVES:

- To acquire the knowledge about the magneto and electro optic effects.
- To know about laser principles and their types.
- To study the holographic formation and applications.
- To understand the principles and applications of fiber and non-linear optics and their applications.
- To teach an introduction on radar system and its application.

Unit: I	**Magneto – optics and Electro – optics**	18 Hrs.

Faraday effect – Determination of magnetic rotation – Classical theory of Faraday effects - Electro-optic effect – Kerr electro – optic effect – Determination of speed of light by Kerr cell – Significance of the velocity of light.

Unit: II	**Lasers**	19 Hrs.

Absorption and emission of radiation by matter – Einstein's theory: A and B co-efficient - Population inversion : different methods – Basic laser system : Main components _ Optical resonator : Q- value – Threshold condition for laser action – An alternative expression for threshold condition – Typical lasers: Pulsed Ruby laser – Continuous He-Ne laser – CO_2 laser – Nd :YAG laser – Semiconductor laser – Properties and uses of a laser beam.

Unit: III	**Fibre Optics**	19 Hrs.

Structure and classification – Acceptance angle and numerical aperture – Fractional index change – Skip distance : Number of internal reflections – Ray path in a graded – index (GRIN) fibre – Dispersion: Intermodal dispersion – Intra-modal dispersion - Fibre optic sensors – Losses in optical fibre – Mechanisms of attenuation – Fibre optics communication system – Advantages of optical fibre communication – Applications of fibre optics.

Unit: IV	**Atom Laser**	17 Hrs.

Bose-Einstein condensation - Methods of cooling the atoms – Laser Doppler cooling – Trapping of atoms – Evaporate cooling – Basic laser system – Important characteristics of a laser beam – Optical laser Vs atom laser – applications of atom laser.

Unit: V	**Non- linear optics**	17 Hrs.

Linear and non-linear optics – Harmonic generation – Wave propagation and momentum conservation – Momentum mismatch: Phase matching condition, angle tuning – Sum and difference of frequency generation – Self-focusing phenomenon of light – Stimulated Raman scattering.

	Total Lecture Hours	90 Hrs.

Book for study:

1. B. Gupta, Modern Optics, 3rd edition, Arunabha Sen Books & Allied Pvt. Ltd., Kolkata, (2012).
Unit I: Chapter - 19
Unit 2: Chapter – 21 (21.1 - 21.14)
Unit 3: Chapter - 22
Unit 4: Chapter -23
Unit 5: Chapter - 24

Books for References:

1. Grant R. Fowles, Introduction to Modern optics, 2nd Edition, Dover Publications, INC., New York, 2012.
2. B.D. Guenther, Modern optics, 2nd Edition, Oxford University Press, New York, 2015.
3. S. H. Guang, Non- linear optic and Photonics, 1st Edition, Oxford University Press, New York, 2014.

Web Resources:

https://www.mooc-list.com/course/phys201x-waves-optics-edx
https://nptel.ac.in/courses/117/101/117101002/
https://onlinecourses.nptel.ac.in/noc20_ee48/preview

COURSE OUTCOMES		K Level
CO1:	Analyze the propagation of light in conducting and non-conducting media.	K4
CO2:	Examine the laser behavior and light matter interaction.	K4
CO3:	Apply wave optics and diffraction theory to a range of problems.	K3
CO4:	Classify the tools, methodologies, language and conventions of physics for test and communicative ideas and explanations.	K4
CO5:	Predict the properties of various lasers and the propagation of laser beams.	K5

CO & PO Mapping:

