QUEEN MARY'S COLLEGE

(AUTONOMOUS), CHENNAI – 600 004

Affiliated to University of Madras Re-accredited by NAAC with 'A' Grade

PG & RESEARCH DEPARTMENT OF PHYSICS

M.Sc PHYSICS

SYLLABUS

With effect from the Academic Year

2024 - 2025 Onwards

QUEEN MARY'S COLLEGE (AUTONOMOUS) Chennai - 600 004.

Affiliated to University of Madras Re-accredited by NAAC with 'A' Grade

CONTENTS

PG AND RESEARCH DEPARTMENT OF PHYSICS

I. MINUTES OF THE BOARD MEETING

The meeting of the Board of studies was held on **28.08.2024**. The proposed new syllabi were presented before the board.

MEMBERS OF THE BOARD

1. DR. HEMAMALINI RAJAGOPAL **CHAIR PERSON**

ASSOCIATE PROFESSOR and HEAD

PG and RESEARCH DEPARTMENT OF PHYSICS

QUEEN MARY'S COLLEGE (A), CHENNAI - 4

2. DR. J.PADMANABHAN **SUBJECT EXPERT**

ASSOCIATE PROFESSOR OF PHYSICS

GOVT ARTS COLLEGE FOR MEN, NANDANAM

CHENNAI - 35

3. MRS.DHARMA SWAMINATHAN **SUBJECT EXPERT**

ASSISTANT PROFESSOR OF PHYSICS

QUAID-E-MILLETH COLLEGE FOR WOMEN

CHENNAI - 2

INTERNAL MEMBERS (ALL THE MEMBERS OF STAFF)

4. DR.(MRS). J. SRIVIDYA - ASSOCIATE PROFESSOR
5. DR. (MRS). G. USHA - ASSOCIATE PROFESSOR
6. DR.(MRS). JOVITA THEODORE - ASSOCIATE PROFESSOR
7. DR. (MRS). D. JAYALAKSHMI - ASSOCIATE PROFESSOR
8. DR.(MRS). R. VASANTHI - ASSOCIATE PROFESSOR
9. DR. (MRS). R. RAJAKUMARI - ASSOCIATE PROFESSOR
10. DR. (MRS). V. NIRMALA - ASSOCIATE PROFESSOR
11. DR. MRS. M. P. SAVITHIRI - ASSOCIATE PROFESSOR
12. DR. (MRS). A. ANURADHA - ASSOCIATE PROFESSOR
13. DR. (MRS). S. SAROJINI - ASSOCIATE PROFESSOR
14. DR.(MRS). R.VANATHI VIJAYALAKSHMI - ASSOCIATE PROFESSOR
15. DR.(MRS). K. S. EZHILARASI - ASSOCIATE PROFESSOR
16. DR. (MRS). B. ANITHA - ASSOCIATE PROFESSOR
17. DR. (MRS). S. MAHALAKSHMI - ASSISTANT PROFESSOR
18. DR. (MRS). M. LOGANAYAKI - ASSISTANT PROFESSOR
19. MS. B.JIJILA - DEPT. ALUMNI
20. MS. B. CHARUMATHI - STUDENT REPRESENTATIVE
21. MR.V.LOGANATHAN - INDUSTRY REPRESENTATIVE

CHANGES MADE IN THE SYLLABUS

Mathematical Physics - I

Topics Included : Expression for gradient, divergence and curl in spherical polar coordinates. Deduction of Gauss' law from Gauss divergence theorem IN UNIT I

Dirac-delta function-some representations - properties- – Green's function for one dimensional case IN UNIT II

Mathematical Physics – II

Topics Included: Evaluation of definite integrals of trigonometric functions round the Unit circle only–Problems IN UNIT I. Dirac-delta function-some representations - properties- – Green's function for one dimensional case IN UNIT II

Electromagnetic Theory

Topics Included: Multipole expansion of electric fie IN UNIT I. Wave guides IN UNIT IV

Physics of Functional Materials

Materials science paper is renamed as physics of functional materials and suitably restructured.

Topics Included: This unit has become Material Properties and Requirements instead of Nanomaterials IN UNIT I. This unit has been replaced by Fundamentals of Nanoscience and Nanomaterialsas its inevitable part of materials science in the present research scenario IN UNIT II. This unit has become a synthesis of Nanomaterials IN UNIT III. This unit has become Advanced material characterization techniques IN UNIT IV. This unit has become New materials IN UNIT V.

Topics Deleted : Nanomaterials FROM UNIT I. New materials FROM UNIT II. Ceramics FROM UNIT III. Polymers FROM UNIT IV. Units II and V have been swapped with some changes.

General Nuclear Physics

Topics Included

Mirror Nuclei method has been included IN UNIT I. UNIT II unit has become a Nuclear model. UNIT III has become Nuclear reactions and Nuclear energy. UNIT IV has become Nuclear decay. UNIT V has become Elementary particle physics.

Topics Deleted:

The radioactivity in Unit II has been moved to Unit IV as Nuclear decay. Nuclear models in this unit has been removed as it is now become unit II. UNIT IVt has been removed

Advanced Nuclear Physics

Topics Included

UNIT I title has been changed. Some more nuclear models have been introduced along with the existing ones IN UNIT II. Instead of Heavy ion nuclear reaction, it becomes a special type of nuclear reaction that includes heavy ion reaction so that the students can learn about special nuclear reactions in IN UNIT III. Atmospheric Neutrino has been included IN UNIT IV.

Topics Deleted:

UNIT III has been completely removed

Space Science

Topics Included

The solar system, the features and atmospheric layers of the sun have been incorporated IN UNIT I. The Chandrasekhar limit has been included next to the white dwarf IN UNIT II. Chandrasekhar limit moved to unit II.

Topics Deleted: Chandrasekhar limit removed FROM UNIT III .

Numerical Methods and C programming paper is split into two elective papers as numerical methods separately and C programming separately under computational Physics I and Computational Physics II

II. INTRODUCTION TO THE PROGRAMME

1. MSc in Physics is a 2-year postgraduate degree program

2. The Programme focuses on advanced study and research in the field of Physics.

3. This programme is generally chosen by students who wish to get in-depth knowledge and expertise in the specific areas of Physics.

4. Provide students with an advanced knowledge of Physical laws and research

5. Can gain a set of incredibly useful skills that make the students attractive to a wide range of employers. A physics degree trains the students to become an expert problem solver.

6. To explore range of topics and develop a strong foundation in Physics

7. The students will be trained to work at the leading edge of ideas in science, technology, academia, government and other industrial sectors

III. CHOICE BASED CREDIT SYSTEM FOR P.G. PROGRAMME

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising Core, Elective and Skill based courses.

The PG programme consists of a number of courses. The 'course' is applied to indicate a logical part of the subject matter of the programme and is invariably equivalent to the subject matter of a ' paper' in the conventional sense. The following are the various categories of courses suggested for the PG PROGRAMME.

It includes **Core Courses (CC), Elective Courses (EC) and Skill Enhancement Courses (SEC).**

Core Course (CC): They are the basic courses compulsorily required for each of the programme of study. It is related to the subject of programme in which the candidate gets her degree. The number of Core Courses shall be 13 for All PG Programme.

Elective Course (EC): Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline. The number of Elective (Discipline Specific/Generic) Courses shall be 6 for the PG Programme.

Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

Skill Enhancement Courses: In view of enhancing the employability skills of the students 3 courses are given.

Internship: All PG Program Students have to undergo **Summer Training** at the end of the II semester and submit a report which will be evaluated in the III Semester for which 2 Credits will be offered.

PG AND RESEARCH DEPARTMENT OF PHYSICS

IV. CURRICULUM STRUCTURE - CORE

Course No.	Sem.	Title of the Course	Sub. Code	CIA	ESE	Total	Credits
CORE I	I	CLASSICAL AND STATISTICAL MECHANICS	24PPYC01	25	75	100	5
CORE II	I	MATHEMATICAL PHYSICS - I	24PPYC02	25	75	100	5
CORE III	I	PRACTICALS I – GENERAL I	24PPYC03	25	75	100	5
CORE IV	II	QUANTUM MECHANICS -I	24PPYC04	25	75	100	5
CORE V	II	MATHEMATICAL PHYSICS - II	24PPYC05	25	75	100	5
CORE VI	II	PRACTICALS II- ADVANCED ELECTRONICS	24PPYC06	25	75	100	5
CORE VII	III	QUANTUM MECHANICS -II	24PPYC07	25	75	100	5
CORE VIII	III	ELECTROMAGNETIC THEORY	24PPYC08	25	75	100	5
CORE IX	III	PRACTICALS III – GENERAL II	24PPYC09	25	75	100	5
CORE X	III	CONDENSED MATTER PHYSICS	24PPYC10	25	75	100	5
CORE XI	IV	METHODS OF SPECTROSCOPY	24PPYC11	25	75	100	5
CORE XII	IV	PHYSICS OF FUNCTIONAL MATERIALS	24PPYC12	25	75	100	5
CORE XIII	IV	PRACTICALS IV- MICROPRICESSOR, MICROCONTROLLER AND C PROGRAMMING	24PPYC13	25	75	100	5
CORE XIV	IV	PROJECT	24PPYPJT	25	75	100	5

V. CURRICULUM STRUCTURE -DISCIPLINE SPECIFIC ELECTIVE

Course No.	Sem.	Title of the Course	Sub. Code	CIA	ESE	Total	Credits
DSE-I	I	INTEGRATED ELECTRONICS AND MICROPROCESSOR / SPACE SCIENCE	24PPYE1A 24PPYE1B	25	75	100	3
DSE-II	I	GENERAL NUCLEAR PHYSICS / INSTRUMENTATION TECNIQUES	24PPYE2A 24PPYE2B	25	75	100	3
DSE-III	II	ADVANCED NUCLEAR PHYSICS / ADVANCED ELECTRONICS	24PPYE3A 24PPYE3B	25	75	100	3
DSE-IV	IV	INDUSTRIAL TRAINING / SELF LEARNING COURSE	24PPYE4A 24PPYE4B	25	75	100	3

V. CURRICULUM STRUCTURE -GENERIC ELECTIVE

Course No.	Sem.	Title of the Course	Sub. Code	CIA	ESE	Total	Credits
GE-I	II	PHYSICS AND ARCHAEOLOGY/ ASTROPHYSICS	24PPYG1A 24PPYG1B	25	75	100	3
GE-II	III	PHYSICS OF BIOLOGICAL SYSTEMS/ MEDICAL INSTRUMENTATION	24PPYG2A 24PPYG2B	25	75	100	3

V. CURRICULUM STRUCTURE - SKILL ENHANCEMENT COURSES

Course No.	Sem.	Title of the Course	Sub. Code	CIA	ESE	Total	Credits
SEC-I	II	COMPUTATIONAL PHYSICS I-NUMERICAL METHODS	24PPYS01	25	75	100	3
SEC-II	III	COMPUTATIONAL PHYSICS II- C PROGRAMMING	24PPYS02	25	75	100	3
SEC-III	IV	BASICS OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	24PPYS03	25	75	100	3

V. CURRICULUM STRUCTURE – INTERNSHIP AND EXTENSION ACTIVITY

Course No.	Sem.	Title of the Course	Sub. Code	CIA	ESE	Total	Credits
INT	III	INTERNSHIP	24PINT	-	100	100	2
EXT	IV	EXTENSION ACTIVITY	24PEXT	-	100	100	1

CATEGORY WISE CREDIT DISTRIBUTION

2024 - 2025

CREDIT DISTRIBUTION FOR PG PROGRAMMES - 97 CREDITS			
TYPE OF COURSE	**NO.OF COURSES**	**CREDITS PER COURSE**	**TOTAL**
CORE	13	5	65
PROJECT	1	5	5
ELECTIVE	6	3	18
SEC	3	2	6
SUMMER INTERNSHIP	1	2	2
EXTENSION ACTIVITY	1	1	1
TOTAL	25	18	97

- Week - 6 Working Day Order
- 15 Weeks per Semester
- Number of Units in the Syllabus of Courses : 5

- Number of Units in the Syllabus of Elective Courses : 5
- Maximum Marks per Paper : 100

VI. INTERNAL EVALUATION METHODOLOGY FOR ALL THE PROGRAMS

- Quiz programme
- Periodical class tests
- Objective type assignments
- Problem solving assignments (Individual / Group)
- Seminar based on lecture notes available online / Using Power point
- Online exercises from open source/resource
- E-quiz
- Group Discussion or debate
- Question session
- Descriptive assignments with creative questions

QUANTIFICATION OF INTERNAL EVALUATION - PG THEORY

- Minimum 2 Tests
- Minimum 2 Assignments
- Model Examination for 75 Marks reduced to 10 Marks

TEST	ASSIGNMENT	SEMINAR	MODEL EXAM	TOTAL	CONTINUOUS INTERNAL ASSESSMENT
10	**10**	**5**	**75**	**100**	**-**
Reduced To					
5	**5**	**5**	**10**		**25**

VII. EXTERNAL EVALUATION

QUESTION PAPER PATTERN

Maximum Marks: 100

Internal Assessment: 25 External Evaluation: 75

Overall Aggregate should be 50%

QUESTION PAPER PATTERN FOR CORE , ELECTIVE & SEC COURSES (EFFECTIVE FROM THE ACADEMIC YEAR 2024 - 2025)					
Part – A 5 x 2 = 10 Marks Answer all the questions		**Part – B 5 x 5 = 25 Marks Answer all the questions**		**Part – C 4× 10 = 40 Marks Answer any Four questions**	
Question	**Unit**	**Question**	**Unit**	**Question**	**Unit**
1	I	6(a) or 6(b)	I	11	I
2	II	7(a) or 7(b)	II	12	II
3	III	8(a) or 8(b)	III	13	III
4	IV	9(a) or 9(b)	IV	14	IV
5	V	10(a) or 10(b)	V	15	V
				16	(Any Unit)

PROJECT EVALUATION

PROJECT	
INTERNAL	**25**
EXTERNAL	**75**
VIVA	**25**
DISSERTATION	**50**
TOTAL	**100**

VIII. TEACHING METHODOLOGIES ADOPTED FOR THE PG PROGRAM

1. Chalk Board and Lecture
2. Text Book Learning
3. Digital Learning- Online PPt - Lecture Notes
4. Video Lecture – Online – You Tube – Google Meet - Classroom
5. Interactive Sessions
6. Student Seminar
7. Lecture By Subjects Experts

IX. PG PROGRAMME EDUCATIONAL OBJECTIVES (PEO):

On par with the institutional vision and mission, M.Sc Physics Programme aims at imparting knowledge and skills to the students enabling them to

- Pursue higher education, enrich research habits and procure job opportunities through strong and ample learning of the core and related subjects with adequate exposure to digital literacy and training to communicate their original ideas effectively. (PEO1)

- Probe and utilize appropriate resources and tools to be life – long learners, demonstrate analytical skills and befit globally competent. (PEO2)

- Improve leadership qualities in creating successful and self-confident citizens with rational thinking and scientific temper. (PEO3)

PG PROGRAMME SPECIFIC OUTCOMES (PSO):

After completing M.Sc. Physics Programme, the student would be able to

- Transmit fundamental knowledge in the core subjects, explore new pathways in experimental and theoretical physics, perceive new ideas and analogy in every approach towards learning, choose an area of research and pursue higher education **(PSO1: PO1).**
- Utilize digital tools and e-resources available as open-source for knowledge addition, learning and create innovative applications **(PSO2:PO7).**

- Critically analyze any problem scientifically, accompanied by original and diversified thinking and perform duties successfully with rational thinking and scientific temper **(PSO3: PO3).**

- Exhibit good interpersonal skills through effective communication and interactions, propose ideas and participate in core discussions and conferences, adopt better perspective towards life with confidence and remain a responsible citizen **(PSO4: PO2).**

- Foster inquiring qualities, focus upon deep self-learning, thrive with the quest of enhanced and self-disciplined learning and raise queries of interest **(PSO5: PO4).**

X. PG PROGRAM OUTCOMES (PO):

Program Outcomes are statements about the knowledge, skill and attitudes. It deals with the general aspects of graduation for a particular program, and the competencies and expertise a graduate will possess after completion of the program.

PO1. **Disciplinary Knowledge and Skills:** To develop a science graduate highly productive and constructive unit of society by acquiring a fundamental, systematic, coherent understanding of the academic field of Computer Science and its related disciplinary areas .

PO2. **Skilled communicators:** To develop communication and leadership skills and overall personality development of the students.

PO3. **Critical Thinker And Problem Solver:** Apply critical thinking which improves cognitive skills and logical decision making as problem solvers.

PO4. **Sense of Enquiry:** Develop sense of enquiry and exhibit professionalism.

PO5. **Team Player / Worker:** To promote team work and time management.

PO6. **Skilled Project Managers:** Understand the flow of project/plan, effective interaction with team members, method and means for its implementation.

Understand the flow of projects/experimentation, effective interaction with team members, method and means for its implementation.

PO7. **Digitally Efficient:** Use information communication technology to gather knowledge and update scientific information and skills through ICT tools**.**

PO8. **Ethical Awareness Reasoning:** Apply ethical principles and commitment towards professional ethics and responsibility.

PO9. **National And International Perspective:** Participate in global citizen science projects using e-learning materials as well execute proposals of national and international importance.

PO10. **Lifelong Learners:** Learn, unlearn, relearn as well seeks solutions to real life problems.

XI. PG COURSE OUTCOMES (CO)

- The curriculum has been designed in such a manner by taking into account the ideologies of Blooms taxonomy with strong and adequate skill, knowledge and education base.
- Due weightage to creativity is given for internal assessment. The rational correlation between CO's and PO's which enhance the strength and value of our curriculum.
- Bloom's taxonomy is a hierarchical ordering of cognitive skills. It represents different levels of learning and it should be utilized scientifically in a systematic manner.

  There are six levels of cognitive learning

  1. Knowledge – remembering information (K1)
  2. Comprehension- explaining the meaning of information (K2)
  3. Application – using abstraction in concrete situation (K3)
  4. Analysis- breaking down a hole into component parts (K4)
  5. Evaluation (K5)

6. Creative component in activity- comprehend, construct (new) & compile innovative thinking and ideas (K6)

XII. Template for P.G Programme 2024

Sem.I	Credit	Hrs	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester–IV	Credit	Hours
Core-I	5	6	. Core-IV	5	6	Core-VII	5	6	Core-XI	5	6
Core-II	5	6	Core-V	5	6	Core-VIII	5	6	Core-XII	5	6
Core – III	5	6	Core – VI	5	6	Core – IX	5	6	Core-XIII	5	5
Elective -I Discipline Specific Elective	3	6	Elective – III Discipline Specific Elective	3	5	Core – X	5	5	Project with viva voce	5	6
Elective-II Discipline Specific Elective	3	6	Elective -IV Generic Elective	3	5	Elective - V Generic Elective	3	5	Elective - VI DSE (Industry / Entrepreneurship) 20% Theory 80% Practical / Normal Subject	3	5
			Skill Enhancement Course I	2	2	Skill Enhancement Course II	2	2	Skill Enhancement course III / Professional Competency Skill	2	2
						Internship / Industrial Activity	2	-	Extension Activity	1	
	21	30		23	30		27	30		26	30
Total Credit Points -97											

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System for all Post – Graduate Courses including Lab Hours

First Year – Semester – I

Part	List of Courses	Credits	No. of Hours
	Core – I	5	6
	Core – II	5	6
	Core – III	5	6
	Elective – I Discipline Specific Elective	3	6
	Elective – II Discipline Specific Elective	3	6
		21	**30**

Semester-II

Part	List of Courses	Credits	No. of Hours
	Core – IV	5	6
	Core – V	5	6
	Core – VI	5	6
	Elective – III Discipline Specific Elective	3	5
	Elective – IV Generic Elective	3	5
	Skill Enhancement Course [SEC] – I	2	2
		23	**30**

Second Year – Semester – III

Part	List of Courses	Credits	No. of Hours
	Core – VII	5	6
	Core – VIII	5	6
	Core – IX	5	6
	Core (Industry Module) – X	5	5
	Elective – V Generic Elective	3	5
	Skill Enhancement Course – II	2	2
	Internship / Industrial Activity	2	-
		27	**30**

Semester-IV

Part	List of Courses	Credits	No. of Hours
	Core – XI	5	6
	Core – XII	5	6
	Core – XIII	5	5
	Core-XIV Project with VIVA VOCE	5	6
	Elective – VI (Industry Entrepreneurship)	3	5
	Skill Enhancement Course – III / Professional Competency Skill	2	2
	Extension Activity	1	-
		26	**30**

Courses	**Credit Distribution**	
Core courses	13×5	65
Core Project	1×5	5
Elective courses	6×3	18
Skill Enhancement Course	3×2	6
Internship / Industrial Activity	1×2	2
Extension Activity	1×1	1
Total		97

QUEEN MARY'S COLLEGE (A), CHENNAI 4
PG AND RESEARCH DEPARTMENT OF PHYSICS
MSC PHYSICS SYLLABI REVISION 2024-25 (COURSES OFFERED)

