E.M.G. YADAVA WOMEN'S COLLEGE, MADURAI – 625 014.

(*An Autonomous Institution – Affiliated to Madurai Kamaraj University*)

Re-accredited **(3rd Cycle)** with Grade **A+** & **CGPA 3.51** by NAAC

DEPARTMENT OF PHYSICS

TANSCHE-CBCS with OBE

MASTER OF SCIENCE

PROGRAMME CODE - PP

COURSE STRUCTURE

(w.e.f. 2023 – 2024 Batch onwards)

Annexure - 7

E.M.G.YADAVA WOMEN'S COLLEGE, MADURAI-14.

(An Autonomous Institution – Affiliated to Madurai Kamaraj University)
Re-accredited (3rd Cycle) with Grade A+ and CGPA 3.51 by NAAC

DEPARTMENT OF PHYSICS- PG

TANSCHE – CBCS WITH OBE

(w.e.f. 2023 – 2024 onwards)

VISION

To enhance the knowledge of physics in teaching and research through holistic education

MISSION

- ✓ Imparting quality education both in theoretical as well as experimental physics
- ✓ Providing students with rigorous and comprehensive courses that allow them to perform at a high level
- ✓ Striving for excellence in performance based teaching and research

Programme Educational Objectives(PEOs) M.Sc.,

S.No	On completion of the programme ,the student will be able to
PEO1	To Specialize knowledge and expertise to identify formulate, analyze and implement on the problems.
PEO2	To pursue higher studies in related fields of physics
PEO3	To enhance leadership quality to handle all kind of circumstances in diverse interdisciplinary learning environment
PEO4	To achieve successful employability in private/Government institutions or as on entrepreneur
PEO5	To inculcate the sense of ethics and effective communication skills

Annexure - 7

Programme Outcomes (POs) with Graduate Attributes

S.No	Graduate Attributes	On completion of the programme ,the student will be able to
PO1	Knowledge base	Exploration of knowledge and skills in their respective disciplines
PO2	Problem Analysis and Investigation	Acquire knowledge to analyze and solve problems to their respective field
PO3	Communication skills and design	Ability to carry out advance tasks and project successfully
PO4	Individual and Team work	Adequate project training, research activities in relevant skill sector and creating employable abilities
PO5	Professionalism, Ethics and Equality	Developing socio economic ethics executing their actions in all their decisions
PO6	Lifelong learning	Lifelong independent and reflective learning skills in their career.

Programme Specific Outcomes (POs) with Graduate Attributes

S.No	Graduate Attributes	On completion of the programme ,the student will be able to
PSO1	Knowledge base	Develop experimental and data analysis skills through laboratory experiments
PSO2	Problem Analysis and Investigation	Recognize the importance of mathematical approaches and computing to describe the concept of physics
PSO3	Communication skills and design	Acquire subject knowledge and caliber sought by industry and education field
PSO4	Individual and Team work	Perform independent and group activities of projects to experience the aspects of research and to develop their presentation
PSO5	Professionalism, Ethics and Equality	Applying professional ethics contributing society to develop equity
PSO6	Lifelong learning	Recognizing the need and lifelong learning to solve real life problems

Eligibility for Admission: Pass in B.Sc., Physics

Duration of the Course:

The students shall undergo prescribed courses of study for the period of two academic years under CBCS semester pattern with Outcome Based Education.

Medium of Instruction: English

System: TANSCHE - Choice Based Credit System with Outcome Based Education.

Nature of the Course

Courses are classified according to the following nature

1. Knowledge & Skill
2. Employability Oriented
3. Entrepreneurship Oriented

Outcome Based Education (OBE) & Assessment

Students understanding must be built on and assessed for wide range of learning activities, which includes different approaches and are classified along several bases, such as

1. Based on purpose:

- Formative (Internal tests, Assignment, Seminar, Quiz, Documentation, Case lets, ICT based Assignment, Mini Projects administered during the learning process)
- Summative (Evaluation of students learning at the end of instructional unit)

2. Based on Domain knowledge: (Post Graduate Upto K5 Levels)

- Assessment through K1, K2, K3, K4 & K5

Annexure - 7

E.M.G.YADAVA WOMEN'S COLLEGE, MADURAI-14.