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

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

LESSON PLAN

UNIT	ADVANCED OPTICS	Hrs	Mode
I Magneto – optics and Electro – optics	Faraday effect, Determination of magnetic rotation, Classical theory of Faraday effects	**7**	**Chalk, Talk & PPT**
	Electro-optic effect, Kerr electro , optic effect , Determination of speed of light by Kerr cell	**6**	
	Significance of the velocity of light	**5**	
II Lasers	Absorption and emission of radiation by matter, Einstein‟s theory : A and B co-efficient, Population inversion : different methods	**6**	**Chalk,Talk**
	Basic laser system : Main components , Optical resonator : Q-value , Threshold condition for laser action	**6**	
	An alternative expression for threshold condition , Typical lasers: Pulsed Ruby laser, Continuous He-Ne laser, CO2 laser, Nd :YAG laser , Semiconductor laser , Properties and uses of a laser beam	**7**	
III Fibre Optics	Structure and classification, Acceptance angle and numerical aperture, Fractional index change , Skip distance : Number of internal reflections	**6**	**Chalk, Talk &Assignment**
	Ray path in a graded, index (GRIN) fibre, Dispersion: Intermodal dispersion , Intra-modal dispersion	**6**	
	Fibre optic sensors, Losses in optical fibre, Mechanisms of attenuation, Fibre optics communication system, Advantages of optical fibre communication, Applications of fibre optics	**7**	
IV Atom Laser	Bose-Einstein condensation , Methods of cooling the atoms	**5**	**Chalk, Talk & Exercise**
	Laser Doppler cooling, Trapping of atoms , Evaporate cooling, Basic laser system	**6**	
	Important characteristics of a laser beam , Optical laser vs atom laser , applications of atom laser	**6**	
V Non- linear optics	Linear and non-linear optics, Harmonic generation, Wave propagation and momentum conservation	**5**	**Chalk, Talk &Seminar**
	Momentum mismatch: Phase matching condition, angle tuning , Sum and difference of frequency generation	**6**	
	Self-focusing phenomenon of light, Stimulated Raman scattering	**6**	

Course designed by: **Mr. P. Dharmaraja & 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**		
CI	**CO1**	**K4**	2	K1	1	K1	2 (K3&K3)	1(K4)
AI	**CO2**	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
CI	**CO3**	**K3**	2	K1	1	K1	2 (K3&K3)	1(K3)
AII	**CO4**	**K4**	2	K2	2	K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	**K1**	2	2	-	-	4	8	20
	K2	2	4	-	-	6	12	
	K3	-	-	20	10	30	60	60
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answer Questions) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either or Choice Questions) **Answer All Questions**			**(5x5=25 marks)**
Q. No	**CO**	**K Level**	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher levelof K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**ASTROPHYSICS**			
Course Code	**21PPHE44**	**L**	**P**	**C**
Category	**Elective**	**6**	**-**	**6**

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP

COURSE OBJECTIVES:

- To acquire knowledge about the fundamentals of stars
- To understand the concepts of laws of radiation and Important relations between stellar parameters
- To recognize the concepts of internal structure of stars
- To familiarize with stellar evolution and study the concepts of binary stars
- To use the phenomenological theories on astronomical instruments

Unit: I	**Spectral Classification of Stars**	18 Hrs.

Bolzmann's formula – Saha's equation of thermal ionization. Harvard system of spectral classification: The Hendry-draper (HD) Catalogue – The luminosity effect on stellar spectra – Importance of ionization theory in astrophysics – Spectroscopic parallax – The Hertzsprung – Russell diagram.

Unit: II	**The Sun**	17 Hrs.

Sun – A Typical Star. The photosphere: Limb-darkening – Solar granulation – Faculae – The chromosphere – Solar corona – Prominences – The eleven year solar cycle and sun spots – The solar magnetic fields – Theory of sun spots – Solar flares – Radio emission from the sun – Solar wind – The solar neutrino puzzle.

Unit: III	**Atmosphere of Stars**	17 Hrs.

Some important definitions **–** The equation of transfer – The solution of the equation of the transfer – Process of absorption in stellar atmospheres – Continuous absorption by the negative hydrogen ions (H^-) in cooler stars – Analysis of spectral line broadening – The curve of growth – Stellar temperatures – The chemical composition of stars.

Unit: IV	**Binary, multiple and variable Stars**	19 Hrs.

Visual Binary – spectroscopic Binary – Eclipsing binary – Multiple Stars – Origin of binary stars – Stellar masses and mass luminosity relation – Mass transfer in close binary systems - Classification of variable stars – The Cepheid group of variables – Period luminosity relations of Cepheid group of variables.

Unit: V	**More stars of interest**	19 Hrs.

Stars with extended atmospheres: The Wolf-Rayet stars – P Cygni and a Cygni stars – Be stars: Shell stars – Of stars – Some cooler stars of interest: Peculiar A stars and Metallic-line A stars – T Tauri stars – The emission-line Red Dwarf (dMe stars) – R Coronae Borealis (R Cor Bor) stars – The carbon stars (R and N stars) – The heavy-metal oxide stars (S stars) – Infrared stars – Sundwarfs - Brown dwarfs.

	Total Lecture Hours	90 Hrs.

Book for study:

1. B. Basu, T. Chattopadhyay, S.N. Biswas, An Introduction to Astrophysics, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, (2011).