COURSE TYPE	SEMESTER	TITLE OF COURSE	HOURS	CREDITS
CORE I	I	CLASSICAL AND STATISTICAL MECHANICS	6	5
CORE II	I	MATHEMATICAL PHYSICS-I	6	5
CORE III	I	PRACTICALS I - GENERAL -I	6	5
CORE IV	II	QUANTUM MECHANICS –I	6	5
CORE V	II	MATHEMATICAL PHYSICS-II	6	5
CORE VI	II	PRACTICALS II- ADVANCED ELECTRONICS	6	5
CORE VII	III	QUANTUM MECHANICS-II	6	5
CORE VIII	III	ELECTROMAGNETIC THEORY	6	5
CORE IX	III	PRACTICALS III- GENERAL -II	6	5
CORE X	III	CONDENSED MATTER PHYSICS	6	5
CORE XI	IV	METHODS OF SPECTROSCOPY	6	5
CORE XII	IV	PHYSICS OF FUNCTIONAL MATERIALS	6	5
CORE XIII	IV	PRACTICALS IV- MICROPROCESSOR, MICROCONTROLLER AND C PROGRAMMING	6	3
CORE XIV	IV	PROJECT	6	5
DSE-I	I	INTEGRATED ELECTRONICS AND MICROPROCESSOR / SPACE SCIENCE	6	3
DSE-II	I	GENERAL NUCLEAR PHYSICS / INSTRUMENTATION TECHNIQUES	6	3
DSE-III	II	ADVANCED NUCLEAR PHYSICS / ADVANCED ELECTRONICS	5	3
DSE-IV	IV	INDUSTRIAL TRAINING / SELF LEARNING COURSE	5	3
GE-I	II	PHYSICS AND ARCHAEOLOGY / ASTROPHYSICS	5	3
GE-II	III	PHYSICS OF BIOLOGICAL SYSTEMS/ MEDICAL INSTRUMENTATION	5	3
SEC-I	II	COMPUTATIONAL PHYSICS I -NUMERICAL METHODS	2	2
SEC-II	III	COMPUTATIONAL PHYSICS II- C PROGRAMMING	2	2
SEC-II	IV	BASICS OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	2	2

SYLLABUS

FIRST YEAR - SEMESTER – I										
CLASSICAL AND STATISTICAL MECHANICS										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC01	**Core - I**	**5**	**-**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives		
LO1	To educate students to identify, formulate and solve the problems in rigid body dynamics.	
LO2	To learn about Lagrangian formulation of Classical mechanics.	
LO3	To learn the fundamental concepts of classical and quantum statistics and their applications to microscopic systems.	
UNIT	**Contents**	**No. of Hours**
I	**Canonical Transformations** Canonical transformations and their generators - condition for transformation to be canonical- Poisson's brackets – properties – invariance of Poisson's brackets under canonical transformation– Lagrange's brackets – properties –Relation between Lagrange's and Poisson's bracket - Hamiltonian Jacobi method- Solution of Hamilton Jacobi equation - harmonic oscillator problem and Kepler's Problem by Hamilton Jacobi method	20
II	**Dynamics of Rigid Body** Generalized coordinates of a rigid body – body and space coordinates - Euler's angles –components of angular velocity - angular momentum and inertia tensor- rotational kinetic energy of a rigid body – motion of heavy symmetrical top under the action of gravity – fast top - sleeping top.	20
III	**Small Oscillations** Stable, unstable and neutral equilibrium –Langrange's equations for small oscillations - Properties of T,V and ω- normal coordinates and normal modes of vibration– motion of a linear triatomic molecule.	15
IV	**Classical Statistics** Phase space - Liouville theorem and its significance - ensembles – Types of ensembles - Perfect mono atomic gas in microcanonical ensemble - Entropy - Gibb's Paradox - Partition function and its correlation with thermodynamic parameters - Micro states and Macro states - Maxwell's distribution (qualitative only)– Maxwell's distribution of molecular velocities – experimental test for Maxwell's law.	20
V	**Quantum Statistics** Bose Einstein statistics (qualitative only) – black body radiation - Planck's radiation law - ideal BE gas and degeneracy- BE condensation and its application to liquid helium -Fermi Dirac statistics (qualitative only) – electron gas in metals – free electron model and electronic emission.	15
	Total	90

Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recall** the basic idea about classical mechanics and understand a set of canonical coordinates for all dynamical systems with the same number of degrees of	K1, K2,K3 K5

	freedom. **Use** the transformations to **solve** the given physical problems in new coordinates easily. **(PO3**)	
CO2	**Recollect** the idea of rigid body to identify, **formulate** and to **solve** the problems in rigid body dynamics especially the various stages of motion of heavy symmetrical top classically. (**PO3**)	K1, K2,K4
CO3	**Summarize** the knowledge of equilibrium and formulate the Lagrangian equation to **solve** the small oscillation problem i.e. the motion near the equilibrium**. (Discussions)[PO2, PO3, PO5]**	K1, K2,K3, K5
CO4	**Understand** the concept of Phase space, micro and macro states, **state** and prove Liouville's theorem, **Compare** the different types of ensembles, **utilize** them to arrive thermo dynamical functions of perfect gas, **recalling** the thermodynamic parameters **derive** their correlation with partition function, explain entropy and Gibb's paradox, **explain** Maxwell-Boltzmann distribution law, **Apply** it to distribution of molecular velocities. (**Online quizzes on basic concepts of classical statistics and need for quantum statistics) (PO7) https://www.youtube.com/watch?v=wZUMgLBReEY (NPTEL-NOC IITM) [PO2]**	K1,K2,K3
CO5	**Understand** the concept of quantum statistics **explain** Bose Einstein statistics, **apply** it to blackbody radiation to derive Planck's radiation law, **Discuss** ideal BE gas and BE condensation and its application to liquid helium, **explain** Fermi Dirac statistics ,electron gas in metals, **appreciate** its use in free electron model & electronic emission. https://www.youtube.com/watch?v=O_zjGYvP4Ps **Group discussions, individual Seminar through ppts and assignments can be given on following topics to enhance their further learning**, i. distinction between classical and quantum statistics, **ii. comparison between** Bose Einstein and Fermi Dirac statistics, the different particles, their different applications**. (PO2,PO5,PO4,PO6,PO7)**	K1,K2,K3 K4,K6
Text Books		
1	Classical Mechanics – Gupta, Kumar and Sharma – K. Nath and Co. Meerut II Edition. [Unit – I, II and III]	
2	Classical Mechanics – J. C. Upadhyaya - 2nd edition (2009) - Himalayan Publication House. [Unit – I, II and III]	
3	Statistical Mechanics - Gupta, Kumar and Sharma – K. Nath and Co. Meerut II Edition. [Unit – IV, V]	
	Statistical Mechanics – Satya Prakash and T.P. Agarwal – Kedarnath Ramnath and Co, VI Edition. [Unit – IV, V]	
Reference Books		
1	Classical Mechanics – H. Goldstein - Narosa Publication.	
2	Statistical Mechanics – Kerson Huang – Wiley Eastern - New Delhi, 199.	
3	Classical Mechanics for particles and rigid bodies – Keran C. Gupta - Wiley Eastern, 1988.	
4	Classical Mechanics -N.C. Rana and P.S. Joag (Tata McGraw-Hill, New Delhi, 1991).	
Web Resources		
1	http://www.phy.auckland.nz/staff/smt/453310SC.html	
2	https://www.youtube.com/watch?v=yGyoTMeQWbQ	
3	https://www.youtube.com/watch?v=Ocm4Hp**PO**lgs	
4	www.powershow.com/.../Rigid_Body_Dynamics_I_An_Introduction.	
5	http://farside.ph.utexas.edu/teaching/301/lectures/lectures.html	

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			Moderately Correlated - 2					Weakly Correlated – 1		
CO / PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player /worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	1	2	-	-	-	1	1	-	-
CO2	3	1	2	-	-	-	1	1	-	-
CO3	3	2	2	-	1	-	1	1	1	1
CO4	3	2	1	2	-	-	2	1	1	1
CO5	3	2	1	2	2	1	2	2	-	1
AVG	3	2	2	1	1		1	1	-	1
TOTAL	15	8	8	4	3	1	7	6	2	3

FIRST YEAR - SEMESTER – I										
MATHEMATICAL PHYSICS - I										
Course Code	**Category Core/Ele /Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC02	**Core - II**	**4**	**1**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	This course aims to explore various topics in mathematics that are used in Physics and to define and formulate mathematical concepts like vector algebra, linear vector space, matrices.
LO2	To understand the concepts of group theory, tensors, their properties and applications in physics.
LO3	To acquire problem-solving skills and use the concepts learnt as a tool for understanding and analyzing different problems in physics

UNIT	**Contents**	**No. of Hours**
I	**Vector Algebra** Important vector identities – proof. Concept of gradient, divergence and curl and their physical significance - expression for gradient, divergence and curl in spherical polar coordinates. Line, surface and volume integrals (basic ideas)-Gauss divergence theorem – physical significance and proof –deduction of Gauss' law from Gauss divergence theorem , Gauss' law in differential form,. Poisson's and Laplace equations - Stokes' theorem -physical significance and proof- Green's theorem -Green's theorem in a plane.	20
II	**Linear Vector space and Green's function** Definition of a Linear Vector space - Linear independence - basis and dimension - Inner product and Unitary spaces – orthonormal sets - Gram Schmidt's Orthogonalization- Schwartz inequality- Dirac-delta function-some representations - properties-Green's function – Green's function for one dimensional case -Eigen function: expansion of Green's function.	15
III	**Matrices** Elementary ideas – Special types of matrices: Square and diagonal matrix – Symmetric and anti-symmetric – orthogonal – Hermitian – skew Hermitian– Unitary- singular and nonsingular– inverse, conjugate of a matrix - elementary and equivalent matrices. Characteristic equation of a matrix – Eigen values and Eigen vectors – Cayley-Hamilton theorem – Statement and proof – Inverse of a matrix by Cayley-Hamilton theorem only – similarity and Unitary transformation - Diagonalisation of a matrix – Basic ideas of Rotation, Pauli spin and Dirac matrices.	20
IV	**Tensors** Basic ideas of Coordinate transformation – Indicial and summation conventions – Dummy and real indices – Kronecker delta and its properties – Contravariant and covariant vectors – Definition of tensors – Rank – tensors of higher ranks - Addition and subtraction – Equality – Inner and outer product - contraction of tensors - Quotient law - symmetric and antisymmetric tensors.	15
	Group Theory and its Applications	20

V	Basic definitions of Abelian group and cyclic group– subgroups -Lagrange's theorem for finite group-Homomorphism and Isomorphism between groups - Representation of a group -Unitary representations - Reducible and Irreducible representations - Schur's Lemmas – Great Orthogonality theorem - Character table – properties - Character table of C2v, C3v and D3h – salient features of SU(2) - O(3)groups.	
	Total	90
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**What** is Vector Algebra and **How** is it applied in physics. **Explain** in detail different concepts and identities in vector algebra. **Modelling** Gauss divergence, Stokes and Green's theorem. **Interpret** Gauss divergence theorem to derive important laws of Physics such as Gauss law in electrostatics. https://nptel.ac.in/courses/115/105/115105097/	K1,K2, K3,K5
CO2	**What** are Linear Vector spaces and **Outline** its properties, **Examine** Gram Schmidt's Orthogonalization to check linear independence of vectors. **Explain** the method of Green's function to **show** how it is used to solve difficult problems in quantum mechanics, pertubatively using Green's function. www.youtube.com%2Fwatch%3Fv%3DF3ATYBGC_tY	K1,K2 K3,K4 K6
CO3	**Recall** Elementary ideas of matrices and**classify** them**. Develop** the concept of Eigen values and Eigen vectors and **deduce** Cayley- Hamilton theorem.**Analyze** the basic ideas of Rotation matrices and **apply** to Pauli spin and Dirac matrices.(GD) https://nptel.ac.in/courses/115/105/115105097/ Interactive seminar on application of Pauli spin and Dirac matrices in quantum mechanical phenomena and properties of Pauli spin and Dirac matrices**. [K6 PO2,PO3,PO4]**	K1,K2 K3,K4 K5
CO4	**Outline**: what are tensors and **why** do we need them. **Define** tensors. Discuss indicial and summation conventions. **Discuss** Kronecker delta and its properties. **Classify** tensors as scalar, covariant, contravariant and mixed tensors. **Discuss** algebraic operations of tensors. **Explain** rank of a tensor. **Assignment**: Explain algebraic operations of tensors (Addition, subtraction, equality, outer and inner product, contraction of tensors), using simple problems as illustrations.	K1,K2 K3,K4 K6
CO5	**Relate** the concept of group, subgroup and their types. **Compare and contrast** Homomorphic and Isomorphic groups. **Formulate** representation of groups and their respective theorems. **Construct** Character table of C_{2v}, C_{3v} and D_{3h} groups. **Apply** SU(2) - O(3) group symmetry to elementary particles. https://onlinecourses.nptel.ac.in/noc20_ph03/unit?unit=58&lesson=68**PPT and assignment** on different molecular symmetry groups [https://symotter.org/tutorial/intro], [https://symotter.org/gallery] and construct character table for the same.[K6 **PO**2,**PO**3,**PO**4,**PO**5	K1,K2 K3,K5
Text Books		
	Books for Problems: **Worked out problems in Mathematical Physics by Sathya Prakash are encouraged.**	
1	Sathya Prakash – Mathematical Physics – 14th Edition – 1999 - Sultan Chand and Co. (All Units).	

2	B. D. Gupta – Mathematical Physics - 3rd Edition – 2004 – Vikas Publishing House Pvt Ltd., - (All Units).
3	B. S. Rajput – Mathematical Physics – 14th Edition – 1999 – Pragathi Prakashan (All Units).
Reference Books	
1	A. W. Joshi - Matrices and Tensors in Physics – 3rd Edition – Wiley Eastern Ltd., (Unit III and IV).
2	F. A. Cotton – Chemical Applications of group Theory - 3rd Edition – 1990 –John Wiley and Sons (Unit V).
3	E. Kreyszig – Advanced Engineering Mathematics - 8th Edition – 1999 - Wiley, NY.
Web Resources	
1	http://www.mpipks-dresden.mpg.de/~jochen/methods/outline/html
2	http://phy.syr.edu/~trodden/courses/mathmethods/
3	http://dmoz.org/Science/Physics/Mathematical_Physics/
4	http://www.thphys.nuim.ie/Notes/engineering/frame-notes.html
5	www.thphys.nuim.ie/ Notes/frame-notes.html

MAPPING WITH PROGRAM OUTCOMES

Strongly Correlated - 3 **Moderately Correlated - 2** **Weakly Correlated – 1**

CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	1	1	1	-	-	2	1	1	1
CO2	3	1	2	1	-	-	1	1	1	1
CO3	3	1	2	1	2	1	2	2	1	1
CO4	3	1	2	1	-	-	1	1	-	1
CO5	3	1	2	2	1	-	2	2	1	1
AVG	3	1	2	1	1		2	1	1	1
TOTAL	15	5	9	6	3	1	8	7	4	5

FIRST YEAR - SEMESTER – I										
PRACTICALS I- GENERAL-I										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC03	**Core - I**	**-**	**6**	**-**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To impart practical skills through hands on experience with instruments and understand basic concepts underlying
LO2	To strengthen analytical, interpretation and report making skills
LO3	To enhance the computing and analyzing skills

UNIT	**Contents**	**No. of Hours**
I	**CO1** 1. Young's Modulus by Elliptic Fringes 2. Young's Modulus by Hyperbolic Fringes 3. Coefficient of viscosity of liquid – Meyer's oscillating disc method	12
II	**CO2** 4. Determination of Stefan's constant 5. Temperature coefficient of resistance – Thermistor 6. Energy loss calculations – B -H curve 7. Specific heat capacity of liquid- Ferguson's method 8. Four probe method- resistivity of a sample.	20
III	**CO3** 9. Hartmann's interpolation formula –Hydrogen spectrum - Rydberg's constant 10. Hartmann's interpolation formula- Solar spectrum - Fraunhofer lines 11. F.P. Etalon – Distance between plates.	12
IV	**CO4** 11. Maxwell's Bridge – Self inductance 12. Determination of self inductance - Anderson's bridge 13. Determination of Planck's constant – Photoelectric cell. 14. Impedance measurement of a polymer film using electrochemical work station.(Demonstration) **15.** Zeeman Effect - study.	20
V	**CO5** 16. Determination of Energy band gap of semiconductors 17. LASER- study of laser beam parameters and particle size. 18. Determination of numerical aperture, acceptance angle and attenuation coefficient of an Optical fiber – LASER 20. Dielectric constant of a solid.	16
	Total	90

Course Outcomes		K Level
CO	On completion of this course, students will	
CO1	**Recall** the basic concepts of moduli of elasticity and interference by forming circular and elliptic fringes to **find** the modulus of Perspex plates, Utilizing the **principles** of black body radiation, **apply** laws of viscosity to **determine** viscosity of a liquid and **evaluate** Stefan's constant. https://www.youtube.com/watch?v=onGuJZS8. **Manual calculations can be verified using excel sheets .(PO7)**	K1,K2,K3,K5
CO2	**Determine** specific heat capacity of liquids .**Demonstrate** the effect of temperature on resistance by determining the temperature coefficient of resistance of a thermistor and **find** resistivity of a sample by Four probe method. **Examine** the energy loss of magnetic materials by drawing B -H curve..https://www.youtube.com/watch?v=I9RmGM1kbs8 **(PO6,PO7).**	K1,K2,K3,K4
CO3	**Recall** Hartmann's interpolation formula, **apply** it to **evaluate** Rydberg's constant using Hydrogen spectrum and **Determine** the wavelengths of Fraunhofer lines in solar spectrum. **Appreciate** the concept of photoelectric emission in determination of Planck's constant using Photoelectric cell. **Determine** the distance between plates in F.P. Etalon utilising the principles of interference.	K1,K2,K3,K5
CO4	**Understand** the principles of self induction,**apply** it to **determine** the selfinductance of the given coils by Maxwell's Bridge and Anderson's bridge .**compare** the two bridges and **analyse** the efficacy of the methods. (Graphs can be plotted using ORIGIN software**) (PO7).Design a circuit containing an inductance coil which can be used for everyday applications.(K6)** **Demonstrate** Impedance measurement of a polymer film Study Zeeman Effect and **understand** its basic principle.	K1,K2,K3,K4,K6
CO5	**Study** laser beam parameters and particle size of the given Laser beam and **interpret** their importance. **Determine** numerical aperture, acceptance angle and attenuation coefficient of an Optical fiber https://www.youtube.com/watch?v=b7dLcINlvwE optical fiber and **appreciate** its application in the optoelectronic industry (**PO**3). **Determine** Energy band gap of semiconductors and understand it's role in conductivity. **Evaluate** Dielectric constant of a solid .Virtual lab is recommended to understand the basic concepts in every discipline of physics. http://vlab.amrita.edu/?sub=1&brch=189&sim=343&cnt=6 (**PO**7).	K1,K2,K4

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	2	2	1	2	1	3	2	1	2
CO2	3	2	1	2	2	1	3	1	1	2
CO3	3	2	2	2	2	1	1	1		1
CO4	3	1	1	1	2	1	1	1		1
CO5	3	1	2	2	2	1	2	1	2	2
AVG	3	2	2	2	2	1	2	1	1	2
TOTAL	15	8	8	8	10	5	10	6	4	8

FIRST YEAR - SEMESTER – I										
INTEGRATED ELECTRONICS AND MICROPROCESSOR										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYE1A	**DSE - I**	**5**	**-**	**-**	**1**	**3**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To impart a diversified knowledge on operational amplifiers and their applications.
LO2	To make the students conversant with the programmable aspect of the microprocessor technology which is a growing field which will pervade the industry for decades to come.
LO3	Strong grasp of fundamentals and confident in OPAMP basics and can design circuits.