(An Autonomous Institution – Affiliated to Madurai Kamaraj University)
Re-accredited (3rd Cycle) with Grade A+ and CGPA 3.51 by NAAC

DEPARTMENT OF PHYSICS- PG

TANSCHE – CBCS WITH OBE

(w.e.f. 2023 – 2024 onwards)

EVALUATION

Continuous Internal Assessment Test (CIA) : 25 Marks

Summative Examination : 75 Marks

Total : 100 Marks

CIA-Continuous Internal Assessment: 25 Marks

Components	Marks
Test (Average of two tests) (Conduct for 120 marks and converted into 12 marks)	12
Creative Assignment	3
Assignment	5
Seminar	5
Total	**25**

- Centralized system of Internal Assessment Tests
- There will be a two Internal Assessment Tests
- Duration of Internal Assessment Test I and II will be 2 1/2 hours.
- Students shall write retest on the genuine grounds if they are absent in either Test I & Test II with the approval of Head of the Department.

Annexure - 7

Question Paper Pattern for Continuous Internal Assessment Test I and Test II

Section	Marks
A – Multiple Choice Questions (8x1Mark)	8
B – Short Answer (6 x 2 Marks)	12
C – Either Or type (4/8 x 5 Marks)	20
D – Open Choice type (2/4 x 10 Marks)	20
Total	**60**

Conducted for 120 marks and converted into 15 marks

Question Paper Pattern for Summative Examination

Section	Marks
A – Multiple Choice Questions without choice (10x 1Mark)	10
B – Short Answer Questions without choice (5 x 2 Marks)	10
C – Either Or type (5/10 X 5Marks)	25
D – Open Choice type(3out of 5 X 10Marks)	30
Total	**75**

- In respect of external examinations passing minimum is **45%** for Post Graduate Courses and in total, aggregate of **50%.**
- Latest amendments and revisions as per UGC and TANSCHE Norms are taken into consideration in curriculum preparation.

Distribution of Marks in % with K levels CIA I, II & External Assessment

Blooms Taxonomy	Internal Assessment		External Assessment
	I	II	
Knowledge (K1	8 %	8 %	5 %
Understanding (K2)	8 %	8 %	14 %
Apply (K3)	24 %	24 %	27%
Analyze (K4)	30 %	30 %	27%
Evaluate (K5)	30%	30%	27%

Annexure - 7

BLUEPRINT FOR INTERNAL ASSESSMENT–I

Articulation Mapping –K Levels with Course Learning Outcomes(CLOs)

Sl.No	CLOs	K-Level	Section A		Section B		Section C	Section D	Total
			MCQs (No Choice)		Short Answers (No Choice)		(Either or Type)	(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO1	Upto K5	1 2	K1 K2	1 1	K1 K3	1(K3) 1(K5)	1(K4)	
2	CLO2	Upto K5	2 1	K1 K2	1 1	K1 K2	1(K3) (Each set of questions must be in the same level)	1(K4) 1(K5)	
3.	CLO3	Upto K5	1 1	K1 K2	1 1	K2 K3	1(K4)	1(K5)	
No. of Questions to be asked			8		6		8	4	26
No .of Questions to Be answered			8		6		4	2	20
Marks for each question			1		2		5	10	
Total Marks for each section			8		1 2		40	40	100

Annexure - 7

BLUEPRINT FOR INTERNAL ASSESSMENT– II

Articulation Mapping –K Levels with Course Learning Outcomes (CLOs)