Unit –I: Chapter 4

Unit –II: Chapter 5 Unit –III: Chapter 6 Unit –IV: Chapter 7, Chapter 8 (8.1 to 8.3) Unit –V: Chapter 10
Books for References: 1. J. Dufay, Introduction to Astro Physics, 1st Edition, Dover Publications, INC, New York, 2012. 2. K. Badmanabhan, Theoretical Astro Physics, Volume - I, Cambridge University Press, Chennai, 2010. 3. K. D. Abhyankar, AstroPhyscis: Stars and galaxies, Universities Press, Hyderabad, 2001. 4. N. Thomas, An Introduction to Comets, 1st Edition, Springer, 2020.
Web Resources:
https://www.mooc-list.com/tags/astrophysics **https://nptel.ac.in/courses/115/105/115105046/** **https://onlinecourses.swayam2.ac.in/arp19_ap73/preview**

COURSE OUTCOMES		**K Level**
CO1:	Discover the spectral classifications of the stars	**K4**
CO2:	Apply basic physical principles from a broad range of topics in physics to astronomical situations	**K4**
CO3:	Develop skills to design observing instruments with research telescopes and take projects upon literature data and achieves.	**K3**
CO4:	Distinguish the competence in focused areas of astronomical theory and its experiment.	**K4**
CO5:	Categorize the various types of stars with their spectral analyses	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

UNIT	ASTROPHYSICS	Hrs	Mode
I Spectral Classification of Stars	Bolzmann's formula, Saha's equation of thermal ionization. Harvard system of spectral classification	**6**	Chalk, Talk & PPT
	Hendry draper (HD) Catalogue luminosity effect on stellar spectra, Importance of ionization theory in astrophysics	**7**	
	Spectroscopic parallax, Hertzsprung, Russell diagram.	**5**	
II The Sun	Sun, A Typical Star. The photosphere: Limb-darkening, Solar granulation, Faculae, The chromospheres	**5**	Chalk, Talk & Assignment
	Solar corona, Prominences, The eleven year solar cycle and sun spots, Solar magnetic fields	**5**	
	Theory of sun spots, Solar flares, Radio emission from the sun, solar wind, Solar neutrino puzzle.	**7**	
III Atmosphere of Stars	Some important definitions – The equation of transfer – The solution of the equation of the transfer.	**5**	Chalk, Talk, Test & Seminar
	Process of absorption in stellar atmospheres – Continuous absorption by the negative hydrogen ions (H^-) in cooler stars.	**5**	
	Analysis of spectral line broadening – The curve of growth – Stellar temperatures – The chemical composition of stars.	**7**	
IV Binary, multiple and variable Stars	Visual Binary, spectroscopic Binary, Eclipsing binary, Multiple Stars, Origin of binary stars	**6**	Chalk, Talk & Group discussion
	Stellar masses and mass luminosity relation, mass transfer in close binary systems , Classification of variable stars	**7**	
	The Cepheid group of variables, Period luminosity relations of Cepheid group of variables	**6**	
V More stars of interest	Stars with extended atmospheres: The Wolf-Rayet stars, P Cygni and Cygni stars	**6**	Chalk, Talk & Exercise
	Be stars: Shell stars, Of stars, Some cooler stars of interest: Peculiar A stars and Metallic-line Red Dwarf (dMe stars)	**7**	
	R Coronae Borealis (R CorBor) stars, The carbon stars (R and N stars), The heavy-metal oxide stars (S stars), Infrared stars – Brown dwarfs.	**6**	

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

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**	**8**	**20**
	K2	**2**	**4**	**-**	**-**	**6**	**12**	
	K3	**-**	**-**	**20**	**10**	**30**	**60**	**60**
	K4	**-**	**-**	**-**	**10**	**10**	**20**	**20**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**20**
	K2	**2**	**6**	**-**	**-**	**8**	**16**	
	K3	**-**	**-**	**20**	**-**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**20**	**20**	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

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

K3- Application oriented- Solving Problems

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

CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answer Questions)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either or Choice Questions)
Answer All Questions **(5x5=25 marks)**

Q. No	CO	K Level	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	

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

Section D (Open Choice)
Answer Any Three questions **(3x10=30 marks)**

Q. No	CO	K Level	Questions
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**BIO – MEDICAL INSTRUMENTATION**							
Course Code	**21PPHE45**					**L**	**P**	**C**
Category	**Elective**					6	-	6
Nature of Course	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			

COURSE OBJECTIVES:

- To describe the basic transducer principles and their sources
- To discuss the cardiovascular system and measurement of heart sound
- To analyze the principles of monitoring equipment in the patient care
- To illustrate the techniques of equipment for respiratory therapy and ultrasonic diagnosis
- To apply the clinical instruments for diagnosis X-rays &radio therapy.