UNIT	**Contents**	**No. of Hours**
I	**Operational Amplifier** Instrumentation amplifier –- Voltage to current converter- current to voltage converter – active filters: low pass, high pass, band pass –first order, second order Butterworth filter circuits – Solving simultaneous and differential equations. Op - amp as comparator- regenerative comparator (Schmitt trigger).	6
II	**Op-Amp Applications (Oscillators and Convertors)** Wien bridge, phase shift oscillators – triangular, saw-tooth and square wave generators –Schmitt's trigger – sample and hold circuits. Basic D to A conversion: weighted resister DAC – Binary R-2R ladder DAC – Basic A to D conversion: counter type ADC – successive approximation converter – dual slope ADC.	6
III	**Microprocessor 8085** Introduction to Intel Microprocessor – Pin functions of 8085 – Architecture of 8085 – Machine language and Assembly language –Instructions – Data Transfer, Arithmetic, Logic, Branch Stack and Stack related, I/O and Machine control instructions – 8085 addressing modes – Timing diagram (MEM R, MEM W)	6
IV	**Programming With 8085** Addition, Subtraction, Multiplication and Division (16 bit) – Square and Square root (8 bit) , largest/smallest number in an array – Ascending/ Descending order- reversing the elements in an array Code conversion – BCD to Binary and Binary to BCD (8 bit) debugging a program.	6
V	**Memory,Interfacing And I/O Operations** RAM - ROM - EPROM – RAM : Introduction to memory interfacing (2K X 8 and 4K X 8). I/O Operations : Interrupts of 8085 – Software Interrupt - Hardware Interrupt – properties of Interrupts – Enabling,Disabling and Masking of 8085 Interrupts–Peripheral Device- DMA - Support chip (8156) – Port numbers – Programming the I/O ports – Programming the timer.	6
	Total	**90**

Course Outcomes		K Level
CO	On completion of this course, students will	
CO1	**Recall t**he basic ideas of operational amplifier, **Applications** of operational amplifiers. Formulate the conditions for various categories of filters depending on frequencies. **Solving** simultaneous and differential equations. **Demonstrate** Op - amp as regenerative comparator. https://www.youtube.com/watch?v=9cxzu2-85II (**PO2**)	**K1 K2 K3**
CO2	**What** is the condition of oscillation? **Construction** of sinusoidal and non-sinusoidal oscillators. **Analyze** their waveforms. **Explanation** of A/D and D/A converters. **Compare** different types and justify their merits and demerits. **(Seminar-PPT-Questions) Practice sheets: http://tuttle.merc.iastate.edu/ee201/quiz_practice.html ((PO2, PO5, PO7, PO3, PO4, PO6, PO9)**	**K1 K2 K3 K4 K5**
CO3	**Explain** pin functions of 8085and Architecture of 8085. **Compare** Machine language and Assembly language. **Why** addressing modes are needed? **Summarize** Instructions set and addressing modes of 8085. **Create** timing diagram for READ and WRITE memories. https://www.youtube.com/watch?v=zAXAb_ttazY. (**PO7**)	**K1 K2 K5 K6**
CO4	**Build** assembly language program to perform arithmetic and logical operations. **Develop** multiplication program to find the square of a given number. **Demonstrate** the program for BCD to Binary and Binary to BCD code conversion**. Define** debugging.	**K1 K2 K3 K6**
CO5	**List** the types of memories. **Explain** the concept of interfacing and. I/O Operations, **Demonstrate** Interrupt circuits and DMA. **Function** of Support chip and **applications** as Programming the I/O ports and the timer. **(Group Seminar-PPT-Questions) (PO2, PO5, PO7)**	**K1 K2 K3 K4**

Text Books	
1	OP-AMPs and Linear Integrated circuits - Ramakant A Gayakwad – (Unit I and II)
2	Introduction to Integrated Electronics – V.Vijayendran - Viswanathan Pub. –(Unit I &II)
3	Microprocessor architecture – Gaonkar - 3 rd edition - Willey eastern ltd (Unit III,IV,V)
Reference Books	
1	Analog and Digital circuits and systems – Jacob Milman and Christos c Halkias Tata McGraw Hill Company
2	Microprocessors and applications – A. Nagoor Kani RBA Pubblications 1999
3	Fundamentals of microprocessor and microcomputers B Ram -Dhanapat Rai
Web Resources	
1.	https://www.coursera.org/learn/electronics/lecture/.../2-5-active-filt..
2.	https://www.allaboutcircuits.com/...lectures/op-amp-band-pass-ban
3.	8085 PROGRAMMING COUNTING and LOOPING - YouTube https://www.youtube.com/watch?v=1d9sSoYYjcA
4.	https://www.youtube.com/watch?v=U3BGOaiyjz8
5.	PPT – Digital to Analog Converters DAC PowerPoint presentation ...www.powershow.com/.../Digital_to_Analog_Converters_DAC_po

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learner**
CO1	3	1	1	1	-	-	1	1	1	1
CO2	3	1	2	3	2	1	3	1	1	1
CO3	3	1	1	1	-	-	1	1	1	1
CO4	3	1	1	1	-	-	1	1	-	1
CO5	3	2	2	2	1	-	2	1	-	1
AVG	3	1	1	2	1	-	2	1	-	1
TOTAL	15	6	7	8	3	1	8	5	3	5

FIRST YEAR - SEMESTER – I										
SPACE SCIENCE										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYE1B	**DSE - I**	**5**	**-**	**-**	**1**	**3**	**6**	**25**	**75**	**100**

Learning Objectives		
LO1	To educate the students about the basic concepts of Modern Astronomy and Astrophysics.	
LO2	To enrich the student's theoretical knowledge of the various instrumentation used in the field.	
LO3	To acquire knowledge of satellite communication systems and their applications.	
UNIT	**Contents**	**No. of Hours**
I	**Galaxies and Solar System** Galaxies - Types of Galaxies – Milky Way galaxy: General structure - Solar system: Internal structure of Sun and its atmospheric layers– Planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune) - Asteroids and its types– Meteoroids and its types–Meteor – Meteorites - Comets.	20
II	**Stellar Evolution** Life cycle of a star: Birth of a star - Evolution of stars - Post main sequence –Death of a star - White dwarfs - Chandrasekhar limit - Red giants -Neutron stars - Equation of state for stellar interior (Qualitative only) - Energy generation in stars - Structure of Stellar Atmosphere.	15
III	**Spectral Classification of Stars** Stellar spectra - Harvard system of spectral classification – Hertzsprung - Russel Diagram – Stellar magnitude - Luminosity effect on stellar spectra –Stellar distance measurement - Variable stars - Composite stars: Binary stars - Star Clusters- Supernovae - Black Hole - Quasars – Nebulae.	20
IV	**Astronomical Instruments** Optical telescope - Celestial and Terrestrial telescopes - General properties of a telescope: light gathering power - angular magnification - resolving power - Astronomical standard spectrograph - Characteristics of spectrographs: Resolving Power-Dispersion-Speed-Throughput - Radio telescope – Hubble space telescope.	15
V	**Satellite Communication** Kepler's laws – Orbits and inclination power systems – Altitude control – Geostationary orbits – Advantages and disadvantages - Satellite links – Parameters: Angle of elevation-Propagation delay-Orbital spacing – Satellite communication frequency bands, GIS and GPS (elementary ideas) – Indian satellites and applications.	20
	Total	90

Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recall** the shape and basic structure of Milky way galaxy and the location of solar system in it. **Understand,** how the interplanetary space is filled the debris like asteroids, meteoroid and comets. **Imagine** the tail structure of comets, on their	K1 K2 K6

	perihelion passage.**(PPT presentation on galaxy, interplanetary debris) [PO2], [PO7], [PO9].**	
CO2	**Be familiar** with the birth of a star and the process of stellar evolution by which a star changes over time. **Understand** the formation of neutron stars on the outburst of supernovae. **Define t**he Chandrasekhar limit and **assess** how stars that have more mass will be converted into a black hole as the pressure due to the electron degeneration will keep them from collapsing until the density is extremely high..**Apply and analyze the** knowledge of the fusion of hydrogen nuclei by thermonuclear fusion reaction with the release of binding energy is the primary source of energy generation in stars. **(PPT presentation on the birth and death of stars)** interplanetary debris) **[PO2], [PO7], [PO9].**	K1 K2 K3 K4
CO3	**Illustrate** the Harvard system of spectral classification of stars. **Relate** surface temperature, luminosity, and absolute magnitude of stars in H-R diagram. **Apply** the knowledge of the theory of general relativity, which predicts that a sufficiently compact mass can deform space-time to form a black hole. **(Group discussion - PPT presentation on H-R diagram)) [PO2], [PO3], [PO7], [PO9].**	K1 K2 K3
CO4	**Distinguish** between celestial and terrestrial telescopes. **List** the basic properties of the telescope and **analyze** the characteristics of the spectrograph. **Make use of** spectrograph to measure the spectrum of electromagnetic radiation, including visible light and radio, which radiates from stars and other celestial objects.**(Seminar Presentation on the telescopes and spectrographs through any technical tool [PO2], [PO7],[PO9].** https://www.cfa.harvard.edu/~dfinkbei/ay192/lectures/ay192-telescopes-spectrographs.pdf	K1 K2 K3 K4
CO5	**Recollect** Kepler's laws **used** to predict the orbits of many objects such as asteroids and comets and were pivotal in the discovery of dark matter in the Milky Way. **Understand and apply** the satellite-based navigation system GPS, which enables anyone with a handheld receiver to determine his location to within a few meters. **Combine** the use of GIS in the telecom sector and the INSAT system, provides services to telecommunications, television broadcasting, satellite newsgathering, societal applications, weather forecasting, disaster warning and Search and Rescue operations.**(Seminar Presentation on satellite communication through any technical tool) [PO2], [PO3], [PO7], [PO9].**	K1 K2 K3 K6
Text Books		
1	Astrophysics - K. D. Abhyankar, Tata McGraw Hill Co. [All units]	
2	Introduction to Astrophysics - Baidyanath Basu, Prentice Hall of India Pvt. Ltd. [Unit – II, Unit – III and Unit - IV]	
3	Communication Electronics – N D Deshpande, D A Deshpande and P K Rangole, Tata McGraw Hill Co.[Unit - IV,(1989) [Unit – V]	
Reference Books		
1	Stellar structure -S.Chandrasekar, Donar - New York.	
2	Astrophysics and Stellar Astronomy - T. L. Surihart, John Wiley, New York.	

3	Astrophysics A modern Perspective. .K. S. Krishnaswami, New Age International.
Web Resources	
1	https://ocw.mit.edu/courses/physics/8-901-astrophysics-i-spring-2006
2	https://www.slideshare.net/gbbantayearth/stars-stellar-evolution
3	https://www.slideshare.net/junelynhigara/astronomical-instruments
4	https://www.slideshare.net/niranjan123456789/satellite-communications-ppt
5	courses.missouristate.edu/huiliu/csc690/slides/satellite.ppt

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	2	-	1	-	-	2	1	1	1
CO2	3	2	-	1	-	-	2	1	1	1
CO3	3	2	2	1	1	-	2	1	1	1
CO4	3	2	-	1	1	-	2	1	1	1
CO5	3	2	2	1	1	-	2	1	2	1
AVG	3	2	1	1	1	-	2	1	1	1
TOTAL	15	10	4	5	3	-	10	5	6	5

FIRST YEAR - SEMESTER – I										
GENERAL NUCLEAR PHYSICS										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYE2A	**DSE - II**	**5**	**-**	**-**	**1**	**3**	**6**	**25**	**75**	**100**

Learning Objectives		
LO1	To introduce students to the fundamental principles and concepts governing nuclear and particle physics.	
LO2	To understand nuclear models and predict the type of decay that a nucleus will undergo based on its composition relative to the band of stability.	
LO3	To comprehend the concept of elementary particles.	
UNIT	**Contents**	**No. of Hours**
I	**Nuclear Structure and Nuclear Forces** Nuclear radius - Electron scattering method – Mirror nuclei method -Nuclear magnetic dipole moment –Rabi's magnetic resonance method - Electric Quadrupole moment – Symmetry and statistics of Nuclei - Nuclear forces – Characteristics of nuclear forces - Central forces - Ground state of the Deuteron - Magnetic moment of deuteron - Quadrupole moment of deuteron -Exchange forces – Iso-spin formalism - Tensor forces - S and D state admixtures.	20
II	**Nuclear Models** Liquid Drop model – Semi-Empirical Mass formula and its applications –Magic numbers – Evidence for the existence of magic numbers - Nuclear Shell model - Nuclear spin-orbit coupling – Predictions of Nuclear shell model: Angular momenta and parities of nuclear ground states – Magnetic moments: Schmidt lines – Quadrupole moments.	15
III	**Nuclear Reactions and Nuclear Energy** Types of nuclear reactions – Conservation laws in nuclear reactions – Energetics of nuclear reactions: Q-value – Nuclear reaction cross section - Nuclear fission– Bohr-Wheeler theory of nuclear fission – Nuclear chain reaction – Four-factor formula – Thermal neutrons – Neutron cycle in a thermonuclear reactor – Critical size - Classification of nuclear reactors – Nuclear fusion – Sources of stellar energy.	20
IV	**Nuclear Decay** Gamow's Theory of Alpha decay - Fermi's theory of Beta decay – Curie plots – Selection rules in beta decay: Fermi & Gamow-Teller Selection rules – Electron capture – Parity violation in Beta decay -– Gamma decay – Angular momentum and parity selection rules - Internal Conversion - Nuclear Isomerism.	20

V	**Elementary Particle Physics** Classification of elementary particles-fundamental interactions among particles - Quantum numbers specifying states of particles (Nucleon, lepton, spin, Isospin, strangeness and hypercharge) – Symmetry and conservation laws – Special symmetry groups SU (2) and SU (3) – Quarks and its types - Gell-Mann-Nishijima formula of hadrons- Gell-Mann - Okubo mass formula for octet and decuplet hadrons.	15
	Total	90
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recall** various properties of the nuclei and the strong nuclear forces holding the nucleus together.Get insight into nuclear size by electron scattering and mirror nuclei methods.**Make use of the** bound state of the Deuteron quantum mechanically **assuming** central forces, **extend** the idea to learn about magnetic dipole moment and electric quadrupole moment.Gain knowledge about exchange forces, Isotopic spin formalism, tensor forces and S and D state admixtures[**PO**7].	K1 K2 K3 K4
CO2	**Recollect** and **comprehend** nuclear models and **analyze** the analogy that correlates a large amount of information and enables predictions of the properties of nuclei. Able to list out magic numbers and analyze the magicality of a number in terms of the incremental binding energies of the nuclei. [PO1], [PO2], [PO3].	K1 K2 K4
CO3	**List** the types of nuclear reactions and conservation laws related to it. **Elicit** the release of energy in a nuclear reaction and able to calculate Q-value. **Distinguish** between fission and fusion reactions. Able to **correlate** how nuclear fission and fusion reactions are responsible for controlled chain reaction and sources of energy production in stars respectively. [PO2], [PO3], [PO4], [PO9].	K1 K2 K3 K4 K5
CO4	**Remember** the occurrence of nuclear decay when the unstable nucleus spontaneously emits energy in the form of radiation. **Analyze** the violation of parity in a β-decay. Able to **comprehend** how the high energy radiation emitted from gamma decay is extremely penetrating and thereby dangerous to biological life forms. [PO1], [PO2], [PO3].	K1 K2 K4
CO5	Able to **classify** elementary particles and**compare**the fundamental interactions with examples. **List** out the quantum numbers of elementary particles.**Outline**the Quark model and symmetries SU(2), SU(3). Octet and Gellman-Okubo formula. **Group discussion**: Methods to develop Octet and Decuplet symmetry [**PO**2].e-learning**:** [**PO**9]	K1 K2 K4
Text Books		
1	Nuclear Physics – D.C. Tayal, Himalaya Publishing House, 5th edition 2021 (Units I – V)	
2	Nuclear Physics and Particle Physics –Sathyaprakash, Sultan Chand & Sons, 5th edition 2005 (Units I - V).	
3	Nuclear Physics – Dr. S.N. Ghoshal, S.Chand, Revised edition 2020 (Units I – V)	
Reference Books		
1	Nuclear Physics-R.R.Roy and B.P. Nigam Wiley Eastern Limited Co	
2	Elementary Particles – Michael longo- McGraw Hill Koga Kuswa Limited. Co	
3	Nuclear Physics-V. Devanathan, Narosa Publishers, 2006 Co	
Web Resources		
1	www.fen.bilkent.edu.tr/~bulutay/453/intro-nuclear-particle-physics.pdf	
2	nptel.ac.in/courses/115104043	

3	https://ocw.mit.edu/.../nuclear...nuclear-physics.../lecture-notes/MIT22_02S12_lec_ch.
4	https://sites.google.com/a/northgeorgia.edu/ngcsu-physics-note-sharing/home/nuclear
5	https://courses.mak.ac.ug/sites/default/files/downloads/phy7211.pdf

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learner**
CO1	3	1	2	1	-	-	1	1	-	-
CO2	3	1	2	2			1	1	-	-
CO3	3	2	2	1	1	-	2	1	-	1
CO4	3	1	2	2	-	-	1	1	-	1
CO5	3	2	2	2	1	-	2	1	1	1
AVG	3	1	2	2	1	-	1	1	-	1
TOTAL	15	7	10	8	3	-	7	5	1	3

FIRST YEAR - SEMESTER – I										
INSTRUMENTATION TECHNIQUES										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYE2B	**DSE - II**	**5**	**-**	**-**	**1**	**3**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To develop the knowledge on the Physics for the structural characterization through the X-ray diffraction.
LO2	To study how the transducers are used for energy conversion and their uses in various physical quantity measurements.
LO3	To understand the concept of Thermal analysis in medicine and industry

UNIT	**Contents**	**No. of Hours**
I	**Diffraction Techniques** Principle- Instrumentation and application of Electron diffraction- principle- Instrumentation and application of Neutron diffraction- principle – Instrumentation and application	18
II	**Electronic Measurements and Instruments** Analog and digital instruments-comparison- Basic controls of CRO- Dual trace oscilloscope- Dual beam oscilloscope- Digital storage oscilloscope.	16
III	**Transducers** Classification of Transducer -Active and passive transducer- force and displacement transducer- Strain gauges–Effects of changes in temperature- Piezoelectric transducer- Thermistors- Thermoelectric transducers.	20
IV	**Thermal Instrumentation** **Thermal Detectors**: TGA(Thermogravimetric Analysis, DTA(Differential thermal analysis), DSC(Differential Scanning Calorimetry) ; Principle-Instrumentation-Applications (Basic Ideas) **Thermography**: Block Diagram-microwave thermography-Medical applications of thermography	20
V	**Bio Medical Instrumentation** Bio amplifiers- Bio potentials- Bio electricity- Bio potential recording: ECG, EEG, EMG, ERG- Specific types of electrodes used- different lead systems- their waveforms.	16
	Total	90

Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recall** the principles of various techniques and **classify** its properties, **Analyze** the x – ray, neutron and electron diffraction and its properties, **compare** its applications and **choose** the instrument for particular characterization, Encourage the students to visit various labs for develop their skills and interpret the results (**PO**6 &**PO**8), [S**eminar** with question session with e-resources**) (PO2, PO4, PO7,PO9).**	K1 K2 K4 K5 K6

CO2	**Select** the instruments and **Develop** their knowledge in understanding the various parameters of analog and digital instruments and **explain** the working of it, **analyze** the errors and rectify to make use of it, Be adept in the usage of techniques, skills and modern tools for sustained professional development (**PO4). Learn CRO: https://eleceng.dit.ie/dsp/elab/ (PO7, PO3, PO9)**	K1 K2 K3 K4
CO3	**Define** transducer, **Compare** active and passive transducer, A**pplications** of transducers, different types of transducers **used** for various measurement of physical quantities. https://www.youtube.com/watch?v=w4GCDX8iOuA(**PO5, PO7,PO9) (PO3,PO4**)	K1 K2 K3 K5
CO4	**Understand** thermal methods analysis in industry and medicine, **learn**Function of instruments, **Deduct** qualitative and quantitative information relevant to the output based on temperature. A**nalyze** their uses in different fields https://crimsonpublishers.com/mapp/pdf/MAPP.000509.pdf **(PO3, PO4)**	K1 K3 K5 K6
CO5	**Recollect** the definition of electric potential, **Illustrate** the concept of recording the electric potentials regarding the functioning of human organs using ECG, EEG, EMG and ERG, types of electrodes, **Analyzing** the waveforms of ECG by visiting bio instrument labs.(**GD**)globaljournals.org>GJMR_volume12 **(PO3,PO4, PO5,PO9**)	K1 K2 K3 K4

Text Books	
1	Elements of crystallography – Dr.V.Velmurugan, MJP Publishers (Unit – I)
2	Electrical and Electronic Measurements and Instrumentation – ER.R.K.Rajput, S.Chand(New edition)(Unit – II and III)
3	Bio medical instrumentation- M.Arumugam, Anuradha agencies publishers, II edition(Unit – IV and V)
Reference Books	
1	Elements of X-Ray diffraction R.D.Culity
2	Instrumental methods of chemical analysis , Gurdeep R. Chatwal Sham K. Anand **(UNIT IV)**
3	Medical Instrumentation, Application and Design, John G. Webster, 3/E, John
Web Resources	
1	X-ray diffraction and structural analysis - nptel*nptel.ac.in/courses/115103030/2* Neutron diffraction - nptel*nptel.ac.in/courses/115103030/6*
2	https://en.wikipedia.org/wiki/Transducer
3	biopotential amplifiers - WordPress.comhttps://hkumarblog.files.wordpress.com/2014/04/biopotential-amp.pptx
4	Biopotential – Wikipedia https://sv.wikipedia.org/wiki/Biopotential
5	https://www.medicalmagazine.in/thermography-and-its-applications-in-medical-and-clinical-research-field/

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	2	1	2	1	-	2	1	1	1
CO2	3	1	2	2	1	-	2	1	1	1
CO3	3	1	2	2	1	-	2	1	1	1
CO4	3	1	2	2	1	-	2	1	1	1
CO5	3	1	2	2	2	1	1	1	1	1
AVG	3	1	2	2	1	-	2	1	1	1
TOTAL	15	6	9	10	6	1	9	5	5	5

FIRST YEAR - SEMESTER – II										
QUANTUM MECHANICS - I										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC04	**Core - IV**	**5**	**-**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To make the students, understand the concept and postulates of quantum mechanics, Importance of wave function and wave equation, and expectation values and dual space
LO2	To expose the students to operator formalism, representation theory, matrix theory and representation of operators through pictures, to develop problem solving skill among the students via solving Schrodinger equation for various 3D problems. Also to learn about particles, identical particles and their properties.
LO3	To enable the students, acquire knowledge on orbital, spin and total angular momentum and commutation relation among their components, learn and apply approximation methods to solve outstanding problems

UNIT	**Contents**	**No. of Hours**
I	**General formalism** Quantum concept and postulates-Physical interpretation of the wave function- Normalised and Orthogonal wave function - Expansion theorem - Conditions to be satisfied by the wave function-Solution of the Shroedinger time dependent and time independent equation-Stationary state solutions-Operators associated with different observables- Expectation values of dynamical quantities - Probability current density: Particle flux-Ehrenfest's Theorem - Dirac's- Bra - ket vectors - Dual space.	18
II	**Representation Theory** Coordinate and momentum representations – operators as matrices-Matrix form of wave function - Schrodinger equation in momentum representation theory - Matrix theory of harmonic oscillator-time evolution-Representation of operators in Schrodinger, Heisenberg and Interaction(Dirac) pictures.	18
III	**Eigen value - 3D problems and Identical particles** Free particle-the particle in a box-free axis rigid rotator-reduction of two body Hamiltonian - the hydrogen atom -total angular momentum and spherical harmonics. System of identical particles - symmetric and anti-symmetric wave functions -bosons and fermions - construction of symmetric and anti symmetric wave functions - Pauli's spin matrices and their commutation relations-the density operator, density matrix and its limitations.	24
IV	**Angular momentum** Commutation relations for orbital angular momentum operator and its components - Eigen values of L_z and L^2- ladder operators[raising and lowering]-commutation relations with J_z and	12