Sl.No	CLOs	K-Level	Section A		Section B		Section C	Section D	Total
			MCQs (No Choice)		Short Answers (No Choice)		(Either or Type)	(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO3	UptoK5	1 2	K1 K2	1 1	K1 K3	1(K3) 1(K5)	1(K4)	
2	CLO4	UptoK5	2 1	K1 K2	1 1	K1 K2	1(K3) (Each set of questions must be in The same level)	1(K4) 1(K5)	
3.	CLO5	Upto K5	1 1	K1 K2	1 1	K2 K3	1(K4)	1(K5)	
No. of Questions to be asked			8		6		8	4	26
No. of Questions to Be answered			8		6		4	2	20
Marks for each question			1		2		5	10	
Total Marks for each section			**8**		**12**		**40**	**40**	**100**

Annexure - 7

Distribution of Marks with choice K Levels CIA – I CIA and II-CIA

CIA	K Levels	Section- A MCQ (No choice)	Section –B (Short Answer (No choice))	Section- C (Either or Type)	Section-D (Open Choice)	Total Marks	% of Marks
I	K1	4	4			8	**8**
	K2	4	4			8	**12**
	K3		4	20		24	**40**
	K4			10	20	30	**40**
	K5			10	20	30	**20**
	Marks	**8**	**12**	**40**	**40**	**100**	**100**
II	K1	4	4			8	**8**
	K2	4	4			8	**12**
	K3		4	20		24	**40**
	K4			10	20	30	**40**
	K5			10	20	30	**20**
	Marks	**8**	**12**	**40**	**40**	**100**	**100**

Sl.No	CLOs	K-Level	Section A		Section B		Section C	Section D	Total
			MCQs (No choice)		Short Answers (No choice)		(Either/ or Type)	(open choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO1	Upto K4	2	K1			2(K3&K3)	1(K3)	
2	CLO2	Upto K4	2	K1			2(K3&K3)	1(K4)	
3	CLO3	Upto K4			2	K2	2(K4&K4)	1(K4)	
4	CLO4	Upto K5			2	K2	2(K5&K5)	1(K5)	
5	CLO5	Upto K5			2	K2		1(K5)	
No. of Questions to be asked			4		3		8	5	20
No. of Questions to be answered			4		3		4	2	13
Marks for each questions			1		2		5	10	
Total Marks for each section			4		6		20	20	50 (Marks)

Annexure - 7

Articulation Mapping –K Levels with Course Learning Outcomes (CLOs) for Internal Assessment (SEC)

Distribution of Section-wise Marks with K Levels for Internal Assessment (SEC)

K Levels	Section A (MCQ'S) (No choice)	Section B(Short Answer) (No choice)	Section C(Either or Type)	Section D (Open Choice)	Total Marks	% of Marks
K1	4				**4**	**4**
K2		6			**6**	**6**
K3			20	10	**30**	**30**
K4			10	20	**30**	**30**
K5			10	20	**30**	**30**
Total Marks	**4**	**6**	**40**	**50**	**100**	

K1-Rememberingandrecallingfactswithspecificanswers.

K2- Basic understanding off acts and stating main ideas with general answers.

K3-Application oriented Solving Problems, Justifying the statement and deriving inferences

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

K5-Evaluating, making Judgments based on criteria

Annexure - 7

Articulation Mapping –K Levels with Course Learning Outcomes (CLOs) for External Assessment

Sl.No	CLOs	K-Level	Section A		Section B		Section C	Section D	Total
			MCQs (No choice)		Short Answers (No choice)		(Either/orType)	(open choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO1	Upto K4	2	K1&K2	1	K1	2(K2&K2)	1(K3)	
2	CLO2	Upto K4	2	K&K2	1	K2	2(K3&K3)	1(K4)	
3	CLO3	Upto K4	2	K1&K2	1	K3	2(K3&K3)	1(K4)	
4	CLO4	Upto K5	2	K1&K2	1	K4	2(K4 &K4)	1(K5)	
5	CLO5	Upto K5	2	K1&K2	1	K5	2(K5 &K5)	1(K5)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each section			10		10		25	30	75 (Marks)