Unit: I	**BASIC TRANSDUCER PRINCIPLES AND SOURCES OF BIOELECTRIC POTENTIALS**	18 Hrs.

The transducer and transduction principles – active transducers – passive transducers – transducers for biomedical applications – Resting and action potentials – propagation of action potentials – The bioelectric potentials.

Unit: II	**THE CARDIOVASCULAR SYSTEM AND MEASUREMENTS**	18 Hrs.

The Heart and Cardiovascular system – The Heart-Blood pressure – Characteristics of blood flow – Heart sounds – Electrocardiography – Measurement of Blood pressure – Measurement of blood flow and cardiac output – Plethhysmography – Measurement of heart sounds.

Unit: III	**PATIENT CARE AND MONITORING**	18 Hrs.

The elements of Intensive – care monitoring – Diagnosis, Calibration &Respairability of Patient - monitoring equipment – Other instrumentation for monitoring patients – The Organization of the hospital for patient care monitoring – Pacemakers – Defibrillators.

Unit: IV	**RESPIRATORY SYSTEM & NONINVASIVE DIAGNOSTIC INSTRUMENTATION**	18 Hrs.

The Physiology of the Respiratory System – Tests and Instrumentation for the Mechanics of Breathing – Gas exchange and Distribution – Respiratory Therapy Equipment. Temperature measurements – Principles of Ultrasonic measurement – Ultrasonic Diagnosis. The Nervous System: Measurements from the Nervous System.

Unit: V	**X – RAY, RADIOISOTOPE AND CLINICAL INSTRUMENTATIONS**	18 Hrs.

Generation of Ionizing Radiation – Instrumentation for Diagnostic X rays – Special Techniques – Instrumentation for the medical use of Radioisotopes – Radio Therapy. The Blood: Test on Blood cells – Chemical tests.

	Total Lecture Hours	90 Hrs.

Books for study:

1. L. Cromwell , Fred J. Weibell , Erich A. Pfeiffer, Biomedical Instrumentation and measurements, 2nd Edition, Pearson Education Inc, (2005).

Unit I: Chapter 2 & 3
Unit II: Chapter 5 & 6
Unit III: Chapter 7
Unit IV: Chapter 8 & 9 and 10.7

Unit V: Chapter 14 & Chapter 13 (13.1 to 13.3)		
Books for Reference:		
1. John R. Cameron and James G. Skofronick, *Medical Physics,* John Wiley & Sons, New York 1978. 2. M. Arumugam ,*Bio*-medical Instrumentation, Anuradha Publications, First Edition , Reprint 2015. 3. K.S. Khandpur, Handbook of biomedical Instrumentation, 3rdEdition,Mc.Graw Hills Education (India) Pvt Ltd, New Delhi.		
Web Resoueces		
https://nptel.ac.in/courses/108/105/108105101/#		
Course Outcomes		**K Level**
On Completion of this course, the student will be able to		
CO1:	Describe the basic transducer principles and their sources	**K2**
CO2:	Compute the cardiovascular system and measurement of heard sound	**K3**
CO3:	Apply the principles of monitoring equipment into the patient care monitoring	**K3**
CO4:	Analyze the techniques of respiratory therapy equipment and ultrasonic diagnosis equipment	**K4**
CO5:	Conclude the clinical instrument of diagnosis X-rays &radio therapy.	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