	J^2 - matrix representation (Eigen values) of angular momentum operators (J^2, J_Z, J_+ and J_-) - addition of two angular momentum - Clebsch-Gordon coefficients - calculation of C. G coefficients for $j_1 = j_2 = 1/2$.	
V	**Stationary states –Approximation methods** Time independent perturbation theory-first order correction to wave function and energy-non-degenerate case-the perturbed harmonic oscillator-degenerate level-Stark effect in hydrogen atom- variation method- application to ground state of helium atom-WKB approximation - application to linear harmonic oscillator.	18
	Total	**90**
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recall** postulates of quantum mechanics, **What** are wave functions? , **List** the properties of wave functions, **Name** the operators, How will you **solve** Schrodinger time dependent and time independent equation? **Summarize** the operators associated with observables. Group a**ssignment on the development of quantum mechanics using e-resources (PO2, PO5, PO9)**	K1,K2,K3,K4
CO2	**Define** operators, **state** coordinate and momentum representations, **demonstrate** operators as matrices, **Explain** Schrodinger equation in momentum representation theory, **Outline** the matrix theory of harmonic oscillator, **what** is time evolution? **Explain** Heisenberg picture, **Compare** Schrodinger, Heisenberg and Dirac pictures. **Group discussion on the merits and limitations of pictures. using e-resources(PO2, PO3, PO4, PO5,PO9)**	K1,K2,K3,K5
CO3	**Define** Eigen value and Eigen function, Refer: https://www.st-andrews.ac.uk/physics/quvis/simulations_html5/sims/infwell1d/infwell1d.html to understand probability density, **Describe** rigid rotator, **Give** the theory of reduction of two body Hamiltonian, **Classify** symmetric and anti-symmetric wave functions, **Analyze** Pauli's spin matrices and their commutation relation, **Explain** density matrix and its limitations. **Construct symmetric and anti-symmetric wave functions for six particle system(PO3,PO4,PO7,PO9)**	K1, K2,K4,K5,K6
CO4	**Recall** momentum and angular momentum, **Discuss** Eigen values of L_z and L^2, **illustrate** ladder operators, **Apply** ladder operators to derive commutation relations with J_z and J^2 , **Analyze** Eigen values of angular momentum operators of J^2, J_Z, J_+ and J_-, explain the theory of Clebsch-Gordon coefficients, **Calculate Clebsch-Gordon coefficients for $j_1 = j_2 = 3/2$.Angularmomentumoperators-PPT-** https://www.powershow.com/view1/1daf5c-ZDc1Z/51_Angular_momentum_operators_powerpoint_ppt_presentation***. (PO9, PO7, PO3)(Problems)***	K1,K2,K3,K5,K6
CO5	**What** is meant by degeneracy? **differentiate** between degenerate and non-degenerate levels, **develop and explain** the time	K1,K2,K3,K4

	independent perturbation theory in the case of Stark effect in hydrogen atom, **Use** variation method to estimate the Eigen values and Eigen functions for the ground state of helium atom, **Examine** WKB approximation and it's applications. Additional information about WKB approximation using ***www.powershow.com/.../WenzelKramersBrillouin_Approximation***.	
Text Books		
1	Quantum mechanics. Sathya Prakash - Kedarnath, Ramnath and Co. Publications.(All Units)	
2	Quantum Mechanics. Gupta, Kumar and Sharma - Jai Prakash Nath and Co, Meerut. 11th edition.(Unit – II to V)	
3	A Text Book of Quantum Mechanics. P. M. Mathews and K. Venkatesan - Tata McGraw Hill, New Delhi, 2000	
Reference Books		
1	Quantum Mechanics- A.K. Ghatak and S. Loganathan-McMillan India, 3rd edition.	
2	Advanced Quantum mechanics. Sathya Prakash -Kedar Nath, Ram Nath and Co.	
3	Quantum Mechanics - V. Devanathan - Narosa Publishing - New Delhi, 2006 Quantum Mechanics. V. K. Thankappan - Wiley - Eastern, New Delhi, 1985	
Web Resources		
1	http://walet.phy.umist.ac.uk/QM/LectureNotes/	
2	www.powershow.com/.../Introduction_to_Quantum_Theory_of_Ang...	
3	www.powershow.com/.../51_Angular_momentum_operators_power..	
4	http://ocw.mit.edu/8-05F13 ... Bra ket vectors	
5	https://www.youtube.com/watch?v=pYG8I0ENlEg	

MAPPING WITH PROGRAM OUTCOMES

Strongly Correlated - 3 **Moderately Correlated - 2** **Weakly Correlated – 1**

CO / PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	1	-	-	1	-	1	1	1	1
CO2	3	2	2	1	1	-	1	2	1	1
CO3	3	1	2	1	-	-	2	1	1	1
CO4	3	1	2	1	-	-	2	1	1	1
CO5	3	1	2	1	-	-	1	1	1	1
AVG	3	1	2	1	-	-	1	1	1	1
TOTAL	15	6	8	5	2	-	8	6	5	5

FIRST YEAR - SEMESTER – II										
MATHEMATICAL PHYSICS - II										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC05	**Core - V**	**4**	**1**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To learn to integrate complex functions through contour integrals and analyze numerical values statistically.
LO2	To generate moments and generating function of Binomial, Poisson and Normal distribution and solve differential equations through Laplace and Fourier transforms.
LO3	To formulate special functions like Bessel, Hermite, Legendre and Laguerre polynomials and study their properties

UNIT	**Contents**	**No. of Hours**
I	**Complex Integration** Analytic functions – Cauchy - Riemann conditions –Problems- C.R equations in polar form - Harmonic functions - singular points –Cauchy's integral theorem - Cauchy's integral formula with proof –problems- - Taylor and Laurent's expansion (Statement and proof only) –Poles, Residues - Cauchy's Residue theorem – Problems-Evaluation of definite integrals of trigonometric functions round the Unit circle only–Problems.	**20**
II	**Statistics** Probability- definition- sample space- mutually exclusive events- theorem of total probability -binomial theorem of probability -simple problems. Measures of central tendency –mean – arithmetic mean – geometric mean – harmonic mean – median – mode- Methods of dispersion – standard deviation – numerical problems. Binomial distribution- moments - first two moments- moment generating function – numerical problems-Poisson distribution – -moments - first two moments- moment generating function – numerical problems – Normal distribution – - moments - first two moments- moment generating function – numerical problems properties of normal curve-Problems.	**20**
III	**Fourier and Laplace Transforms** Fourier series – Dirichlet conditions - half range series - application of Fourier series to generate square, triangular and saw tooth wave - Fourier transforms – Properties- convolution theorem- Fourier sine and cosine transform -Derivative of Fourier transforms-Application of Fourier transform-Heat transfer equations-Problems. Laplace transforms - linearity property – change of scale property - shifting property -transform of derivatives- inverse Laplace transform– Fourier - Mellin Theorem - – Properties - change of scale property - shifting property- Application of Laplace transform for the solution of differential equations with constant coefficients	**20**

IV	**Special Functions - I** Beta and gamma functions – properties -Bessel differential equation - recurrence relations and generating function for Jn(x) - orthonormality of Bessel function. Hermite differential equation - Hermite polynomials - generating function - recurrence relation - Rodrigue's formula - orthogonal property of Hermite polynomials.	**15**
V	**Special functions - II** Legendre differential equations – Polynomials - generating function - recurrence relations - Rodrigue's formula - orthogonal property - Laguerre differential equations – Polynomial - generating function - recurrence relations - Rodrigue's formula - orthogonal property.	**15**
	Total	**90**
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recall** complex numbers and their properties. **Extend** the idea to complex variables and **outline** the concepts of analyticity, poles and residues. **Identify** analytic functions and Harmonic functions. **Develop** Cauchy-Riemann equations, Cauchy's integral formula and Cauchy's integral theorem for analytic functions. https://nptel.ac.in/courses/115/105/115105097/.**Compare and contrast** Taylors and Laurent's series for simply and multi-connected regions and apply the same. **Evaluation** of definite integrals of trigonometric functions round the Unit circle.	K1 K2 K3 K5 K6
CO2	**How** is statistical analysis and probability**important** as a tool in scientific calculations? **Classify** mean, median, mode and standard deviation as a measure of central tendency and **illustrate** the concepts by **using** numerical problems. **Analyze** different distribution functions and **distinguish** them (Binomial, Poisson and Normal).**Group project**: Refer e-resource -**Formulate** basic theory of errors, their analysis, and estimation with examples of simple experiments in Physics with excel(PPT).[K6 **PO**2,**PO**3,**PO**5,**PO**7,**PO**9]	K1 K2 K3 K4 K6
CO3	**What** are periodic functions and explain the Fourier analysis of periodic functions with Dirichlet conditions - **Application** of Fourier series to generate square, triangular and saw tooth wave. Fourier and Laplace transforms –Properties-Fourier sine and cosine transform -**Interpretation** of Fourier transform-Heat transfer equations-**Problems**. Fourier - Mellin Theorem - Application of Laplace transforms to **solve** differential equations with constant coefficients-Problemshttp://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25 [K5 **PO**2,**PO**3,**PO**5].	K1 K2 K3 K4 K5
CO4	**Define** and **evaluate** Beta, and Gamma functions and **analyze** their applications in estimating integrals. **Explain** the special functions, such as the Hermite and Bessel functions and their differential equations. **Develop** the polynomial of Hermite and Bessel functions and **estimate** the values of polynomials .**Discuss** their properties such as orthogonality.	K1 K2 K3 K4
CO5	**Explain** the special functions, such as the Legendre and Laguerre functions and their differential equations. **Develop** the polynomial of Legendre and Laguerre functions and **estimate** the values of polynomials.**Discuss** their properties such as orthogonality.(Sci-lab)	K1 K2 K3,K4
Text Books		
	Books for problems: **Worked out problems Mathematics Physics, H. K. Dassand Mathematical Physics, Satyaprakash are encouraged**.	

1	SathyaPrakash – Mathematical Physics – 14th Edition – 1999 - Sultan Chand and Co. (All Units)
2	H.K.Dass and Rama Verma-Mathematical Physics- 1997-Sultan Chand and Co (All Units
3	B. D. Gupta – Mathematical Physics - 3rd Edition – 2004 – Vikas Publishing House Pvt Ltd., - (All Units)
Reference Books	
1	Fourier Analysis – Schaum Series – M. R. Speigel, Tata Mc GrawHill , NY
2	Theories and Problems of Laplace transforms - Schaum Series – M. R. Speigel, TataMcGrawHill , NY
3	Complex Variables - Vectors and tensors -Schaum Series - M. R. Speigel, TataMcGrawHill , NY
Web Resources	
1	http://www.mpipks-dresden.mpg.de/~jochen/methods/outline/html
2	http://phy.syr.edu/~trodden/courses/mathmethods/
3	http://dmoz.org/Science/Physics/Mathematical_Physics/
4	http://www.thphys.nuim.ie/Notes/engineering/frame-notes.html
5	http://www.thphys.nuim.ie/Notes/frame-notes.html

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**					**Weakly Correlated – 1**		
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	1	2	1			1	1	1	1
CO2	3	2	2	1	2	1	3	2	1	1
CO3	3	1	2	1	2	1	1	1	1	1
CO4	3	1	2	1			1	1		1
CO5	3	1	2	1			2	1	1	1
AVG	3	1	2	1	1		2	1	1	1
TOTAL	15	6	10	5	4	2	8	6	4	5

FIRST YEAR - SEMESTER – II										
PRACTICALS II- ADVANCED ELECTRONICS										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC06	**Core -VI**	**-**	**-**	**6**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	Students will be able to learn fundamentals of digital circuits, principle of flip flops, construct power supplies, oscillators and vibrators.
LO2	They will be able to learn assembly language programs for 8bit and 16bit arithmetic operations, data transfers using various Programming techniques
LO3	They will be enabled to design circuits and write programs and execute.

UNIT	**Contents**	**No. of Hours**
I	**CO1** 1. Dual IC Regulated Power Supply – Construction of Voltage follower	4
II	**CO2** 2.OP-AMP- Wien's bridge Oscillator 3.OP-AMP- Phase shift Oscillator 4.OP-AMP - waveform generator - square and triangular waves 5. Solving simultaneous equations - Op-Amp– 6.Construction of Astable multivibrator using 555 timer 7.Construction of Schmitt trigger using 555 timer	24
III	**CO3** 8.Verification of Boolean expression - SOP and POS method 9.Half adder and Full adder – Simplification using K map - Using Nand gates 10.Half Subtractor and Full Subtractor - Simplification using K map - Using Nand gates 11.Study of R-S, clocked R-S and D flip flop using NAND /NOR and J-K, D and T flip flops using 7476 / 7473	16
IV	**CO4** 12.Shift left register, Ring counter and Johnson counter 13.Synchronous and Asynchronous (up and down) counter using IC 74193 14.Designing n- modulo counter using IC 7490	24

	15.Binary Adder / Subtractor using IC 7483 16. Study of D/A converter - R-2R ladder network- resolution and accuracy.	
V	**CO5** 17. Study of ALU. 18. Frequency counter to count up to 99 19.UJT - Characteristics and construction of relaxation oscillator	20
	Total	90
Course Outcomes		K Level
CO	On completion of this course, students will	
CO1	Construct power supplies using active and passive components https://youtu.be/KE5QJtU6ZA8	K1 ,K2,K3, K4 , K6
CO2	Understand the concept of OPAMP to construct oscillators and vibrators. https://youtu.be/gbUXbaxvX94	K1, K2,K3, K4 ,K5
CO3	Construct circuits to demonstrate the principle of flip flops and to verify truth tables.	K1, K2,K5, K6
CO4	Acquire proficiency to construct and analyse registers, counters and converts used in digital circuits. https://youtu.be/gEGq1vozv9g	K1, K2,K3, K4,K5
CO5	Apply theoretical knowledge acquired about electronic components and design circuits.	K1, K2,K3, K4,K5, K6

MAPPING WITH PROGRAM OUTCOMES

Strongly Correlated - 3 **Moderately Correlated - 2** **Weakly Correlated – 1**

CO / PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player /worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	1		1	2	1	1	1	1	1
CO2	3	2	1	1	2	1	1	1	1	1
CO3	3	2	1	1	2	1	1	1		
CO4	3	1	1	1	2	1	1	1	1	1
CO5	3	1	1	1	2	1	1	1		
AVG	3	2	1	1	2	1	1	1	1	1
TOTAL	15	7	4	5	10	5	5	5	3	3

FIRST YEAR - SEMESTER – II										
ADVANCED NUCLEAR PHYSICS										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYE3A	**DSE - III**	**4**	**-**	**-**	**1**	**3**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the advanced nuclear models and special types of nuclear reactions.
LO2	To learn neutrino physics and the experimental evidence of the existence of neutrino.
LO3	To gain knowledge about Quantum chromodynamics, the MIT bag model of hadrons and the Abdus Salam model of electroweak unification.

UNIT	**Contents**	**No. of Hours**
I	**Nuclear Interactions** Nucleon - Nucleon scattering: Basic concepts – Low-energy n-p scattering – Partial wave analysis of n-p scattering -Spin dependence of nuclear forces – Effective range theory -– Proton - Proton scattering below 10MeV: Theory and Experimental data– Differences between (p - p) and (n - p) scattering - High energy nucleon-nucleon scattering: (n-p) and (p-p) scattering above 10 MeV.	15
II	**Nuclear Models** Introduction – Fermi Gas model – Single particle shell model – Individual particle model - Collective model of Bohr and Mottelson: Vibrational states – Mathematical analysis of Vibrational spectra – Rotational states – The Nilsson Model – Super fluid model - Optical Model.	10
III	**Special Types of Nuclear Reactions** Compound nucleus reactions - Compound Nuclear Theory – Resonance scattering: Breit – Wigner dispersion formula - Direct reactions – Theory of stripping and pick-up reactions – Nuclear transmutation: Proton induced nuclear reactions – Deuteron induced nuclear reactions – α-particles induced nuclear reactions – Neutrons induced nuclear reactions – Gamma ray induced nuclear reactions – Heavy ion nuclear reactions.	15
IV	**Neutrino Physics** Pauli's Neutrino Hypothesis – Properties of Neutrino (charge, spin, mass, helicity) - Experimental verification of the existence of Neutrino: Leipunski's experiment – Alikhanov experiment – Cowan and Reines experiment – Neutrino mass and double β-decay rates – Solar neutrino problem - Neutrino oscillation and mixing – Atmospheric neutrinos.	15
V	**Quark Model and Weak Interaction** Quark model of hadrons – Colour quantum numbers - Quantum chromo dynamics (QCD) – Properties of QCD: Colour confinement– Asymptotic freedom - Elementary ideas on MIT bag model - Tau - Theta puzzle – Weak interaction - Parity non-conservation in weak interactions - Exchange bosons of the weak interaction - Unification of fundamental interactions: Electroweak unification - Basic ideas of Weinberg and Abdus Salam model of electro-weak unification – Elementary ideas of Grand Unification Theory (GUT).	20
	Total	**75**

Course Outcomes		K Level
CO	On completion of this course, students will	
CO1	**Recall** the basic properties of nuclear forces and **understand** the interaction between nucleons **[PO2]. Analyze** the proton scattering, which reveals strongly- correlated proton-neutron pairs in atomic nuclei **[PO3]. Apply** proton-proton scattering to obtain the information on nuclear structure **[PO4]. Compare** (p-p) and (n-p) scattering.	K1 K2 K3 K4 K5
CO2	**Relate** the Fermi gas model that pictures the nucleus as a degenerate gas of protons and neutrons with the electron gas in metals. **Comprehend** the features of the nucleus's liquid drop and shell models to study the collective model, which incorporates the aspects of both models **[PO2].Analyze**, how thecollectiv emodel,can explain certain magnetic and electric properties that neither of the two separately can explain **[PO3], [PO4].**	K1 K2 K4
CO3	**Understand** nuclear transmutation entails a change in the structure of atomic nuclei. **Recollect** and **analyze** induced nuclear reactions by protons, neutrons, deuterons, α, β and γ particles [PO3].**(Seminar Presentation/PPT on special types of nuclear reactions through any technical tool) [PO5], [PO7] [PO4].**	K1 K2 K4
CO4	**Remember** the basics of the β-decay process that concerns neutrinos**.Explain the** different experimental methods which support the existence of neutrinos**. Understand** the origin of neutrino masses and mixing and of the symmetries governing the lepton sector of particle interactions **[PO2]. (e -quiz on neutrinos) [PO7] [PO4]**	K1 K2 K3, K5
CO5	**Recollect** and visualize the quark model, which is a classification scheme for hadrons in terms of their valence quarks. **Comprehend** the concept of colour quantum number and colour confinement in QCD. **Apply** the concepts of the Bogoliubov model to study MIT bag model. **Analyze** the parity violation in weak interaction and the electro-weak unification in Abdus Salam model (discussions).**(e-quiz on quarks)[[PO2],[PO3]& [PO7][PO4]**	K1 K2 K3 K4
Text Books		
1	Nuclear Physics and Particle Physics –Sathyaprakash, Sultan Chand & Sons, 5th edition 2005 (Units I - V).	
2	Nuclear Physics – Dr. S.N. Ghoshal, S.Chand, Revised edition 2020 (Units I – V)	
3	Fundamentals of Nuclear Physics - Jahan Singh, Pragati Publication. (Unit III, IV and V)	
Reference Books		
1	Nuclear Physics – D.C. Tayal, Himalaya Publishing House, 5th edition 2021 (Units I – V)	
2	Concepts of Nuclear Physics, B.L. Cohen, Tata McGraw Hill	
3	Nuclear and Particle Physics, W.E. Burcham and M. Jobes, John Wiley and Sons.	
Web Resources		
1	https://en.wikipedia.org/wiki/Cowan–Reines_neutrino_experiment	
2	http://courses.theophys.kth.se/SI2350/reports/fleischmann.pdf	
3	Physics | Nuclear Reactions | Pauli's Neutrino Hypothesis | by *...https://www.youtube.com/watch=MuhHgTVQNZE*	
4	Quantum ChromoDynamics*https://arxiv.org/pdf/hep-ph/0505192*	
5	https://www.britannica.com/science/electroweak-theory	

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learner**
CO1	3	1	2	1			1	1		
CO2	3	1	2	2			1	1		
CO3	3	2	2	1	1		2	1		1
CO4	3	1	2	2			1	1		1
CO5	3	2	2	2	1		2	1	1	1
AVG	3	1	2	2	1		1	1		1
TOTAL	15	7	10	8	3		7	5	1	3

FIRST YEAR - SEMESTER – II										
ADVANCED ELECTRONICS										
Course Code	**Category Core/Ele/ Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours/ Week**	**Marks**		
								CIA	**ESE**	**Total**
24PPYE3B	**DSE - III**	**4**	**-**	**-**	**1**	**3**	**5**	**25**	**75**	**100**