Distribution of Section-wise Marks with K Levels for External Assessment

K Levels	Section A (MCQ'S) (No choice)	Section B (Short Answer) (No choice)	Section C (Either or Type)	Section D (Open Choice)	Total Marks	% of Marks
K1	5	2	-	-	**7**	**5**
K2	5	2	10	-	**17**	**14**
K3	-	2	20	10	**32**	**27**
K4	-	2	10	20	**32**	**27**
K5	-	2	10	20	**32**	**27**
Total Marks	**10**	**10**	**50**	**50**	**120**	**100**

K1-Remembering and recalling facts with specific answers.

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

K3-Application Oriented Solving Problems, Justifying the statement and deriving inferences

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

K5-Evaluating, making Judgments based on criteria

Annexure - 7

E.M.G.YADAVA WOMEN'S COLLEGE, MADURAI-14.

(An Autonomous Institution – Affiliated to Madurai Kamaraj University)
Re-accredited (3rd Cycle) with Grade A+ and CGPA 3.51 by NAAC

DEPARTMENT OF PHYSICS- PG

TANSCHE – CBCS WITH OBE

(w.e.f. 2023 – 2024 onwards)

M.Sc PHYSICS

COURSE STRUCTURE-SEMESTER WISE

Sem	Part	Course Code	Course Title	Teaching hrs (Per week)	Exam duration (hrs)	Marks allotted			Credits
						C.A	S.E	Total	
I	III	23OPPH11	**CORE** : Mathematical Physics	7	3	25	75	100	5
		23OPPH12	**CORE** : Classical Mechanics and Relativity	7	3	25	75	100	5
		23OPPH1P	**CORE** : Practical-I	6	3	40	60	100	4
			DSEC-I	5	3	25	75	100	3
			DSEC-II	5	3	25	75	100	3
II	III	23OPPH21	**CORE** : Statistical Mechanics	6	3	25	75	100	5
		23OPPH22	**CORE** : Quantum mechanics-I	6	3	25	75	100	5
		23OPPH2P	**CORE** : Practical-II	6	3	40	60	100	4
			DSEC-III	5	3	25	75	100	3
			DSEC-IV	5	3	25	75	100	3
	IV	23OPPHSEC21	**SEC** : Microprocessor 8085 and Microcontroller 8051	2	3	25	75	100	2
III	III	23OPPH31	**CORE** : Quantum Mechanics II	6	3	25	75	100	5
		23OPPH32	**CORE** :Condensed Matter Physics	6	3	25	75	100	5
		23OPPH33	**CORE :** Electromagnetic theory	6	3	25	75	100	5
		23OPPH3P	**CORE** :Practical III	6	3	40	60	100	4
	IV		**DSEC -V**	3	3	25	75	100	3
		23OPPHSEC3	**SEC** :Medical Physics	3	3	25	75	100	2
		23OPPHIN3	Internship	-	-	-	-	-	2

IV	III	23OPPH41	**CORE** :Nuclear and Particle Physics	6	3	25	75	100	5
		23OPPH42	**CORE:** Spectroscopy	6	3	25	75	100	5
		23OPPHPR4	**CORE:** Project with viva voce	10	3	20	80	100	7
		23OPPH4P	**DSEC VI :** Practical IV	6	3	40	60	100	3
	IV	23OPPHSEC4	**SEC** :Material Science	2	3	25	75	100	2
	V	23OP5EA4	Extension Activity	-	-	-	-	-	1

DSEC-Discipline Specific Elective Course

Semester I

DSEC-I (Choose any one)

1. Linear and Digital ICs and Applications -23OPPHDSE1A
2. Physics of Nano Science and Technology -23OPPHDSE1B

DSEC-II (Choose any one)

1. Energy Physics -23OPPHDSE1C
2. Communication electronics -23OPPHDSE1D

Semester II

DSEC-III (Choose any one)