Units	BIO – MEDICAL INSTRUMENTATION	Hrs	Mode
I Basic Transducer Principles and Sources of Bioelectric Potentials	The transducer and transduction principles, active transducer, passive transducer	**6**	**Chalk & Talk**
	transducers of biomedical applications, Resting and action potentials	**6**	
	propagation of action potentials, The bioelectric potentials	**6**	
II The Cardiovascular System and Measurements	The Heart and Cardiovascular system, The Heart, Blood pressure	**7**	**Chalk & Talk, PPT, Group discussion**
	Characteristics of blood flow, Heart sounds, Electrocardiography, Measurement of Blood pressure	**5**	
	Measurement of blood flow and cardiac output, Plethhysmography, Measurement of heart sounds	**6**	
III Patient Care and Monitoring	The elements of Intensive, care monitoring, Respairability of Patient, monitoring equipment	**6**	**Chalk & Talk, exercise**
	Other instrumentation for monitoring patients	**6**	
	The Organization of the hospital for patient care monitoring, Pacemakers ,Defibrillators	**6**	
IV Respiratory System & Noninvasive Diagnostic Instrumentation	The Physiology of the Respiratory System, Tests and Instrumentation for the Mechanics of Breathing	**7**	**Chalk & Talk, Assignment**
	Gas exchange and Distribution, Respiratory Therapy Equipment, Temperature measurements, Principles of Ultrasonic measurement	**5**	
	Ultrasonic Diagnosis. The Nervous System: Measurements from the Nervous System	**6**	
V X – RAY, Radioisotope and Clinical Instrumentations	Generation of Ionizing Radiation, Instrumentation for Diagnostic X rays	**6**	**Chalk & Talk , Exercise**
	Special Techniques, Instrumentation for the medical use of Radioisotopes	**6**	
	Radio Therapy. The Blood: Test on Blood cells – Chemical test.	**6**	

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 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	1	K1	2 (K2&K2)	1(K2)
	CO2	**K3**	2	K2	2	K2	2 (K3&K3)	1(K3)
CI AII	**CO3**	**K3**	2	K1	1	K2	2 (K3&K3)	1(K3)
	CO4	**K4**	2	K2	2	K2	2 (K4&K4)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	4	8	20
	K2	2	6	-	-	6	12	
	K3	-	-	10	10	20	40	40
	K4	-	-	10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as a 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	K2	2	K1 & K2	1	K1	2 (K2&K2)	1 (K2)
2	CO2	K3	2	K1 & K2	1	K1	2 (K2&K2)	1 (K3)
3	CO3	K3	2	K1 & K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	**50**
K2	5	6	30	10	51	42.5	
K3	-	-	20	20	40	33.34	**33**
K4	-	-	-	10	10	8.33	**8**
K5	-	-	-	10	10	8.33	**9**
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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answer Questions)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either or Choice Questions)
Answer All Questions **(5x5=25 marks)**

Q. No	CO	K Level	
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	

NB: Higher level of perform ance 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	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

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

Course Name	**COMPUTER ORIENTED NUMERICAL METHODS**			
Course Code	**21PPHE46**	**L**	**P**	**C**
Category	**Elective**	6	-	6

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP

COURSE OBJECTIVES:

- To find roots using bisection, linear interpolation, Secant and/or Newton's methods
- To demonstrate the ability to use Least squares and Lagrangian polynomials
- To apply method of interpolation and extrapolation for predictions
- To develop the mathematical skills of the students in the areas of numerical methods
- To facilitate numerical computing by the method studied

Unit: I	**Iterative methods**	17 Hrs.

Beginning an iterative methods- The method of successive bisection- The method of false position- Newton-Raphson iterative method- The secant method- The method of successive approximations- Comparison of iterative methods – Solution of polynomial and simultaneous non linear equations.

Unit: II	**Solution of simultaneous algebraic equations**	18 Hrs.

The Gauss elimination method- pivoting- III conditioned equations - Refinement of the solution obtained by Gaussian elimination- The Gauss-Seidel iterative method – An algorithm to implement the Gauss-Seidel method - Comparison of direct and iterative methods.

Unit: III	**Interpolation and Least square approximation functions**	19 Hrs.

Lagrange Interpolation-difference tables-Truncation error in interpolation – Spline interpolation- Least squares approximation of function: Linear regression- Algorithm for linear regression – Polynomial regression – Fitting exponential and trigonometric functions.

Unit: IV	**Differentiation and integration**	18 Hrs.

Formulae for numerical differentiation and integration – Simpson's rule – Errors in integration formulae – Algorithms for integration of tabulated function – Algorithm for integrating a known function - Gaussian quadrature formulae - Comparison of integration formulae.

Unit: V	**Numerical solution of differential equations**	18 Hrs.

Euler's method – Taylor series method - Runge-Kutta methods - Runge-Kutta fourth order formula - Predictor-corrector method – Higher order differential equations – Comparison of predictor - corrector and Runge-Kutta methods.

	Total Lecture Hours	90 Hrs.