Learning Objectives		
LO1	To understand peripheral devices applied to microprocessors and microcontrollers.	
LO2	To learn, interfacing the peripheral devices with microprocessors and microcontroller programming. To update knowledge on satellite communication and Antennas. Student will be able to write and execute programs using 8085 interface and microcontroller 8051.	
LO3	To understand peripheral devices applied to microprocessors and microcontrollers.	
UNIT	**Contents**	**No. of Hours**
I	**Peripheral Devices / Interfacing of 8085** Peripheral Devices – Hand shake signals – Programmable peripheral interface – 8255 . Interfacing 8255 to 8085 - Programmable keyboard/display interface – 8279 - Block diagram of 8279 – Keyboard section – Scan section – Display section – MPU interface section –Interfacing of 8279 with 8085	15
II	**Architecture of Microcontroller 8051** Introduction - Pin out functions of 8051 – Internal architecture of 8051 – Program counter – Program memory – Data memory – Internal RAM and registers - Special function registers of 8051 - I/O ports – Timers and Control registers –- Interrupt system - Addressing modes – Immediate, register, direct and indirect addressing modes	15
III	**8051 Instructions and applications** Instruction set of 8051 - Arithmetic, Logical, Data move Jump and Call instructions– Assembly language programming - simple programs to illustrate arithmetic and logical operations (addition, multiplication and division - 8 bit) – Applications: Interfacing of LED	15
IV	**Antenna** Radiation field and Radiation resistance of a short dipole antenna -Grounded λ/4 Antenna-Ungrounded λ/2 Antenna- Antenna Arrays-Broadside and End Side Arrays-Antenna Gain-Directional High Frequency Antennas- Sky Wave Propagation-Ionosphere- Ground Wave Propagation.	15
V	**Satellite Communication** Satellite Communication: Orbits, Station keeping; Satellite attitude; Path loss calculation; Link calculation - link models – system parameters – link equations – link budget; Multiple access techniques; Transponders; Effects of nonlinearity of transponders	15
	Total	**75**
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recall t**he basic ideas of operational amplifier, **Applications** of operational amplifiers. Formulate the conditions for various categories of filters depending on	K1 K2 K3

	frequencies. **Solving** simultaneous and differential equations. **Demonstrate** Op - amp as regenerative comparator. https://www.youtube.com/watch?v=9cxzu2-85II (**PO2**)	
CO2	**What** is the condition of oscillation? **Construction** of sinusoidal and non-sinusoidal oscillators. **Analyze** their waveforms. **Explanation** of A/D and D/A converters. **Compare** different types and justify their merits and demerits. **(Seminar-PPT-Questions) Practice sheets: http://tuttle.merc.iastate.edu/ee201/quiz_practice.html ((PO2, PO5, PO7, PO3, PO4, PO6, PO9)**	K1 K2 K3 K4 K5
CO3	**Explain** pin functions of 8085and Architecture of 8085. **Compare** Machine language and Assembly language. **Why** addressing modes are needed? **Summarize** Instructions set and addressing modes of 8085. **Create** timing diagram for READ and WRITE memories. https://www.youtube.com/watch?v=zAXAb_ttazY. (**PO7**)	K1 K2 K5 K6
CO4	**Build** assembly language program to perform arithmetic and logical operations. **Develop** multiplication program to find the square of a given number. **Demonstrate** the program for BCD to Binary and Binary to BCD code conversion**.Define** debugging.	K1,K2 K3,K6
CO5	**List** the types of memories. **Explain** the concept of interfacing and. I/O Operations, **Demonstrate** Interrupt circuits and DMA. **Function** of Support chip and **applications** as Programming the I/O ports and the timer. **(Group Seminar-PPT-Questions) (PO2, PO5, PO7)**	K1, K2 K3,K4
Text Books		
1	Fundamentals of 8085 microprocessor, V.Vijayendran -Viswanathan Pub.(nit I, II, III)	
2	Fundamentals of 8086 microprocessor- V.Vijayendran -Viswanathan Pub .(Unit I, II, III)	
3	Communication systems, B.P.Lathi, Willey eastern ltd. (Unit IV,V)	
Reference Books		
1	Microprocessor and its applications, Nagoorkani, first edition, RBA publications,1999	
2	Electronics Communication system by G.Kennedy . Davis .Tata Mc Graw Hill Pub.	
3	Electronic Communications – Dennis Roddy and Coolen , Prentice Hall of India, IV Edition,1995 (Unit IV,V)	
Web Resources		
1	https://www.ectnote.com/2009/12/8255-programmable-peripheral-interface.html	
2	https://www.tutorialspoint.com › ... › Satellite Communications	
3	https://www.tutorialspoint.com › Microprocessor › Programmable Peripheral Interface	
4	https://www.elprocus.com/led-interfacing-with-8051-microcontroller/	
5	https://www.slideshare.net/ishanegi35/antennas-wave-and-propagationEC6602 ANTENNA and WAVE PROPAGATION - ppt downloads*lideplayer.com/slide/10388121/*	

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**					**Weakly Correlated – 1**		
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learner**
CO1	3	1	1	1	-	-	1	1	1	1
CO2	3	1	3	1	1	-	2	1	2	1
CO3	3	1	3	3	3	2	1	1	1	1
CO4	3	1	1	1	-	-	1	1	-	1
CO5	3	1	2	2	1	-	1	1	1	1
AVG	3	1	2	2	1	-	1	1	1	1
TOTAL	15	5	10	8	5	2	5	5	5	5

FIRST YEAR – SEMESTER II										
PHYSICS AND ARCHAEOLOGY										
Course Code	**Category Core/Ele/ Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hrs**	**Marks**		
								CIA	**ESE**	**Total**
24PPYG1A	**GE - I**	**4**	**-**	**-**	**1**	**3**	**75**	**25**	**75**	**100**

Learning Objectives	
LO1	To enable students from varied departments to understand that physics plays a vital role in the investigation of the unearthed samples and determination of their age.
LO2	To make students gain basic knowledge about the role played by the Archaeological Survey of India (ASI) and Tamil Nadu State Archaeological Department.
LO3	To delve deep into construction of various analytical tools which play an imperative role in the field of archaeology.

UNIT	**Contents**	**No. of Hours**
I	**Introduction to Archaeology** Archaeology – definition – Archaeological time line – introduction to pre-historic age and its types. Divisions in archaeology - Epigraphy – Numismatics – Art and Architecture – Rock paintings – Terracotta artefacts. Important excavation sites in India – Lothal (Gujarat) – Pattinam (Kerala) – Hampi (Karnataka) – Ellora caves (Maharastra).	15
II	**Archaeological Surveyof India (ASI)** History of ASI – Contribution of Indian scientists to ASI – Establishment of State archaeology department – Important contributions - Significant excavation sites in Tamil Nadu – How old is old - General methods used for investigation – relative chronology – bone analysis – pollen analysis – Tree-ring analysis. Museum and conservation. Importance – Museums in Tamil Nadu.	15
III	**Analytical Tools used in Archaeology – Spectroscopic Techniques** Fourier Transform Infrared Spectroscopy (FTIR) – Principle – FTIR spectrometer – schematic diagram – working – analysis by IR technique – detection of organic compounds in pottery shards. Energy Dispersive Analysis of X-rays (EDAX) – principle – instrumentation of EDAX – Schematic diagram and working – Analysis by EDAX – elemental distribution in pottery shards.	15
IV	**Analytical Tools in Archaeology – Imaging Techniques** Optical Microscope – Principle – construction and working (with diagram) – Analysis of structural morphology of ancient artifacts – Ivory beads, Terracotta artifacts, ceramic pots. Scanning electron microscope – principle – Electron microscope – construction and working (diagram) – applications – discovery of carbon nano tubes (CNT) in pottery shards excavated in Keezhadi.	15
V	**Archaeological Dating and Major Archaeological Findings** Introduction – Dating methods – Dendrochronology – Radiocarbon dating – Age of the Earth – Archaeo-magnetic dating – Stratigraphic dating – ArtifactSeriation. Major Findings – Damascus steel (Weapon) – Lycurgus cups (Utensils) – Ivory beads (Ornaments) – Burial Urns (Rituals).	15
	Total	75
Course Outcomes		**K Level**

CO	On completion of this course, students will	
CO1	**Understand** the basic concepts of archaeology, and **Define** important terms involved in archaeology. **Understand** the pre-historic age and its types, and also the divisions in archaeology**Identify**the important excavation sites in India.Assignment on the various divisions of archaeology (Epigraphy – Numismatics – Art and Architecture – Rock paintings – Terracotta artefacts).	K1,K2,K3 K5
CO2	**Relate**ASI and State Archaeology Department. **Understand** the contribution of Indian scientists to archaeology.**Identify**the significant excavation sites in Tamil Nadu.**Examine** the general methods used for investigation.**Groupdiscussion**Museums in Tamil Nadu.	K1,K2,K3 K5,K6
CO3	**Differentiate**FTIR and EDAX. **Understand**the construction and working of FTIR and EDAX instruments**. Investigate** the organic compounds and elemental distribution of pottery shards using above techniques. **Group Discussion**Major results obtained by using the FTIR AND EDAX techniques.	K1, K2, K3, K4
CO4	**Define t**he different terms that help understand working of microscope.**Understand** how optical microscope and electron microscope works. **Discuss** the structural morphology of ancient artefacts. **Assignment** on Keezhadi excavations.	K1, K2, K4, K5
CO5	**List** the different dating methods used in archaeology. **Explain**the physics behind the major findings of archaeology. **Seminar** on dating methods. **Group discussion, PPT** on major findings of archaeology.	K1, K2
Text Books		
1	Scientific methods in medieval archaeology, M.J.Aitken	
2	Fundamentals of spectroscopy, C.N Banwell Tata McGraw Hill	
3	Spectroscopy, Gurdeep Chatwaal, Himalaya Publishing House.	
Reference Books		
1	Molecular structure and spectroscopy,G.Aruldhas, Prentice Hall, New Delhi	
2	A textbook of nanoscience and nanotechnology, T.Pradeep, McGraw Hill Education (India) Pvt.Limited.	
3	Keezhadi –Archaeological Department, Tamil Nadu.	
Web Resources		
1	https://www.deshbandhucollege.ac.in/pdf/resources/1585214200_PHY(H)-VI-NANO_MATERIAL-1-AJAYPRATAP.pdf	
2	https://serc.carleton.edu/research_education/geochemsheets/elementmapping.html	
3	https://en.wikipedia.org/wiki/Optical_microscope	
4	https://crowcanyon.org/education/learn-about-archaeology/archaeological-dating/	
5	https://archaeology.ncdcr.gov/blog/2021-04-14/relative-absolute-dating#:~:text=In%20radiocarbon%20dating%2C%20the%20amounts,the%20plant%20or%20animal%20died.	

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**					**Weakly Correlated – 1**		
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learner**
CO1	3	1	1	1	1	-	1	1	2	1
CO2	3	2	2	2			2	1	3	2
CO3	3	1	2	1	1	-	2	1	-	1
CO4	3	1	2	1			1	1	1	1
CO5	3	1	1	1	1	-	2	1	1	1
AVG	3	1	2	1	1	-	2	1	1	1
TOTAL	15	6	8	6	3	-	8	5	7	6

FIRST YEAR - SEMESTER – II										
ASTROPHYSICS										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours/ Week**	**Marks**		
								CIA	**ESE**	**Total**
24PPYG1B	**GE-I**	**4**	**-**	**-**	**1**	**3**	**5**	**25**	**75**	**100**

Learning Objectives		
LO1	To know about the Solar system,	
LO2	To understand the Stellar evolution	
LO3	To have an idea of galaxies and instrumentation	
UNIT	**Contents**	**No. of Hours**
I	**Introduction** Astronomers and their findings– Electromagnetic spectrum and astronomical units- Emission and absorption spectra-Doppler effect- Units of distances-Parsec- Luminosity	15
II	**Solar system** Solar system - Types of Planets - Asteroids – Meteroids - Comets -– Composition of sun-Photosphere- Chromosphere – Sun spots - Solar flares- Eclipses- Solar and Lunar-Time of Occurence - Similarities and Differences	15
III	**Stellar Evolution** Spectral classification of Stars - Harvard system -Birth of a Star- Protostar –Maturity –Ageing –Death of star- Supernova remnants -White dwarfs- Chandrasekhar limit- Neutron stars - Black holes	15
IV	**Galaxies** Stellar populations – Galaxies - origin of galaxies –- Milky way- Types of galaxies- Elliptical galaxy –Spiral galaxy- Lenticular galaxy - Irregular galaxy-Quasar galaxy	15
V	**Astronomical Instruments** Classification of Telescopes- Optical Telescope - Reflector Telescope - Radio Telescopes - Significance of star chart -Hubble space Telescope- X-ray astronomy:	15
	Total	**75**

Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Remember** basics of Astro Physics**, Name** the famous Astronomers, **Make** the chart of life History of famous Astronomers- **https://nptel.ac.in/courses/121/104/121104006/ (PO9)** ps://www.nasa.gov/audience/forstudents/5-8/features/nasa.../what-is-an-eclipse-58 (Interactive session)	K1 K2 K3
CO2	**Recalling** Solar system**, classify** Planets**, Study about** Sun's Composition, **Learn** about Solar flares, Eclipses- Solar, Lunar, Time of Occurrence**, Find out** Similarities and Differences. Discussions with https://solarsystem.nasa.gov/moon https://theskylive.com/3dsolarsystems/overview/ (**PO**9) https://www.youtube.com/watch?v=zRSPMkUXdMc – Galaxies;	K1 K2 K3 K4

CO3	**Recollect** about Stars, **Categorize** Stars**, Gain knowledge about** Lifecycle of the stars, white dwarfs Chandrasekhar limit, Neutron stars, Black holes **(Students in groups to recollect the age of Sun with other Stars and submit typed report) (K6 in PO4, PO5,PO7, PO9)**	K1 K2 K3 K4 ,K5,K6
CO4	Remember Galaxies, Learn about Milky way, Stellar populations, List down Types of galaxies, Study about origin of galaxies. **https://skyandtelescope.org/astronomy-resources/stargazing-basics/learn-the-sky/(PO9)**	K1 K2 K3
CO5	**Classification** of Telescopes-, **Learn** and **find** out Significance of star chart , Study about X-Ray Astronomy(**students in groups to read the monthly star chart submit typed report) (K6 in PO4, PO5, PO9)**	K1 K2 K3 K5 K6
Text Books		
1	Introductory Astronomy- Nicholas and Thomas,Wesley publishing Company II Encyclopedia-Space (Unit-I,II,III)	
2	Modern Physics – R. Murugesan, S. Chand and Co (Unit-III)	
4	X-ray Astronomy : K D Abhyankar (Unit V)	
Reference Books		
1	Introductory Astronomy- Nicholas and Thomas,Wesley publishing Company	
2	Fredrick and Baker, Astronomy10th edition, D.Van Nostrand company(1976)	
3	Kaufmanns,Universe3rd edition W.H. Freeman and company	
Web Resources		
1	https://www.nasa.gov/audience/forstudents/5-8/features/nasa.../what-is-an-eclipse-58	
2	https://www.youtube.com/watch?v=n1y8w0F8R3s– Sun www.space .com	
3	https://www.youtube.com/watch?v=zzbCEF37MfU – Solar System	
4	https://www.youtube.com/watch?v=zRSPMkUXdMc – Galaxies	
5	https://www.youtube.com/watch?v=RdrGcg_WNaM-Celestial objects	

MAPPING WITH PROGRAM OUTCOMES

Strongly Correlated - 3 **Moderately Correlated - 2** **Weakly Correlated – 1**

CO / PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/ worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	1	1	1	1	-	1	1	2	1
CO2	3	2	2	2	-	-	2	1	3	2
CO3	3	1	2	1	1	-	2	1		1
CO4	3	1	2	1	-	-	1	1	1	1
CO5	3	1	1	1	1	-	2	1	1	1
AVG	3	1	2	1	1	-	2	1		1
TOTAL	15	6	8	6	3	-	8	5		6

FIRST YEAR - SEMESTER – II										
COMPUTATIONAL PHYSICS I- NUMERICAL METHODS										
Course Code	**Category Core/Ele/ Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYS01	**SEC- I**	**1**	**1**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To provide the basic concept of a few numerical methods
LO2	To understand the method of solving different kind of numerical problems in Physics
LO3	To familiarize the students of M.Sc. students with the numerical methods used in computation

UNIT	**Contents**	**No. of Hours**
I	**Roots of equation** Bisection method – iteration method- Newton Raphson method. Solutions of non linear equations: Two equations with two unknowns	5
II	**Numerical differentiation** Newton's forward and backward difference interpolation formulae (equal intervals)- derivatives of y based on Newton's forward and backward difference- Lagrange's interpolation formula (unequal intervals).	10
III	**Numerical integration & Curve fitting** Trapezoidal Rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule –Curve fitting: Principle of least squares – Fitting a/an (i) straight-line ii) curve of the form, $y = ax^b$ (iii) polynomial of the form, $y = a + bx + cx^2$ (iv) exponential curve $y = ae^{bx}$.	5
IV	**Solution of equations** Solution of ordinary differential equations: Euler method – Modified Euler method – Runge - Kutta method (Second and Fourth order).	5
V	**Solving Simultaneous Equations** Solving Simultaneous Equations- Gauss elimination method- Matrix inversion by Gauss elimination method (2 x2 and 3x3 matrix)	5
	Total	30

Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recollect** the basics knowledge of numerical methods of approximation, **understand** different methods of solving non-linear equations and **acquire** familiarity with the methods of iteration, Bisection method and Newton Raphson method. **[PO2][PO4]** E-QUIZ on methods for approximating solutions of non-linear equations.**[PO9]** (e-resources) https://www.youtube.com/watch?v=XcPIQzWZ_1g	K1 K2 K4 K5 K6
CO2	**Acquire** basic knowledge in **Estimating** the missing data through interpolation methods. **Integrate** the ideas to **analyze** errors by difference tables. **Develop** skills in analyzing the methods of interpolating a given data. Evaluate	K1 K2 K3 K5

	conceptual based problems to understand Newton's and Lagrange's interpolation formula. [**PO**3] https://nptel.ac.in/courses/111/107/111107105/[**PO**7] GC	
CO3	**Understand** Newton's forward and backward difference formulae to **determine** the derivatives. **Recollect** the basics of differentiation and integration to solve ordinary differential equations. **Apply** Euler's method and Runge-Kutta method to **solve** a single ordinary differential equation for one or two steps of the independent variable [**PO**2] [**PO**3]	K1 K2 K3 K4 K6
CO4	**Apply** General quadrature formula to **derive** Trapezoidal Rule and Simpson's Rule **Develop** skills in **Analyze** the properties of curves of best fit to the given Curve fitting. **Evaluate** principle of least squares and Fitting different curves. https://nptel.ac.in/courses/111/107/111107105/, e-quiz on curve fitting [**PO**7,**PO**4]	K1 K2 K3 K5
CO5	**Comprehend** solving simultaneous equation **Construct** matrix inversion by gauss elimination method **Compile**[K6] 2x2, 3x3matirices using gauss elimination method[**PO**5][**PO**7] e-quiz on Gauss elimination method[**PO**7,**PO**4]	K1,K2,K4 K5,K6
Text Books		
1	Numerical methods- Dr .P. Kandasamy, Dr. K. Thilagavathi, Dr. K. Gunavathi, S. Chand and company Pvt.Ltd	
2	Numerical Methods in Science and Engineering-Dr. Venkataraman, V Edn., (2013)- The National Publishing Company	
3	Introductory methods of Numerical Analysis - S. S. Sastry, 3rd Edn., Prentice Hall of India Pvt.Ltd.	
Reference Books		
1	Numerical methods with Programs in C , T. Veerarajan, T.Ramachandran, 2nd Edition, Mc Graw Hill (2015)	
2	Numerical Analysis – Scheid, McGraw Hill International Book Company	
3	Advanced Engineering Mathematics - E.Kreyzig, Wiley	
Web Resources		
1	Newton Raphson Method - YouTubehttps://www.youtube.com/watch?v=oE98W4A7Zio	
2	Bisection Method - YouTubehttps://www.youtube.com/watch?v=XPUsRgaMsUs	
3	Euler's Method | MIT 18.03SC Differential Equations, Fall 2011 *...https://www.youtube.com/watch?v=X5-ucBtneVM*	
4	https://dspace.mit.edu/bitstream/handle/1721.../index.htm	
5	Classical Runge-Kutta, ODE4 www.youtube.com/watch?v=Mva9UIz_wwA	

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learner**
CO1	3	1	1	1	-	-	2	1	1	1
CO2	3	1	1	-	-	-	2	1	1	1
CO3	3	1	1	1	-	-	2	1	-	1
CO4	3		2	1	-	-	2	1	2	2
CO5	3	1	3	1	1	-	2	2	2	2
AVG	3	1	2	1	-	-	2	1	1	1
TOTAL	15	4	8	4	1	-	10	6	6	7

SECOND YEAR - SEMESTER – III										
QUANTUM MECHANICS – II										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC07	**Core -VII**	**5**	**-**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	The course is targeted to assimilate the quantum perspective of scattering, and helps to appreciate the role of quantum mechanics in atomic as well as sub-atomic systems
LO2	Learning the origin of relativistic quantum mechanics for sub-atomic systems, the concept of fields and the way to analyze fields are systematically planned
LO3	The theory of time dependent perturbation and the need for other approximations to analyze many-electron systems are discussed to apply it to spectroscopy.