1. Plasma Physics -23OPPHDSE2A
2. Advanced Optics -23OPPHDSE2B

DSEC-IV (Choose any one)

1. Solar Energy Utilization -23OPPHDSE2C
2. Bio physics -23OPPHDSE2D

Semester III

DSEC-V (Choose any one)

1. Numerical methods and computer programming – 23OPPHDSE3A
2. General relativity and cosmology- 23OPPHDSE3B

Annexure - 7

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
III	Core	23OPPH31	Quantum Mechanics II	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

1. To familiarize the students to the crucial concepts of scattering theory such as partial wave analysis and Born approximation.
2. To learn the Time-dependent Perturbation theory and its application to study of interaction of an atom with the electromagnetic field.
3. To give the students a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts
4. To introduce the concept of covariance and the use of Feynman graphs for depicting different interactions
5. To demonstrate an understanding of field quantization and the explanation of the scattering matrix.

Course content:

Unit	Course Content	Hours	K Level	CLO
I	**SCATTERING THEORY** Scattering Cross-Sections - Scattering Amplitude – Partial waves- Scattering by a central potential-Partial wave analysis – Scattering length-Expression for Phase Shifts- The Born approximation- Scattering by Screened coulomb potential – Validity of Born approximation .	18	Upto K5	CLO 1
II	**PERTURBATION THEORY** Time dependent perturbation theory – First order Perturbation- Harmonic perturbations –Transitions to Continuum States- Absorption and Emission of Radiation-Electric dipole approximation-Transition probability-Einstein's A and B Coefficients- Adiabatic approximation – Sudden approximation.	18	Upto K5	CLO 2
III	**RELATIVISTIC QUANTUM MECHANICS** Klein – Gordon Equation – Interpretation of the K-G Equation –Particle in a Coulomb field-Dirac Equation for a Free particle - Dirac Matrices – Probability density- Plane Wave Solutions – Negative Energy States –Spin of the Dirac particle- Magnetic Moment of the Electron Due To Spin	18	Upto K5	CLO 3
IV	**DIRAC EQUATION:** Dirac's relativisitic equation-Matrices for α and β-free particle solutions-Charge density and current density-Electromagnetic potentials-Dirac's equation for a central field-Spin orbit Energy –Separation of the equation- The Hydrogen Atom	18	Upto K5	CLO 4
V	**CLASSICAL FIELDS AND SECOND QUANTIZATION** Concepts of Classical Mechanics – Classical Field Equation- Lagrange Form – Hamiltonian formulation - Quantization of the field- Quantization of the Shcrodinger equation – Creation, Annihilation operators – System of Ferminons.	18	Upto K5	CLO 5

Book for study:

1. G. Aruldhas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi,2009
2. L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill Kogakusha, Tokyo, 1968

Books for Reference:

1. P. A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition,Oxford University Press, London, 1973.
2. B.K.Agarwal & HariPrakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009.
3. Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics,1st edition,I.K.International Publishing house Pvt.Ltd., 2006
4. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi.
5. E. Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970.

Web Resources/ e-Books:

1. https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf
2. http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf
3. http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf
4. https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf
5. https://web.mit.edu/dikaiser/www/FdsAmSci.pdf

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for Nature of the course:

Knowledge and Skill:

Knowledge of postulates of Quantum mechanics, properties of Hermitian operators, ladder operators, degeneracy, angular momentum techniques and commutation rules.

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works and also insist them to check the Books for References and web resources.