Book for study:

1. V. Rajaram, Computer oriented Numerical methods, 2nd Edition, Prentice Hall of India. Pvt. Ltd, New Delhi, 1989

Unit –I: Chapter 3
Unit –II: Chapter 4
Unit –III: Chapters 5 & 6
Unit – IV: Chapter 8
Unit – V: Chapter 9

Books for References:

1. S.D Conte, Carl de Boor, Elementary Numerical Analysis An Algorithmic Approach 3rd Edition, Tata McGraw Hill International company, New Delhi, 1983.

2. Steven C. Chopra. Raymond P. Canale, Numerical Methods for Engineers, 2nd Edition, Tata McGraw Hill International Editions, New Delhi, 1990.
3. M.K Jain, S.R.K Iyengar, R.K Jain, Numerical Method for Scientific and Engineering Computation, New Age International publishers, Kochi, 1992.

Web Resources:

https://www.mooc-list.com/course/numerical-methods-engineers-saylororg?page=9
https://nptel.ac.in/courses/111/107/111107105/
https://onlinecourses.swayam2.ac.in/cec20_ma11/preview

COURSE OUTCOMES		**K Level**
CO1:	Simplify the numerical differentiation and integration whenever and wherever routine methods are not applicable.	**K4**
CO2:	Compare the various interpolation methods and finite difference concepts in least square approximation functions.	**K4**
CO3:	Apply numerical methods to find out solution of algebraic equations using different methods under different conditions and numerical solution of system of algebraic equations.	**K3**
CO4:	Simplify the calculation and interpretation of errors in numerical methods.	**K4**
CO5:	Justify the functions from the programming language library for efficient calculations.	**K5**

CO & PO Mapping:

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

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

LESSON PLAN

UNIT	COMPUTER ORIENTED NUMERICAL METHODS	Hrs	Mode
I Iterative methods	Beginning an iterative method, Method of successive bisection, Newton Rapson iterative method	**7**	Chalk, Talk, Seminar& Test
	The secant method, Method of successive approximation, Comparison of iterative methods	**5**	
	Solution of polynomial and simultaneous nonlinear equation	**5**	
II Solution of simultaneous algebraic equation	Gauss elimination method, pivoting- III conditioned equations	**5**	
	Refinement of the solution obtained by Gaussian elimination, Gauss-Seidel iterative method	**7**	Chalk, Talk & PPT
	An algorithm to implement the Gauss-Seidel method , Comparison of direct and iterative methods	**7**	
III Interpolation and Least square approximation functions	Lagrange Interpolation-difference tables, Truncation error in interpolation	**6**	Chalk, Talk & Assignment
	Least squares approximation of function, Linear regression, Algorithm for linear regression	**6**	
	Polynomial regression, Fitting exponential and trigonometric functions.	**6**	
IV Differentiation and integration	Formulae for numerical differentiation and integration, Simpson's rule, Errors in integration formulae	**6**	Chalk, Talk & Exercise
	Algorithms for integration of tabulated function, Algorithm for integrating a known function	**6**	
	Gaussian quadrature formulae,Comparison of integration formulae.	**6**	
V Numerical solution of differential equations	Euler's method, Taylor series method - Solution of first order differential equation (Runge-Kutta method)	**5**	Chalk, Talk & Group discussion
	Solution of IV order differential equation (Runge- Kutta method), Predictor-corrector method	**7**	
	Higher order differential equations , Comparison of predictor, corrector and Runge-Kutta methods	**6**	

Course designed by: **Dr. P.P. Kannan & 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** **MCQs**		**Section B** **Short Answers**		**Section C Either or Choice**	**Section D 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	**K3**	2	K2	2	K2	2 (K3&K3)	1(K3)
CI AII	**CO3**	**K3**	2	K1	1	K2	2 (K3&K3)	1(K3)
	CO4	**K4**	2	K2	2	K2	2 (K4&K4)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

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	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	4	8	20
	K2	2	6	-	-	6	12	
	K3	-	-	10	10	20	40	40
	K4	-	-	10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as a 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	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
2	CO2	K4	2	K1&K2	1	K1	2 (K3&K3)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3&K3)	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	-	-	9	7.5	8
K2	5	6	-	-	11	9.17	9
K3	-	-	50	10	60	50	50
K4	-	-	-	30	30	25	25
K5	-	-	-	10	10	8.33	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	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answer Questions) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either or Choice Questions) **Answer All Questions**			**(5x5=25 marks)**
Q. No	**CO**	**K Level**	
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
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	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	