UNIT	**Contents**	**No. of Hours**
I	**Unit I: Scattering theory**-Kinematics of scattering process - differential and total cross - section - wave mechanical picture of scattering - scattering amplitude - scattering amplitude in terms of Green's function - Born approximation and its validity - scattering by Yukawa potentials -optical theorem - partial wave analysis - phase shifts - scattering amplitude - very low energy scattering - scattering length – The effective range theory.	18
II	**Unit II: Evolution with time** Time dependent perturbation theory - first and second order transition under constant perturbation - physical interpretation of the curve - transition probability - Fermi - Golden rule- harmonic perturbation - adiabatic and sudden approximation - Semi classical treatment: interaction of atom with quantized radiation- calculation of Einstein's coefficients.	18
III	**Unit III: Relativistic wave equations** The Klein - Gordon equation - plane wave solution - charge and current densities - Dirac equation-matrices and their properties - free particle solution of Dirac equation -- negative energy states of positron - existence of electron spin - covariant form of Dirac equation and proof for covariance - properties of gamma matrices – traces .	16
IV	**Unit IV: Classical fields** Classical fields-canonical coordinates for quantization of fields-Euler Lagrange equations - Hamiltonian formulation - quantization of real and complex scalar fields - creation, destruction and number operators-second quantization - - quantization of Schroedinger equation - second quantization of K.G equation.	20
V	**Unit V: Atomic and molecular structure** Approximation in atomic structure -central field approximation - Thomas - Fermi statistical model - Hartree - Fockself consistent field method – valence band theory - Heitler - London theory of hydrogen molecul - alkali atom-the doublet separation of spectral lines.	18
	Total	**90**

Course Outcomes		K Level
CO	On completion of this course, students will	
CO1	Define scattering terminology from the quantum perspective, distinguish it from classical view point, understand the relation, disclose two main methods of approximation applied to low energy scattering, apply and analyse the method to basic potentials, perceive its applications. [Assignment on Born Approximation with INFLIBNET material: PO8,9]	K1,K2,K3,K4
CO2	Answer with inference to the questions, Why do we need time dependent perturbation and other approximation theory? Where and how are they applied, apply them and understand the physics of practical importance, interpret the results arrived theoretically, analyse to deduce the relation among Einstein's coefficients.[e-quiz on Perturbation theory][PO4]	K1,K2,K3 ,K4 , K5
CO3	Recall the basic Schrodinger wave equation and its difficulty, extend it to relativistic quantum mechanics through the KG equation, understand Dirac equation,solve it, appreciate, analyse its solution, perceive the concept of negative energy states, evaluate the properties of Dirac matrices and gamma matrices and understand covariance through four vector form of Dirac equation. Team work on i. Construction of Dirac equation ii. Evaluation the properties of Dirac matrices iii. Gamma matrices with its properties and iv. Four- vector formulation of Dirac equation as a written assignment to four teams. A question session through PPT at the end of the interactive seminar to invoke further learning and discussions is encouraged. (K5, K6) [PO2, PO3, PO7, PO10]	K1,K2,K3,K4,K5,K6
CO4	Get introduced to the concept of classical fields:https://nptel.ac.in/courses/115/106/115106065/ (GD) formulate Lagrangian density, Hamiltonian density, relate them with the need for second quantization, categorize real and complex fields, infer the motive for operators in the process of second quantization, utilize them to second quantize Schrodinger equation and KG equation. https://nptel.ac.in/courses/115/101/115101117/ (Discussions) (PO2, PO5)	K1,K2,K3,K4
CO5	Recall many electron systems and understand the inadequacy of methods to solve them, elaborately discuss the Valence band theory, Heitler – London theory of hydrogen molecule, apply it to understand the doublet separation in alkali atoms, statistical theory of Thomas – Fermi and Hartree – Fock method of self-consistent field.	K1,K2,K4,K6
Text Books		
1	Quantum Mechanics. L. *Schiff - Tata McGraw Hill, New Delhi, 1968.*	
2	Quantum Mechanics. Gupta, Kumar and Sharma - Jai Prakash Nath and Co, Meerut. 11th edition.	
3	Quantum mechanics. Sathya Prakash -Kedar Nath, Ram Nath and Co. Publications.	
Reference Books		
1	Quantum Mechanics. V. K. Thankappan - Wiley - Eastern, New Delhi, 1985.	
2	Quantum Mechanics - A.K. Ghatak and S. Loganathan -McMillan India, 3rd edition	
3	Quantum Mechanics. . J.L. Powell and B. Crasemann -Narosa Publishing House , New Delhi - 1993	
Web Resources		

1	staff.ustc.edu.cn/~yuanzs/teaching/Fermi-Golden-Rule-No-II.pdf
2	https://en.wikipedia.org/wiki/Klein–Gordon_equation
3	www.philiphofmann.net/book_material/notes/heitlerlondon2.pdf
4	https://en.wikipedia.org/wiki/Gamma_matrices
5	http://www.nscl.msu.edu/~pratt/phy851/lectures/lectures.html

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3				**Moderately Correlated - 2**				**Weakly Correlated – 1**		
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	1	2	-	-	-	2	2	1	1
CO2	3	1	2	1	-	-	2	1	-	
CO3	3	2	2	1	2	1	3	1		
CO4	3	2	2	-	2	1	1	1	2	1
CO5	3	1	2	-	-	-	1	1		1
AVG	3	1	2	1	1	1	2	1	1	1
TOTAL	15	7	10	2	4	2	9	6	3	3

SECOND YEAR - SEMESTER – III										
ELECTROMAGNETIC THEORY										
Course Code	**Category Core/Ele /Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC08	**Core - VIII**	**5**	**-**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives		
LO1	The aim of this course is to explore the different concepts of electrostatics, magnetostatics, dielectrics and boundary value problems	
LO2	To provide an insight into classical electrodynamics based on Maxwell's equations	
LO3	To understand the concepts of propagation characteristics of electromagnetic waves and relativistic electrodynamics.	
UNIT	**Contents**	**No. of Hours**
I	**Electrostatics** Electrostatic Potential- Gauss -theorem Application of Gauss's law to a spherically symmetric charge distribution– Electric field and potential of a dipole and Quadruple – Equi potential surfaces- multipole expansion of electric field- - Energy density of an electrostatic field- Poisson's equation - Laplace equation - Uniqueness theorem - Method of electrical images –A point charge in front of a conducting sphere-when grounded, insulated, and when sphere is charged and insulated.	20
II	**Magnetostatics and Dielectrics** Biot-Savart's law-Ampere's law in circuital form -Magnetic scalar potential-Equivalence of a small current loop and a magnetic dipole-Magnetic vector potential-Lorentz condition-Dielectrics-Polarisation - Different types of Polarisation - Polarisability-,dielectric constant and displacement vector -electric susceptibility and dielectric constant - Boundary conditions on field vectors - potential energy of charge distribution in the presence of dielectrics - dielectric sphere in a uniform field – Lorentz field in a dielectric – Clausius-Mossotti relation.	20
III	**Maxwell's Equations** Equation of continuity - Displacement current - Maxwell's Equations – Physical significance-Integral form – Electromagnetic energy and Poynting's theorem – Poynting,vector - Electromagnetic vector and scalar potentials - Maxwell's equations in terms of electromagnetic potentials - Non - Non-uniqueness of electromagnetic potentials and concept of gauge - Lorentz gauge.	15
IV	**Wave Propagation** Reflection, Refraction: Boundary conditions at the surface of Discontinuity-Fresnel's equations- Wave equation- EM waves in free space, and in conducting medium - Interaction of EM waves with matter - Wave guides-Transverse electric mode(TE) and Transverse magnetic(TM) mode -propagation of EM waves in rectangular waveguides- - Radiation due to an oscillating electric dipole-Expression for radiative power.	20
V	**Relativistic Electrodynamics** Minkowski space - Invariance of D' Alembertian operator -four vectors- Lorentz transformation for space and time in four vector form –Transformation for charge and	

	current densities - Equation of continuity in covariant form–-Transformation of electromagnetic potentials – Lorentz condition in covariant form - Invariance of Maxwell's field equations in terms of four vectors.	15
	Total	90
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Understand** and e**xplain** the fundamentals of the behavior of electric fields and to solve the Laplace equation, **Apply** theoretical knowledge of principles and mathematical concepts to practical problems (**PO**3), E– Quiz on solving problems in GCR (**PO**4)	K1 K2 K3
CO2	**Recall** the basic laws in magnetic fields to **explain** boundary conditions and to find various parameters for **solving** the problems, To enhance the research skill, make them to **analyze** the materials related to dielectric properties (**PO**3), Seminar with group discussion to promote their basic knowledge through PPT (**PO**2).	K1 K2 K3 K4
CO3	**Define the** new formalism of Maxwell's equation with the modification in the equations of electricity and magnetism for time-varying fields. **Rephrase** the law of conservation of energy, as Poynting theorem. **Develop** electromagnetic potentials, and **Analyze** electrodynamics involving changing electromagnetic fields with gauge invariance and non-uniqueness of electromagnetic potential.https:// nptel.ac.in/courses/115/104/115104088/ [**PO2,PO3,PO4,PO7,PO8,PO9]**	K1 K2 K3 K4
CO4	**Illustrate** Electromagnetic waves being transverse in nature. **Demonstrate** properties of reflection, refraction and polarization in terms of Fresnel's equations. **Distinguish** and **solve** wave equation for propagation of electromagnetic waves in vacuum, non-conducting isotropic dielectric medium and linear isotropic conducting medium. https://nptel.ac.in/courses/115/104/115104088/.**Formulate** the propagation of electromagnetic waves through rectangular waveguides. **Estimate** radiative power from an oscillating electric dipole.https://nptel.ac.in/courses/115/104/115104088(discussions)https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=28.**Group discussion** about different modes of propagation through rectangular wave guides in TE and TM modes.**[K6,PO2,PO3,PO5,PO6]**	K1 K2 K4 K5 K6
C05	**Recall** basic relativistic concepts. **Develop** four vectors and **demonstrate** Minkowski's four dimensional vector space. **Interpret** Lorentz transformation equations, charge and current densities in four vector form. **Perceive** the knowledge of four vectors form to **justify** invariance of equation of continuity, electromagnetic potentials and Maxwell's equations.Assignment on Minkowski's four dimensional vector space and its implications in the various physical phenomena with INFLIBNET material. http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=28. **[K5,PO8,PO9,PO10]**	K1 K2 K3 K4 K5
Text Books		
1	Electromagnetic theory and electrodynamics, Sathya Prakash, KedarnathRamnath and Co, Meerut	
2	Electrodynamics, Gupta, Kumar and Singh, S.Chand and Co, New Delhi .	
3	Electrodynamics, Chopra and Agarwal K.Nath and Co, Meerut	
Reference Books		
1	Classical Electrodynamics, J.D.Jackson and John Willey (1962), New york.	
2	Introduction to special theory of relativity – Robert Resnick, Wiley Eastern Ltd, I Edn.	

3	Foundations of Electromagnetic Theory – J.R Reitz, F.J, Milford and R.W. Christry, Narosa, III Edn, New Delhi, 1998.
Web Resources	
1	http://www.plasma.uu.se/CED/Book/index.html
2	http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html
3	http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html
4	http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/
5	https://www.cpp.edu/~pbsiegel/supnotes/nts1331.pdf

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3				**Moderately Correlated - 2**				**Weakly Correlated – 1**		
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	1	2	2	-	-	2	1	1	1
CO2	3	2	1	1	-	-	2	1	1	1
CO3	3	1	2	1	-	-	1	1	1	1
CO4	3	2	1	2	2	1	2	1	3	2
CO5	3	2	2	1	1	-	1	1	1	1
AVG	3	2	2	1	1	-	2	1	1	1
TOTAL	15	8	8	7	3	1	8	5	7	6

SECOND YEAR - SEMESTER – III										
PRACTICALS III - GENERAL - II										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC09	**CORE - IX**	**-**	**6**	**-**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To make the students, understand the theory of working of the instruments.
LO2	To train the students, on handling the instruments, accurate measurement, and tabulating the observations appropriately
LO3	To encourage the students troubleshoot the problems in terms of handling and calculation

UNIT	**Contents**	**No. of Hours**
I	**CO1** 1.Wavelength and separation between wavelengths- Michelson's interferometer. 2.Thickness of mica sheet-Michelson's interferometer. 3.Spectral Analysis- FTIR spectrometer (Demonstration). 4.Spectral Analysis -UV-Visible spectrophotometer (Demonstration)	18
II	**CO2** 5.Thickness of wire- LASER and air wedge. 6.Thickness of plate- Edser Butler fringes. 7.Hall constants of a semiconductor- Hall effect.	18
III	**CO3** 8. Susceptibility- Guoy's method. 9. Susceptibility- Quincke's method. 10. Compressibility in liquids-Ultrasonic interferometer. 11. Ultrasonic diffraction-RF oscillator.	18
IV	**CO4** 12. G. M. Counter- Characteristics. 13. G. M. Counter- Absorption coefficient- maximum range of β rays. 14. Specific charge- Thomson method. 15. Dielectric constant of a liquid.	18

	16. Solar constant- Lee's Disc method.	
V	**CO5** 17. Solar Cell-characteristics and efficiency. 18. Coefficient of thermal expansion-Air wedge method. 19. Mutual Inductance-Carey Faster's bridge. 20. Scilab-Simple experiments (Demonstration).	18
	Total	90
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Recall** the properties of EM waves, **Define** spectrum, **summarize** the laws of reflection and refraction, **identify** the applications of optical instruments, **inspect** the working, **tabulate** the observations, **determine** the parameters, **discuss** the result, **maximize** the accuracy and **minimize** the error. **Demonstrate FTIR and UV instrumentation and understand Analyze the spectra. (PO2,3,4,5,6,7)**	K1,K2 ,K3, K4,K5
CO2	**Define** Hall effect, **compare** ordinary and LASER lights, **illustrate** EB fringes, **examine** the thickness of the wire due to LASER and Air wedge setup, **estimate** Hall constants and **calculate** the thickness of L.G plate using spectrometer. **(PO2,3,4,5,6,7)**	K1,K2 ,K4, K5
CO3	**Recall** the working principle of interferometer, **define** magnetic susceptibility, **make use** of Guoy balance and Quincke's set up to **determine** susceptibility and **compare** the results, **analyze** and **interpret** the ultrasonic diffraction pattern. **Use ultrasonic interferometer to estimate the compressibility in a mixture of liquids, using RF oscillator of frequency 2MHz. (PO2,3,4,5,6,7)**	K1,K2,K3,K5,K6
CO4	**Define** radioactivity and **Recollect** information regarding the sources of α, β and γ radiation, **Summarize** the properties of electrons, what is called specific charge? **Explain** dielectric constant of materials, **use origin software** to draw graphs. **(PO2,3,4,5,6,7)**	K1,K2 K3,K4
CO5	**List** the uses of the solar energy, **construct** solar cell, **illustrate** the characteristics of solar cells, **demonstrate Scilab experiments**, **Explain** Coefficient of thermal expansion, **discuss** the **theory** of Carey Faster's bridge and **determine** mutual inductance **(PO2,3,4,5,6,7)**	K1,K2,K3,K4

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**					**Weakly Correlated – 1**		
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player /worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	2	3	2	2	1	2	1	1	1
CO2	3	1	3	1	2	1	3	1	1	1
CO3	3	2	2	2	2	1	2	1	1	1
CO4	3	1	2	1	2	1	2	1	1	1
CO5	3	1	1	2	1		2	1	1	1
AVG	3	1	2	2	2	1	2	1	1	1
TOTAL	15	7	11	8	9	4	11	5	5	5

SECOND YEAR - SEMESTER – III										
CONDENSED MATTER PHYSICS										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC10	**Core - X**	**5**	**-**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the free electron theory quantum mechanically and learn its applications.
LO2	To learn about band theory, its underlying theoretical development for its successful explanation of certain properties and phenomena of solid states.
LO3	To acquire knowledge about different magnetic materials and superconductors.

UNIT	**Contents**	**No. of Hours**
I	**Lattice Vibrations** Vibrations of one dimensional monoatomic and diatomic linear lattice – the Brillouin zone –Normal modes of vibrations - phonons - momentum of phonons -- lattice thermal conductivity – inelastic scattering of photons and neutrons by phonons - Umklapp process. Debye's model of lattice heat capacity - modes - The Debye approximations - limitations of the Debye model.	15
II	**Free electron theory** Somerfield's Quantum theory - Free electron gas in one dimensional potential well– Free electron gas in three dimensions - Density of states - Fermi energy-Fermi – Dirac statistics - Application of free electron gas model - Electronic specific heat - spin paramagnetism of free electrons.	15
III	**Band theory of solids** Bloch theorem and proof - Kronig - Penny model - electron energy bands - velocity, acceleration and the effective mass of an electron – Tight binding Approximation - Concept of Fermi surface - characteristics of Fermi surface -Distinction between metals, insulators and semiconductors – Energy band diagram and Fermi level – Hall effect.	15
IV	**Superconductivity** Superconductivity - basic concepts - Meissner effect - isotope effect – entropy - specific heat - Thermodynamics of superconducting transition – Type-I, Type-II superconductors - London equations - London penetration depth – BCS Theory (qualitative) - Flux quantization – Quantum tunneling - AC and DC Josephson effect - Applications of Superconductors: SQUIDS – high temp Superconductors- Superfluidity.	15
V	**Magnetic Properties of solids** Quantum theory of Ferromagnetism –Weiss field - exchange interactions - Magnons – Magnon dispersion relation - Domain theory of Ferromagnetism - Bloch wall - Molecular theory of Antiferromagnetism - Neel temp - Ferrimagnetism – Structure of Ferrite:$MgAl_2O_4$- Curie temperature and susceptibility of ferrimagnets - Applications of Ferrite.	15
	Total	75

Course Outcomes		**K Level**
CO	On completion of this course, students will	

CO1	**Understand** the vibrations of one dimensional monoatomic and diatomic linear lattice,**https://www.youtube.com/watch?v=sQtQAGNm3BAIllustrate** the Brillouin zone and normal modes of vibrations **,Define** phonons ,**momentum** of phonons, **how** it contributes to lattice thermal conductivity ,**Explain** inelastic scattering of photons and neutrons by phonons **and** Umklapp process, **Analyse** Debye's model of lattice heat capacity (**Interactive seminars and discussions are encouraged. [PO3, PO7, PO10]**.	K1 K2 K3 K4
CO2	**Justify** the failure of classical model and need for Somerfield's Quantum theory**, explain** free electron gas in one dimensional potential well**, extend it to** three dimensions and **deduce** density of states**, Recall**Fermi – Dirac statistics and Fermi energy**, Apply** to free electron gas model, **examine** the properties likeElectronic specific heat andspin paramagnetism of free electrons.**[Assignment on Sommerfield atom model with INFLIBNET material: PO7,PO8,09]**	K1 K2 K3 K5
CO3	**State** and prove Bloch theorem , **apply** it to Kronig - Penny model **to explain** electron energy bands, **https://www.youtube.com/watch?v=IJJ-JtvJ5uM** **deduce** velocity, acceleration and the effective mass of an electron, **perceive** the concept of Tight binding Approximation **, understand** fermi surface fermi level **to** Distinguish between metals, insulators and semiconductors , describe Hall effect. **Online quizzes on basic concepts of different approximations(PO7)**	K1 K2 K3 K4
CO4	**Recall the** basic concepts of Superconductivity, **apply** thermodynamics to superconducting transition to explain Meissner effect **,**isotope effect ,entropy **and** specific heat, **classify** Type-I, Type-II superconductors **–deduce** London equations ,**explain** BCS Theory ,**discuss** AC and DC Josephson effect, phenomena of Flux quantization and Quantum tunneling **,** of Superconductors **– understand** the need forhigh temp Superconductors, **appreciate** their Applications. **Theoretically analyse and suggest new combination of materials which can act as high temperature superconductors.(K6)**	K1 K2 K3 K4 K6
CO5	Understand the need for Quantum theory of Ferromagnetism, extend it to perceive the concept of Weiss field, define Magnons ,deduce Magnon dispersion relation ,discuss Domain theory of Ferromagnetism **and** Bloch wall **, elaborate** Molecular theory of Antiferromagnetism and Ferrimagnetism **distinguish between** Neel temp and Curie temperature **,Describe** the Structure of Ferrites and their Applications. **Group discussions, individual Seminar through ppts and assignments can be given on the theories underlying different magnetic materials to enhance their further learning.((PO2,PO5,PO6,PO7)**	K1 K2 K5
Text Books		
1	Solid state physics, R.K.Puri and V.K.Babbar, third edition, S.Chand and company Ltd.(2005) (All Units)	
2	Solid State Physics – S.O.Pillai, New Age International, New Delhi, 1997. (All Units)	
3	Solid State Physics - S.L.Gupta and V.Kumar. K.Nath andCo,Meerut. (All Units)	
Reference Books		
1	Introduction to Solid State Physics - C. Kittel - Wiley Eastern - New Delhi	
2	Solid State Physics Rita John,McGraw Hill, New Delhi, 2014.	
3	Solid State Physics - A.J. Dekker - Macmillan India	
Web Resources		
1	Lecture 5: Reciprocal lattice II, Brillouin zone and Bragg s,.- nptel*nptel.ac.in/courses/113104012/5*	
2	Debye Theory of Specific Heat, Lattice Vibrations – Worked., - nptel*nptel.ac.in/courses/115106061/21*	

3	Magnetic properties – nptel *nptel.ac.in/courses/112108150/pdf/PPTs/MTS_16_m.pdf*
4	https://ocw.mit.edu/courses/.../lecture-notes/MIT2_57S12_lec_notes_2004.pdf kronig penney
5	web.mit.edu/8.13/www/JLExperiments/JLExp39.pdf superconductivity

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	2	2	1	1		1	1	1	1
CO2	3	2	1	2	1		1	2	1	1
CO3	3	1	2	1	1		2	1	1	
CO4	3	1	1	1	1		1	1		2
CO5	3	2	2	1	2	1	2	1	1	
AVG	3	2	2	1	1		1	1	1	1
TOTAL	15	8	8	5	6	1	7	6	4	4

SECOND YEAR - SEMESTER – III										
PHYSICS OF BIOLOGICAL SYSTEMS										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYG2A	**GE - II**	**4**	**-**	**-**	**1**	**3**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To enable students from varied departments to understand that physics is the vital force that governs the structure, organization and functioning of living systems
LO2	To make students gain basic knowledge about the different fundamental concepts in physics which enable us to understand and appreciate the functions of different organs in our body
LO3	To delve deep into construction and physics behind the working of various diagnostic tools which play an imperative role in the field of medicine and thereby gain insights about role of physics in medicine.