Annexure - 7

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

CO	Course Outcome	K-level
CO1	Familiarize the concept of scattering theory such as partial wave analysis and Born approximation	Upto K5
CO2	Give a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts	Upto K5
CO3	Discuss the relativistic quantum mechanical equations namely, Klein-Gordon and Dirac equations and the phenomena accounted by them like electron spin and magnetic moment	Upto K5
CO4	Introduce the concept of covariance and the use of Feynman graphs for depicting different interactions	Upto K5
CO5	Demonstrate an understanding of field quantization and the explanation of the scattering matrix.	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	3	2	3	2	3	2
CO3	3	3	3	2	3	2
CO4	2	2	2	2	2	2
CO5	2	2	2	2	2	2

1-Basic Level 2- Intermediate Level 3.Advanced Level

Annexure - 7

LESSON PLAN: TOTAL HOURS (90 Hrs)

Unit	Description	Hours	Mode
I	**SCATTERING THEORY** Scattering Cross-Sections - Scattering Amplitude – Partial waves- Scattering by a central potential-Partial wave analysis – Scattering length-Expression for Phase Shifts- The Born approximation- Scattering by Screened coulomb potential – Validity of Born approximation .	**18**	Chalk & Talk, Seminar and Group Discussion
II	**PERTURBATION THEORY** Time dependent perturbation theory – First order Perturbation- Harmonic perturbations –Transitions to Continuum States- Absorption and Emission of Radiation-Electric dipole approximation-Transition probability-Einstein's A and B Coefficients- Adiabatic approximation – Sudden approximation.	18	Chalk & Talk, Seminar and Group Discussion
III	**RELATIVISTIC QUANTUM MECHANICS** Klein – Gordon Equation – Interpretation of the K-G Equation –Particle in a Coulomb field-Dirac Equation for a Free particle - Dirac Matrices –Probability density- Plane Wave Solutions – Negative Energy States –Spin of the Dirac particle- Magnetic Moment of the Electron Due To Spin	18	PPT, Chalk & Talk, Seminar and Group Discussion
IV	**DIRAC EQUATION:** Dirac's relativisitic equation-Matrices for α and β-free particle solutions-Charge density and current density-Electromagnetic potentials-Dirac's equation for a central field-Spin orbit Energy –Separation of the equation- The Hydrogen Atom	18	Chalk & Talk, Seminar and Group Discussion
V	**CLASSICAL FIELDS AND SECOND QUANTIZATION** Concepts of Classical Mechanics – Classical Field Equation- Lagrange Form – Hamiltonian formulation - Quantization of the field- Quantization of the Shcrodinger equation – Creation, Annihilation operators – System of Ferminons.	18	Chalk & Talk, Seminar and Group Discussion

Annexure - 7

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
III	core	23OPPH32	Condensed Matter Physics	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

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

Course content:

Unit	Course Content	Hours	K Level	CLO
I	**CRYSTAL PHYSICS**: Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc). Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant.	18	Upto K5	CLO 1
II	**LATTICE DYNAMICS:** Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umkalapp processes.	18	Upto K5	CLO 2
III	**THEORY OF METALS AND SEMICONDUCTORS:** Free electron gas in three dimensions - heat capacity of the electron gas - Wiedemann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration –Mobility - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies (de Hass-van Alphen effect) .	18	Upto K5	CLO 3
IV	**MAGNETISM:** Paramagnetism - Quantum theory of paramagnetism - Hund's rule - ferromagnetic order - Curie point and the Exchange integral - Ferromagnetic domains - Bloch wall -Quantization of Spin waves - Magnons –ferrimagnetic order - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.	18	Upto K5	CLO 4
V	**SUPERCONDUCTIVITY: Experimental facts:** Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors.	18	Upto K5	CLO 5

	Theoretical Explanation: Thermodynamics of super conducting transition - London equation - Coherence length - Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS.			

Book for study:

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

Books for Reference:

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

Web Resources/ e-Books:

1. http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html
2. http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html
3. https://www.britannica.com/science/crystal
4. https://www.nationalgeographic.org/encyclopedia/magnetism/
5. https://www.brainkart.com/article/Super-Conductors_6824/

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for Nature of the course:

Knowledge and Skill:

Gain knowledge about various crystal structures and their properties.

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works and also insist them to check the Books for References and web resources.