UNIT	**Contents**	**No. of Hours**
I	**Waves and Wave Motion** Sources of waves-wave motion-types of waves: mechanical waves - Compression and rarefactions, electromagnetic waves - Transverse and longitudinal waves. Amplitude, phase, frequency of a wave-Qualitative treatment only. Sources of sound,characteristics of sound - pitch, intensity, volume. - fundamentals and harmonics. Relation between frequency, wavelength and speed (expression only). Human ear-Parts-functioning. Frequency and pitch, intensity and loudness-sensitivity of human ear-threshold of hearing and threshold of pain. Hearing in Bats - echoes. Application: Stethoscope-construction and working.	15
II	**Fluid Mechanics** Pressure and thrust-definition. Equation of continuity. Bernoulli's theorem-statement and explanation of the terms. Viscosity-definition. Streamline and turbulent flow of a fluid. Poiseulle's law (qualitative treatment). Applications: Circulation of blood-parts and functioning of human heart - heart attack- Blood pressure - effects of changes in blood pressure in body. Measurement of blood pressure.	15

III	**HEAT** Heat capacity-specific heat capacity and latent heat- definition, units and dimensions. Propagation of heat -conduction, convection, radiation. Applications - warm and cold-blooded animals, regulation of body temperature in warm-blooded animals, control of skin temperature, withstanding cold temperatures. Aestivation and hibernation. Heating by the sun through radiation, evaporation-cooling of skin by secretion of sweat.	15
IV	**OPTICS** Dual nature of light-wave and particle nature. Lenses-Refraction through lenses, types of lenses -convex and concave lens - curvature, principal focus, focal length. (qualitative). Power of a lens-definition and unit. Refractive index of a material (definition) Human eye - structure of the eye. Eye as a camera. Lens system of the eye. Defects in vision-myopia, hyperopia and astigmatism-correction using external lens (qualitative treatment only) Applications - Contact lens, confocal microscopy	15
V	**MEDICAL PHYSICS-DIAGNOSTIC INSTRUMENTS** Basic medical instrumentation system. X-rays - properties. X-ray diagnostics and imaging. X-ray computed tomography, ECG, EEG - basic principle, block diagram and working. Ultrasound imaging, diathermy, lithotripsy.	15
	Total	75
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Understand** the physical aspects of waves, and **define** important terms involved in describing wave motion. **Understand** the structure of ear and **apply** wave concept to process of hearing. Assignment on hearing in animals and threshold of hearing and pain for different sounds.	K1,K2,K3,K5
CO2	**Relate** the concepts of viscosity and surface tension to the functioning of heart. **Understand** the concepts of turbulence, streamline motion as **applied** to circulation in human body. **Examine** the effects of blood pressure fluctuations in various parts of the body. **Group discussion,** on latest advances in treatments for cardiac problems, and the physics behind the instruments.	K1,K2,K3, K5, K6
CO3	**Differentiate** the different ways in which heat is transmitted. **Understand** how animals and human adapt to different climatic conditions and **recall** the difference between aestivation and hibernation. **Group Discussion**: hibernation and aestivation habits of different animals.	K1 K2 K3 K4

CO4	**Define t**he different terms that help understand working of lens system. **Understand** how human eye works like a camera. **Discuss** the defects of the eye. **Assignment** on structure and function of different parts of the eye.	K1 K2 K4 K5
CO5	**List** the different diagnostic tools used in medicine. **Explain** their principle, construction and working. **Seminar** on tools used in therapy. **Group discussion, PPT** on physics principles behind the working of the diagnostic tools.	K1 K2
Text Books		
1	A Textbook of Sound, N. Subramaniam and Brijlal, S. Chand & Co, New Delhi, II Revised Edition, 2021.	
2	Physics in Biology and Medicine, Paul Davidovits, Hardcourt Academic Press, 2001.	
3	Biomedical Instrumentation, M. Arumugam, Anuradha Publishing Co., Kumbakkonam, TamilNadu, 2004.	
Reference Books		
1	Handbook of Biomedical Instrumentation R S Khandpur Tata McGraw Hill Publishing Company Ltd. 2003.	
2	Jacobson and Webster, Medicine and clinical Engineering, Prentice Hall of India, New Delhi, 1979.	
3	Richard Aston, Principles of Biomedical Instrumentation and measurement, Merrill Publishing Co., London, 1990	
Web Resources		
1	https://www.physicsclassroom.com/class/sound/u11l1c.cfm	
2	https://www.britannica.com/science/ear/Anatomy-of-the-human-ear	
3	https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves	
4	https://www.slideshare.net/slideshow/eeg-electroencepalogram/235064630#13	
5	https://www.slideshare.net/slideshow/ecg-machine-10693963/10693963#7	

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness / reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	1	1	-	-	-	1	2	1	1
CO2	3	1	1	-	-	-	1	1	1	1
CO3	3	2	1	1	1	-	2	1	1	1
CO4	3	1	1	1	-	-	1	1	2	1
CO5	3	2	1	1	--	-	2	1	-	1
AVG	**3**	**1**	**1**	**1**	**1**	**-**	**2**	**1**	**1**	**1**
TOTAL	**15**	**7**	**5**	**3**	**1**	**-**	**8**	**6**	**5**	**5**

SECOND YEAR - SEMESTER – III										
MEDICAL INSTRUMENTATION										
Course Code	**Category Core/Ele/ Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours/ Week**	**Marks**		
								CIA	**ESE**	**Total**
24PPYG2B	**GE - II**	**4**	**-**	**-**	**1**	**3**	**5**	**25**	**75**	**100**
Learning Objectives										
LO1	To learn the basics of Medical instruments. The origin and characteristics of bio-signal and the basics of medical instrumentation									
LO2	Different types of electrodes used for the process of bio-potential and the transducers for the analysis Recording and interpretation of ECG, EEG etc									
LO3	Principle and working of biomedical instruments and the imaging techniques for diagnostics. The physiological assist devices and the working of different imaging instruments									
UNIT	**Contents**									**No. of Hours**
I	**Physiological System and Medical Instrumentation** Bio-signal and its characteristics -Transport of ions through cell membrane – Resting and action potentials - Bio-electric potentials - Design of medical instrumentation system - Static and dynamic characteristics of medical instruments									15
II	**Bio-Potential Electrodes and Physiological Transducers** Electrode potential - Types of Electrodes – Surface, Needle and Micro electrodes – Chemical electrodes - Pressure transducers – Magnetic induction type transducers - Piezoelectric type transducer- transducer for body temperature measurement.									15
III	**Bio-Potential Recorders** Characteristics of the recording system - Electrical activity of the heart- Electrocardiogram - Block diagram of electrocardiograph and recording system – ECG amplifier - Electroencephalography (EEG) – Action potential of the brain and brain waves – EEG leads - Recording set up of EEG and analysis									15
IV	**Bio-Medical Equipments** X- ray tube & X- ray machine – Radiography and Fluoroscopy - Image intensifiers - Angiography (Basic idea) Ultrasonic Doppler blood flow meter - Blood pressure measurement									15
V	**Physiological Assist Devices and Imaging Techniques** Pacemakers - types and operation – Artificial heart valves – Laser Medicine – instrumentation and imaging – Endoscopes – Nuclear imaging techniques – Computer tomography – Magnetic Resonance Imaging (MRI)									15
	Total									**75**
Course Outcomes										**K Level**
CO	On completion of this course, students will									
CO1	**Recall** the principles of Cell, membrane, bio signals and **classify**Potentials, **Analyze**bioelectric potentials, **compare**static and									K1 K2

	dynamic characteristics of medical instrumentation and **choose** the instrument for particular characterization, Encourage the students to visit various labs for develop their skills and interpret the results (**PO**6 &**PO**8), [S**eminar** with question session with e-resources**) (PO2, PO4, PO7,PO9).**	K4 K5 K6
CO2	**Select** the instruments with electrodes and **Develop**their knowledge in understanding the various electrodes in instruments and **explain** the working of it, **analyze** the usage various of transducers and identify to make use of it, Be adapt in the usage of techniques, skills and modern tools for sustained professional development (**PO4). Learn Transducer:** https://byjus.com/physics/transducer/, https://www.youtube.com/watch?v=w4GCDX8iOuA **(PO7, PO3, PO9)**	K1 K2 K3 K4
CO3	**Define** Recording System, **Compare**EEG and ECG Recording Systems, A**pplications** of EEG and ECG **used**for various measurement of physical quantities., **Analyzing** the waveforms of ECG by visiting bio instrument labs https://www.goodrx.com/health-topic/heart/doctor-decoded-ecg-vs-eeg (**PO5, PO7,PO9) (PO3,PO4**)	K1 K2 K3 K5
CO4	**Application** of X- ray Radiography, Radiography and Fluoroscopy - Image intensifiers - Angiography **,**) Ultrasonic Doppler blood flow meter - Blood pressure measurement **where** they are used? A**nalyze** their uses. https://www.ahajournals.org/doi/full/10.1161/01.str.31.6.1342 **(PO3, PO4)**	K1 K3 K5 K6
CO5	Pacemakers - types and operation – Artificial heart valves – Laser Medicine – instrumentation and imaging – Endoscopes – Nuclear imaging techniques – Computer tomography – Magnetic Resonance Imaging (MRI) **Recollect** the instruments using heart instruments pacemakers and heart valves, laser in medicine**Illustrate** the concept of imaging techniques MRI CT, **Analyzing** the images of CT, MRI by visiting bio instrument labs.(**GD**) **(PO3,PO4, PO5,PO9**)	K1 K2 K3 K4
Text Books		
1	Biomedical Instrumentation, 6/e, Arumugam, M., Anuradha publications, 2006.	
2	Biomedical Instrumentation and Measurements, 2/e, Leslie Cromwell and Weibell, F.J., Pfeiffer, E.A., PHI, 1999	
3	Medical Instrumentation, Application and Design, John G. Webster, 3/E, John Wiley, 2009.	
Reference Books		
1	Hand-book of Biomedical Instrumentation, 2/e, R.S. Khandpur, TMH, 2003.	
2	Principle of Biomedical Instrumentation & Measurement, Richard Aston, TMH, London 1990	
3	Sudip Paul,Vinay Kumar Pandey, in Introduction to Biomedical Instrumentation and Its Applications, 2022.	
Web Resources		
1	https://www.pluxbiosignals.com/blogs/informative/what-are-biosignals-get-started-here	
2	https://www.fer.unizg.hr/_download/repository/01_2015_Biomedical_Instrumentation_-Origin_of_bioelectric_potentials.pdf	
3	https://www.techtarget.com/whatis/definition/transducer#:~:text=A%20transducer%20is%20an%20electronic,and%20pressure%20sensors%2C%20and%20antenna.	
4	https://www.mayoclinic.org/tests-procedures/blood-pressure-test/about/pac-20393098	

5	https://www.nibib.nih.gov/science-education/science-topics/computed-tomography-ct#:~:text=The%20term%20%E2%80%9Ccomputed%20tomography%2C%E2%80%9D,images%2C%20or%20%E2%80%9Cslices.%E2%80%9D

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			Moderately Correlated - 2				Weakly Correlated – 1			
CO / PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/ worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	2	1	2	1	-	2	1	1	1
CO2	3	1	2	2	1	-	2	1	1	1
CO3	3	1	2	2	1	-	2	1	1	1
CO4	3	1	2	2	1	-	2	1	1	1
CO5	3	1	2	2	2	1	1	1	1	1
AVG	3	1	2	2	1		2	1	1	1
TOTAL	15	6	9	10	6	1	9	5	5	5

SECOND YEAR - SEMESTER – III										
COMPUTATIONAL PHYSICS II- C PROGRAMMING										
Course Code	**Category Core/Ele/ Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours/ Week**	**Marks**		
								CIA	**ESE**	**Total**
24PPYS02	**SEC - II**	**1**	**1**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives		
LO1	To impart the knowledge of programming in C and provide platform to enhance student's basic skills required for advanced programming	
LO2	The aim and objective of the course on Computational Physics II is to familiarize the students of M.Sc. students with C programming, so that they can use these in solving simple physics problems.	
LO3	Write algorithms flowchart and programs in C	
UNIT	**Contents**	**No. of Hours**
I	**ELEMENTS OF C** Importance of C - Basic structure of C program - Constants, variables and data types - operators and expression	5
II	**CONTROL STATEMENTS** Statements - Decision making and branching: if...else- switch, goto- Decision making and looping: While, Do, for, Jump in loops	10
III	**ARRAYS** Arrays - One and two dimensional arrays - Intialising two dimensional arrays - multi dimensional arrays - Dynamic arrays - Character arrays and strings - Declaring and reading strings - Arithmetic operations on characters	5
IV	**FUNCTIONS** Definition of function - Return values and their types - Function calls - Function Declaration - Passing arrays to functions - Passing strings to functions	5
V	**Flow Charts and Programs** Simple Programs in C: Temperature conversion - Arranging number in ascending and descending order - Matrix addition and multiplication (2X2 and 3X3) Iteration and Newton Raphson method - Newton's forward and backward difference formula – Simpson's 1/3 and 3/8 Rule – Euler method.	5
	Total	30

Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	Understand the basic structure of C program and acquire the knowledge to write a simple program with proper syntax. Tofamiliar with the role of main () function and return statement. Analyse the program and to initialize variables with different data types (int, float, etc https://youtu.be/EjavYOFoJJ0?si=kw2fm_yDYahfIkA2 https://youtu.be/6F8cTBbh_TI?si=Tq_HF51LQZ5K4Rv9	K1 K2 K4 K5 K6
CO2	By using control statements to write effective C programs and will learn to make decisions using if-else and switch statements, and repeat tasks using while, do-while, and for loops. Also understand how to control loop execution for iterative operations. https://youtu.be/kfZEZj1IOBE?si=hl48u9eadkhXA7w6	K1 K2 K3 K5

CO3	Construct the program by declare and initialize one-dimensional and two-dimensional arrays, as well as multi-dimensional arrays. To effectively use arrays in C programming to store and manipulate data. Arrays | One Two AndMulti Dimensional Arrays (learnloner.com). https://youtu.be/55l-aZ7_F24?si=_Vl35pnU6s3DCrv2	K1 K2 K3 K4,K6
CO4	Comprehensive understanding of functions in C programming, which enable to write modular, reusable, and efficient code. To define and declare functions with proper syntax and understand return values and types. https://youtu.be/puIK6kHcuqA?si=SNTxq546qR5vNVtg	K1 K2 K3 K5
CO5	To construct simple, well-structured C programs to solve numerical problems using flow charts and algorithms. Also to write C programs to different numerical methods used in Physics. https://youtu.be/FxGBoSr4UJw?si=7EtO-LjsO0woHf7p**.**	K1, K2 K4,K5 K6

Text Books	
1	Programming in ANSI C, E. Balaguruswamy, "8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316-513-0.
2	Numerical methods with Programs in C , T. Veerarajan, T.Ramachandran, 2nd Edition, Mc Graw Hill (2015)
3	C Programming for Problem Solving: 300+ solved Programs, Sharath Heggur, Clever Fox Publishing, ISBN 939445733X
Reference Books	
1	Programming In C (2nd Ed.) - Ashok N. Kamthane - Pearson
2	2. The C Programming Language - DENNIS M. RITCHIE- AT&T Bell Laboratories Murray Hill, New Jersey
3	3. Let us C – (15th Ed.) - Yashwant Kanetkar - BPB Publications
Web Resources	
1	C Functions Tutorial : with Example Programs - YouTube
2	*https://www.geeksforgeeks.org/c-programming-language/*
3	https://www.learn-c.org/
4	DEFINITE INTEGRALS using SIMPSON'S 1/3rd RULE - C PROGRAM . *..https://www.youtube.com/watch?V=Hdpg3hHnlkw*
5	C Functions Tutorial : Programs- https://www.youtube.com/watch?v=J1vV1VDnCn0

MAPPING WITH PROGRAM OUTCOMES

Strongly Correlated - 3 **Moderately Correlated - 2** **Weakly Correlated – 1**

CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	1	1	1	-	-	2	1	1	1
CO2	3	1	1	-	-	-	2	1	1	1
CO3	3	1	1	1	-	-	2	1	-	1
CO4	3		2	1	-	-	2	1	2	2
CO5	3	1	3	1	1	-	2	2	2	2
AVG	3	1	2	1	-	-	2	1	1	1
TOTAL	15	4	8	4	1		10	6	6	7

SECOND YEAR - SEMESTER – IV										
METHODS OF SPECTROSCOPY										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC11	**Core - XI**	**5**	**-**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To make the students understand the basic concepts of different spectroscopic methods, their instrumentation techniques.
LO2	To make the students understand the simple applications of spectroscopy in characterizing materials based on their vibrational, rotational, NMR and ESR spectra.
LO3	Upon successfully completing the course, the students will be able to interpret a given spectrum.

UNIT	**Contents**	**No. of Hours**
I	**Microwave and Infrared Spectroscopy** **Microwave Spectroscopy**: Classification of molecules – linear poly atomic molecules – symmetric top molecules – Stark effect – Quadrupole hyperfine interaction – microwave spectrometer – Application – the inversion spectrum of ammonia. **Infrared Spectroscopy**: Vibrational energy of a diatomic molecule – selection rules – vibrating diatomic molecule – diatomic rotator – vibrations of polyatomic molecules – normal vibrations of CO_2 and H_2O molecules – FTIR spectroscopy (instrumentation and advantages only).	20
II	**Raman Spectroscopy** **Raman effect** – quantum mechanical description of the Raman effect – classical approach to Raman effect – mutual exclusion principle – rotational spectroscopy – vibration rotation spectroscopy – FT Raman spectrometer – non-linear Raman effects – hyper Raman effect – stimulated Raman effect – inverse Raman effect – coherent anti-stokes Raman scattering (CARS).	18
III	**Electronic Spectroscopy of Molecules** Electronic spectra of diatomic molecules – The Born–Oppenheimer approximation – Vibrational coarse structure: Progressions – Intensity of Vibrational-Electronic Spectra: the Franck – Condon Principle – Dissociation energy and Dissociation Products – Predissociation – Techniques and instrumentation.	16
IV	**Spin Resonance Spectroscopy** **NMR spectroscopy**: Magnetic properties of nuclei – resonance condition – relaxation processes – Bloch equations – chemical shift. Applications – NMR imaging. **ESR spectroscopy**: Theory of ESR – comparison between NMR and ESR – instrumentation – hyperfine splitting – applications – structural determination – ESR spectrum of methyl radical, benzene anion - biological studies.	20
V	**Surface Spectroscopy** Electron energy loss spectroscopy (EELS) – Reflection absorption IR spectroscopy (RAIRS) – inelastic helium scattering – photoelectron spectroscopy (PES) – X-ray (XPES) - ultraviolet (UPES) – Auger electron spectroscopy (AES) – X-ray fluorescence (XRF) – applications.	16
	Total	90

Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Classify** molecules based on their orientation. Apply the selection rules and **analyse** microwave and vibrational spectra of different types of molecules. **Explain** Stark Effect and	K1 K2

	quadrupole interaction. **Discuss** the applications of microwave and FTIR spectroscopy. **Seminar**: **Compare** IR with FTIR techniques and discuss the advantages of FTIR techniques**. E-learning**:https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Rotational_Spectroscopy/Microwave_Rotational_Spectroscopy;https://www.slideshare.net/cdtpv/vibrational-spectrroscopy; https://www.youtube.com/watch?v=QHkSh3WWKek [**PO**2, **PO**3]	K3 K4
CO2	**Recollect** Tyndall Effect. Discuss the classical and quantum theory of Raman Effect. **Define** Mutual Exclusion Principle and **make use of it** to analyse the vibrational and Raman activity of various molecules**. Explain** rotational and vibrational-rotational spectroscopy. **Develop** the theory of various kinds of Raman Effect – CARS. **PowerPoint presentation** – Life History of Sir C.V. Raman Effect and discovery of Raman Effect.[**PO**2, **PO**3, **PO**7]**E-learning**: https://www.sanfoundry.com/engineering-physics-questions-answers-raman-effect/ [**PO**2, **PO**7]	K1 K2 K3 K4
CO3	**Explain**the electronic spectra of diatomic molecules. **Determine** the vibrational coarse structure of diatomic molecules. **Apply** Franck Condan principle to determine the intensity of vibrational – electronic spectra. **Discuss** the concept of dissociation energy and dissociation products**. Extend** the concept to study predissociation. **Assignment**: Instrumentation techniques of electronic spectroscopy of molecules. **Group Discussion** on the modern ideas of molecular structure and the classification of electronic states accordingly. (**PO**5)	K1 K2 K3 K6
CO4	**Recall** the concept of resonance. Apply it to understand NMR resonance condition. **Discuss** Bloch Equation. **Explain** chemical shift and **determine** the chemical of some common molecules. **Compare** the theory of NMR and ESR. **Build** the concept of hyperfine splitting. **Determination** of g-value. **PowerPoint Presentation (Group)** on application of ESR in structural determination and biological studies. [**PO**2, **PO**5]	K1 K2 K3 K5
CO5	**Categorise** the different types of surface spectroscopy (EELS, RAIRS, inelastic He scattering). **Perceive** the energy transfer process in XPES, UPES and **compare** the two processes. **Discuss** Auger electron spectroscopy and application of XRF. **Group discussion**: Breakthrough made by Bloch, Auger field of spectroscopy.[**PO**2]	K1 K2 K4 K5
Text Books		
1	Molecular structure and spectroscopy,G.Aruldhas, Prentice Hall, New Delhi (Unit I , II, III, IV – NMR)	
2	Vibrational spectroscopy, D.N. Sathyanarayana, New Age International Publishers (Unit II)	
3	Spectroscopy,GurdeepChatwaal. (Unit IV- ESR Spectroscopy)	
Reference Books		
1	Microwave Spectroscopy - Towns and Shallow, McGraw Hill.	
2	Scattering of light and Raman effect - Bhagavantham – Chemical Publishing Co	
3	Electronic spectra of diatomic and polyatomic molecules – Herzberg – Van Nostrand Reinhold Co.	
Web Resources		
1	https://en.wikipedia.org/wiki/Rotational_spectroscopy	
2	https://en.wikipedia.org/wiki/Infrared_spectroscopy	
3	https://www.slideshare.net/sherishahine/infrared-spectroscopy-32876736	
4	https://www.slideshare.net/ajamilan12/raman-spectroscopy-13063160	
5	https://www.chem.fsu.edu/.../10%20CHM%205710%20Vibrational%20spectroscopy.	

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			Moderately Correlated - 2				Weakly Correlated – 1			
CO / PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/ worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	2	1	1	1	-	2	1	3	2
CO2	3	2	2	1	1	-	2	1	1	1
CO3	3	2	1	1	1	-	2	1	-	1
CO4	3	2	1	1	1	-	1	1	-	1
CO5	3	2	3	1	1	1	1	1		1
AVG	3	2	2	1	1		2	1	1	1
TOTAL	15	10	8	5	5	1	8	5	4	6

SECOND YEAR - SEMESTER – IV										
PHYSICS OF FUNCTIONAL MATERIALS										
Course Code	**Category Core/Ele/ Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC12	**Core -XII**	**5**	**-**	**-**	**1**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To acquire knowledge on materials properties and their requirement.
LO2	To provide basic knowledge about nanoscience and nanomaterials.
LO3	To acquire knowledge about synthesis methods of nanomaterials and characterization techniques. To learn about new materials like metallic glasses, shape memory alloys, and smart materials.

UNIT	**Contents**	**No. of Hours**
I	**Materials Properties and Requirements** Need for the study of materials properties – Levels of structure – Structure-property relationship: Mechanical properties, Thermal properties, Electrical properties, Magnetic properties, Physical and Chemical properties, optical properties – Material selection for Engineering application – Classification of Engineering Materials.	15
II	**Fundamentals of Nanoscience and Nanomaterials** Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology – Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells –Carbon nanotubes-SWCN and MWCN- Surface effects of nano materials-Few applications of nanomaterials in energy, Medicine and Sensors.	20
III	**Nanomaterials Synthesis** Top-down and bottom-up approach: Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography – Nanomanipulator.	15
IV	**Advanced Characterization Techniques of Materials** Powder X-ray diffraction –EDAX- X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence –Fourier Transform Infrared Spectroscopy - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) –HRTEM- Scanning probe microscopy (SPM) - Scanning tunnelling microscopy (STM) – Vibrating sample Magnetometer (VSM).	20
V	**New Materials** Metallic glasses and their applications – Surface Acoustic Wave (SAW) materials and their applications – Biomaterials – Ceramic materials – High-temperature materials – Electrets and their applications - Nuclear engineering materials and their classification – Intermetallic compounds and their applications - Shape memory alloys – SMART materials – Classification of Smart materials.	20
	Total	90

Course Outcomes		K Level
CO	On completion of this course, students will	
CO1	**Remember** about materials properties. **List down** the various requisite properties. **Learn** about engineering materials and their classification- **Elucidate** selection of engineering materials forapplications with proper examples with students. (K4, **PO**2, **PO**4, **PO**5, **PO**9, **PO10**)	K1, K2, K3, K4
CO2	**Remember** Nano particles, nano materials. **Explain** knowledge about various classifications of nano materials. **Elucidate** carbon nano tubes with types and application in various fields with appropriate examples. (K6, **PO**2, **PO**3, **PO**4, **PO**5, **PO**9, **PO**10)	K1, K2, K3, K4, K5
CO3	**List**out top down and bottom up approach-. **Explain** the basic principle, methodology and instrumentation of various deposition and lithographic techniques.(**Seminar- PPT**) **(**K3, **PO**2, **PO**3, **PO**4, **PO**5, **PO**7, **PO**9) **PO10)**	K1, K2, K3, K4
CO4	**Learn** X-Ray diffraction, **study** about various microscopy and spectroscopy techniques like Electron microscopy, scanning electron microscope (SEM), Transmission electron microscope (TEM), Absorption spectroscopy (UV) -Photoluminescence (PL). Fourier Transform Infra-red (FTIR) spectroscopy and Vibrating sample Magnetometer **(VSM)**(K5, **PO**2, **PO**3, **PO**4, **PO**5, **PO**6, **PO**7,**PO**9, **PO**10)	K1, K2,K3, K4, K5,
CO5	**Define** Metallic glasses. **Outline** Surface Acoustic Materials (SAM) and Applications. **Learn** Bio and Ceramic materials – Electrets, Nuclear Engineering Materials, shape memory alloys and find out SMART materials. (**PO**9) (PPT-seminar) (**PO2,PO3, PO**4, **PO**7,**PO9, PO**10) **https://engineering.jhu.edu/materials/research-projects/metallic-glasses/**	K1, K2, K3, K4, K6
Text Books		
1	A Textbook of Materials Science – V. Rajendran – McGraw Hill Publisher – 6th reprint 2017 (Unit I).	
2	A textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw-Hill Publishing Co. 2012 (Unit II).	
3	A Textbook of Principles of Nanoscience and Nanotechnology, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., 2010 (Unit III and Unit V).	
Reference Books		
1	V. Raghavan, 2003, Materials Science and Engineering, 6th Edition, Prentice- Hall India, New Delhi	
2	G.K. Narula, K.S. Narula and V.K. Gupta, 1988, Materials Science, Tata McGraw-Hill	
3	B. S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday. Textbook of Nanoscience and Nanotechnology. Springer- Verlag, 2012.	
Web Resources		
1	https://onlinecourses.nptel.ac.in/noc20_mm02/preview	
2	https://nptel.ac.in/courses/112104229	
3	https://archive.nptel.ac.in/courses/113/105/113105081	
4	https://nptel.ac.in/courses/113/105/113105025/	
5	https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_(Materials_Science)/Electronic_Properties/Lattice_Vibrations	

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**					**Weakly Correlated – 1**		
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	2	1	1	-	-	-		1	1
CO2	3	2	2	1	1	-	-	-	1	1
CO3	3	2	1	1	1	-	1	-	1	1
CO4	3	2	2	1	-	1	1	-	1	1
CO5	3	2	2	1	-		1	-	1	1
AVG	3	2	1	1	1	1	1	-	1	1
TOTAL	15	10	9	5	3	2	4	-	5	5

SECOND YEAR - SEMESTER – IV										
PRACTICALS IV-MICROPROCESSOR, MICROCONTROLLER AND C PROGRAMMING										
Course Code	**Category Core/Ele/Sec**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**ESE**	**Total**
24PPYC13	**Core - XIII**	**-**	**-**	**6**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	Write simple programs to interface hardware to microprocessor 8085, microcontroller 8051, execute them.
LO2	Write C programs for numerical methods problems and learn Spreadsheet tool for analysis
LO3	Understand the concept of interfacing and performing simple experiments

UNIT	**Contents**	**No. of Hours**
I	CO1 1.Microprocessor 8085– Addition with carry , Subtraction with borrow, Multiplication and Division 2.Microprocessor 8085– Ascending and descending order, largest and smallest using register Pairs 3. Microprocessor 8085– BCD to binary, Binary to BCD 4. Microprocessor 8085 - Moving a block of data, Fibonacci series, sum of n numbers	12
II	CO2 5.Micro controller 8051 – Ascending and descending order and Fibonacci series 6. Micro controller 8051 – Smallest, Largest in an array and block move. 7.Interfacing PLC to effect traffic signal with microcontroller 8051 8.Interfacing stepper motor with microcontroller 8051	24
III	9.Interfacing PLC to display data in various ports, for blinking of LED in Port A and Port B and to design up and down mod counterwith µP 8085 10.Interfacing external keyboard to receive a single key press and to affect a blinking and rolling of message in the internal LED display withµP 8085through IC 8279	18
	11. Interfacing ADC with µP 8085.	18

IV	12.Interfacing DAC to generate waves with μP8085 13.Scilab-Simple experiments (Demonstration)	
V	14. Programming in C- Newton - Raphson method- four roots- verification by MS-EXCEL / manual Calculation. 15. Programming in C- Trapezoidal rule 16. Programming in C- Simpson's 1/3 and 3/ 8 rules - verification by MS-EXCEL / manual Calculation. 17. Programming in C - Newton's forward and backward interpolation- verification by MS-EXCEL / manual Calculation. 18. Programming in C- Runge-Kutta method – verification by MS-EXCEL / manual Calculation. 19. Programming in C- Euler's modified method	18
	Total	**90**
Course Outcomes		**K Level**
CO	On completion of this course, students will	
CO1	**Evoke** the instructions set for microprocessor 8085, **understand** operations of a microprocessor, **develop** logic to solve simple problems,	K1,K2,K3, K4,K6
CO2	**Recall** the concepts of interfacing a microcontroller 8051 and **realize** the execution through mnemonics, **understand** operations of a microcontroller and its applications, **apply** logic in finding codes for input, **examine** and **creatively build** codes allowing the possibility of the desired task. (PPT for group seminar – all expts)**(Students are allowed to build codes for different schemes in traffic controller – [PO3]) (Interactive session with questions) (Viva – Voce in IA) [PO2]**	K1,K2,K3, K4,K5, K6
CO3	**Evoke** the instructions set for microprocessor 8085, **understand** operations of a microprocessor, **develop** logic to solve simple problems, **apply** them to complex systems like keyboard interfacing and **analyse** graphically. **(Interactive session with questions) (Viva – Voce in IA) [PO2].**	K1,K2,K3,K5,K6
CO4	**Keep in mind** the concept of combinational circuits, DAC, ADC operations, **creatively evaluate [PO3]**	K1,K2,K3,K4 ,K5,K6
CO5	**Remember** all the syntaxes in **C [PO7]**, **understand** the **computational tools [PO7], apply** basic mathematical concepts in **Evaluate [PO3]** the input data for a program, type, save, run, debug program, send email, take print outs **[PO7]**, **execute** the same calculations with EXCEL [**PO**7], **analyse** the results**[PO7][PO10]**and **time-share** systems**. (Interactive session with questions) (Viva – Voce in IA) [PO2].**	K1,K2,K3,K4,K5

MAPPING WITH PROGRAM OUTCOMES										
Strongly Correlated - 3			**Moderately Correlated - 2**				**Weakly Correlated – 1**			
CO / PO	**PO**									
	1 Disciplinary Knowledge and skills	**2 Skilled Communicator**	**3 Critical thinker and problem solver**	**4 Sense of inquiry**	**5 Team player/ worker**	**6 Skilled project manager**	**7 Digitally Efficient**	**8 Ethical awareness/ reasoning**	**9 National and international perspective**	**10 Lifelong learners**
CO1	3	2	2	2	2	1	2	1	1	1
CO2	3	2	2	2	2	1	3	1	1	1
CO3	3	2	2	2	2	1	1	1	1	1
CO4	3	2	1	1	2	1	1	1	1	1
CO5	3	2	1	2	2	1	2	1	1	1
AVG	3	2	2	2	2	1	2	1	1	1
TOTAL	15	10	8	9	10	5	9	5	5	5

SECONDYEAR - SEMESTER – I										
PROJECT										
Course Code	Category Core/Ele/Sec	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	ESE	Total
24PPYC14	Core - XIV		6			5	6	25	75	100

Learning objectives and course outcome

1. Project paper – 90 hours of experimental or theoretical work, deriving scientific results and analysis and interpretation of the results.
2. The project work must be original and independent research by the student.
3. Two copies of the project report and also soft copy of the same should be submitted at the end of the term.
4. The maximum length of the report should not exceed 30 pages (typed matter: Times New Roman – font size 12 and 1.5 line spacing) excluding bibliography, tables, diagrams and annexure.
5. A certificate from the supervisor under whom the candidate worked that the report submitted is a record of research work done during the period of study under her and that report has not formed the basis for the award to the candidate of any degree, diploma, Associateship, fellowship or other similar titles should be provided.
6. A viva (Oral examination) will be conducted on the project work at the end of the term.

CO/PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	2	1	1	-	2	1	1	1	1
CO2	3	2	1	1	-	2	1	1	1	1
CO3	3	3	1	1	-	2	2	1	1	1
CO4	3	2	1	1	-	2	1	1	1	1
CO5	3	2	1	1	-	1	2	1	1	1
Avg	3	3	1	1	-		1	1	1	1
Total	15	13	5	5	-	1	7	5	5	5

SECOND YEAR – SEMESTER -IV										
BASICS OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE										
COURSE CODE	**CATEGORY CORE / ELE / SEC**	**L**	**T**	**P**	**S**	**CREDITS**	**TOTAL HOURS**	**MARKS**		
								CIA	**ESE**	**TOTAL**
24PPYS03	**SEC - III**	**2**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

LEARNING OBJECTIVES	
LO1	Grasp the basics of Data Science, Machine Learning, Deep Learning, and AI, including their history and foundational principles.
LO2	Learn techniques for data handling, preprocessing, statistical inference, and data visualization using relevant tools.
LO3	Gain practical knowledge in AI subfields like computer vision, natural language processing, and robotics. Study the applications and impacts of AI across various industries through real-world case studies

UNIT	**CONTENTS**	**NO. OF HOURS**
I	**Data Science** Data Science and Data Analysis - Perspectives of data science _ Statistical inference - Populations and samples - Types of data - Attributes and measurement - Data Visualization - Process/workflow -Importance of visualization in data science - Types of Data visualization - Data visualization tools - Use cases of data science visualization - Applications of data science	6
II	**AI Foundations and Applications** Definition and Scope of AI - History and Evolution of AI - Types of AI: Narrow, General, and Superintelligent AI - Basic Foundations of AI - Future Technology Trends - Societal and Ethical Implications of AI -Applications of AI in Various Industries.	6
III	**AI Subfields** Computer vision: Object detection – Facial recognition – Medical imaging – Applications of computer vision - Natural language processing: Text classification – Machine translation – Text generation and summarization - Machine learning : classification regression and clustering- Deep learning as a special case of machine learning – Robotics: component of a robot – Types of robots.	6
IV	**Industrial Applications of AI** AI in healthcare: Medical diagnosis - drug discovery and development - virtual medical assistant - challenges of AI in healthcare -AI in agriculture: Precision farming - crop monitoring and management - smart irrigation systems-AI in education: Personalized learning - administrative tasks - AI based language processing tools -AI in transportation: Traffic management and optimization- Ride sharing and mobility services - Safety and Security – Challenges.	6
V	**AI in Research, Generative AI** AI in Astro Physics and space - Application in particle physics - Generative AI – ChatGPT and prompt engineering - Emerging trends and future directions in AI - Al and social inequality. **AI Projects and Future Trends** Implementing AI Projects: Case Studies and Examples - AI for Science, Humanity, and Social Impact - Practical Usage of Generative AI Tools to Advance Learning and Research - Future Trends in AI: Quantum Computing, Edge AI. Preparing for a Career in AI Hands-on Lab: Simple Student AI Projects (**only for internal assessment**)	6

	TOTAL	**30**

CO	COURSE OUTCOMES At the end of the course, the student will be able to	K LEVEL
CO1	**Explain** the perspectives and significance of data science - **Perform** statistical inference and differentiate between populations and samples - **Identify** different types of data and their attributes - **Visualize data** using appropriate techniques and tools - **Apply data** visualization in various use cases and understand its role in data science. Activity – 1: Discussion with https://www.youtube.com/watch?v=pKeVMlkFpRc&list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSHcH, https://www.youtube.com/watch?v=GHpchgLoDvI&list=PL9WZXVlcfHbQ15yg2YwXqSNL6vddM_Out(PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10)	K1 K2 K3 K5
CO2	**Define** and **explain** the scope and history of AI - **Differentiate** between narrow, general, and superintelligent AI - **Discuss** the basic foundations and future technology trends in AI - **Analyze** the societal and ethical implications of AI - **Identify** and **describe** the applications of AI in different industries.Activity 2:Question session with (PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10)https://www.youtube.com/watch?v=K9gH7hBAdpo&list=PL9WZXVlcfHbQ15yg2YwXqSNL6vddM_Out&index=2	K1 K2 K3 K4 K5
CO3	**Explain** the concepts and applications of computer vision, natural language processing, and machine learning - **Implement** techniques such as object detection, facial recognition, and text classification - **Differentiate** between various types of robots and their components - **Understand** the role of deep learning as a special case of machine learning - **Apply** AI techniques to solve real-world problems in various subfields. Activity-3:Seminar – PPT based on https://www.youtube.com/watch?v=a4yd0Au8QLg&list=PLyqSpQzTE6M8X3Veh5ijSQ2UGFFEZIpKf(PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10)	K1 K2 K3 K4 K5
CO4	**Identify** and **describe** the applications of AI in healthcare, agriculture, education, and transportation - **Discuss** the challenges and benefits of AI in these industries - **Analyze** case studies and examples of AI implementation in various sectors - **Apply** AI techniques to industry-specific problems. Activity-4: Group Discussion on (PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10) https://www.youtube.com/watch?v=mmBOZCvX7wo&list=PLyqSpQzTE6M8X3Veh5ijSQ2UGFFEZIpKf&index=9	K1 K2 K3 K4 K5 K6
CO5	**Explain** the applications of AI in research areas like astrophysics and particle physics - **Understand** and **implement** generative AI techniques, including prompt engineering with ChatGPT - **Identify** emerging trends and future directions in AI - **Discuss** the societal impacts and ethical considerations of AI - **Prepare** for a career in AI by working on practical AI projects and staying updated with future trends.Activity – 5: simple Project using generative AI (PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10)	K1 K2 K3 K5 K6

TEXT BOOKS	
1.	Data Science and Artificial intelligence -Renuka Jha - Yking books (Unit -1), 2024.
2.	AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI) by SaptarsiGoswami, Amit Kumar , Amlan, Pearson – 2024 – Edition. Chapter 2: Machine Learning Basics, Chapter 3: Data Handling and Preprocessing(Unit – 2); Chapter 4: Neural Networks and Deep Learning(Unit – 3); Chapter 5: AI in Practice and Future Trends (Unit – 4); Chapter 5: AIin Practice and Future Trends:(Unit – 5)
3.	Artificial Intelligence & Generative AI for Beginners by David M. Patel – 2023 Edition.
REFERENCE BOOKS	
1.	Introduction to Generative AI by Numa Dhamani, Manning publications
2.	Data Science using Python: A Step-by-Step Practical Approach for Beginners by Dr Vishal Goyal

e-RESOURCES

1	Google course: https://www.cloudskillsboost.google/paths/118
2.	Microsoft course :https://learn.microsoft.com/en-us/training/modules/fundamentals-generative-ai/
3.	Generative AI course for beginners :https://microsoft.github.io/generative-ai-for-beginners/#/
4.	https://www.coursera.org/learn/ai-for-everyone
5.	https://www.tensorflow.org/tutorials

CO/PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	2	1	1	1		1	1	1	1
CO2	3	2	1	1	1		1	1	1	1
CO3	3	3	1	1	1		2	1	1	1
CO4	3	2	1	1	1		1	1	1	1
CO5	3	2	1	1	1	1	2	1	1	1
Avg	3	3	1	1	1		1	1	1	1
Total	15	13	5	5	5	1	7	5	5	5

SECOND YEAR – SEMESTER -IV										
INDUSTRIAL TRAINING										
COURSE CODE	**CATEGORY CORE / ELE / SEC**	**L**	**T**	**P**	**S**	**CREDITS**	**TOTAL HOURS**	**MARKS**		
								CIA	**ESE**	**TOTAL**
24PPYE4A	**DSE - IV**	**-**	**-**	**5**	**-**	**3**	**5**	**25**	**75**	**100**

LEARNING OBJECTIVES		
LO1	To get an exposure to the role of Physics in industries	
LO2	This will be a platform for entrepreneurship	
LO3	Students will gain leadership quality and this ensures capacity building	
CO	**A MINIMUM OF 60 HOURS TRAINING AT ANY LEADING INDUSTRY OF STUDENT'S CHOICE.** **THIS SHOULD BE FOLLOWED BY A REPORT AND A PRESENTATION.** **BASED ON THE NATURE OF WORK DONE BY THE STUDENT AND THE SKILL DEVELOPED THE CIA ND ESE CAN BE GIVEN**	**75 HOURS**

SECOND YEAR – SEMESTER -IV										
SELF LEARNING										
COURSE CODE	**CATEGORY CORE / ELE / SEC**	**L**	**T**	**P**	**S**	**CREDITS**	**TOTAL HOURS**	**MARKS**		
								CIA	**ESE**	**TOTAL**
24PPYE4B	**DSE - IV**	**-**	**-**	**5**	**-**	**3**	**5**	**25**	**75**	**100**

LEARNING OBJECTIVES		
LO1	TO CHOOSE A COURSE OF STUDENTS CHOICE AND INTEREST, HER ORIGINAL THINKING WILL IMPROVE	
LO2	SELF LEARNING WILL HELP STUDENT TO IMPROVE INQUIRY SKILLS	
LO3	THIS WILL IMPROVE HER SELF CONFIDENCE AND ALSO CREATE LIKING TO THE SUBJECT	
CO	**STUDENTS CAN DO ANY COURSE RELATED TO PHYSICS THROUGH** **MOOC** **NPTEL** **SWAYAM** **THE COURSE MUST BE TAKEN IN 3RD SEMESTER ITSELF SO THAT THE STUDENTS TAKES THE SELF LEARNING EXAM EXTERNAL BY JANUARY.** **DEPENDING ON THE DIFFICULTY LEVEL OF THE COURSE CHOSEN , THE MARKS FOR CIA AND ESE CAN BE DISTRIBUTED.**	**75 HOURS**