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

CO	Course Outcome	K-level
CO1	describe various crystal structures, symmetry and to differentiate different types of bonding.	Upto K5
CO2	construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat.	Upto K5
CO3	critically assess various theories of electrons in solids and their impact in distinguishing solids.	Upto K5
CO4	Outline different types of magnetic materials and explain the underlying phenomena.	Upto K5
CO5	Elucidation of concepts of superconductivity, the underlying theories – relate to current areas of research.	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	3	2	3	2	3	2
CO3	3	3	3	2	3	2
CO4	2	2	2	2	2	2
CO5	2	2	2	2	2	2

1-Basic Level 2- Intermediate Level 3.Advanced Level

LESSON PLAN: TOTAL HOURS (90 Hrs)

Unit	Description	Hours	Mode
I	**CRYSTAL PHYSICS** : Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc). Structure and properties of liquid crystals. Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).	18	Chalk & Talk, Seminar and Group Discussion
II	**LATTICE DYNAMICS:** Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umkalapp processes.	18	Chalk & Talk, Seminar and Group Discussion
III	**THEORY OF METALS AND SEMICONDUCTORS:** Free electron gas in three dimensions - heat capacity of the electron gas - Wiedemann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration –Mobility - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies (de Hass-van Alphen effect) .	18	PPT, Chalk & Talk, Seminar and Group Discussion

IV	**MAGNETISM:** Paramagnetism - Quantum theory of paramagnetism - Hund's rule - ferromagnetic order - Curie point and the Exchange integral - Ferromagnetic domains - Bloch wall -Quantization of Spin waves - Magnons –ferrimagnetic order - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.	18	Chalk & Talk, Seminar and Group Discussion
V	**SUPERCONDUCTIVITY: Experimental facts:** Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors. **Theoretical Explanation:** Thermodynamics of super conducting transition - London equation - Coherence length - Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS.	18	Chalk & Talk, Seminar and Group Discussion

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
III	Core	23OPPH33	Electromagnetic Theory	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

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

Course content:

Unit	Course Content	Hours	K Level	CLO
I	**ELECTROSTATICS** Laplace equation in one dimension-Two dimension-Three dimension – Boundary conditions and uniqueness theorem – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems. Multipole expansion-The monopole and dipole terms-The Electric field of a Dipole.	18	Upto K5	CLO 1
II	**MAGNETOSTATICS** Biot-Savart's Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magneto static energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetized sphere.	18	Upto K5	CLO 2
III	**MAXWELL EQUATIONS** Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem - Lorentz force - Conservation laws for a system of charges and electromagnetic fields.	18	Upto K5	CLO 3

IV	**Electromagnetic waves** The wave equation in one-dimension – Sinusoidal waves- Boundary conditions –Polarization- The wave equation for E and B – Monochromatic plane waves in vacuum – Energy and momentum of EM waves – Propagation in linear media – Reflection and transmission at normal incidence and oblique incidence- Electromagnetic waves in conductor-Refelection at a conducting surface.	18	Upto K5	CLO 4
V	**Electromagnetic radiation and relativity** Dipole radiation — Electric dipole radiation – Magnetic dipole radiation – Radiation from arbitrary Source.– Power radiated by a point charge- Radiation reaction – Magnetism as a relativistic phenomenon – The transformation of fields- Relativistic mechanics- Proper time and Proper velocity-Relativistic energy and momentum- The field tensor.	18	Upto K5	CLO 5

Book for study:

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

Books for Reference:

1. W. Panofsky and M. Phillips, 1962, Classical Electricity and Magnetism, Addison Wesley, London.
2. J. D. Kraus and D. A. Fleisch, 1999, Electromagnetics with Applications, 5th Edition, WCB McGraw-Hill, New York.
3. B. Chakraborty, 2002, Principles of Electrodynamics, Books and Allied, Kolkata.
4. P. Feynman, R. B. Leighton and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 2, Narosa Publishing House, New Delhi.
5. Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA.

Web Resources/ e-Books:

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.cliffsnotes.com/study-guides/physics/electricity-and-magnetism/electrostatics.

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for Nature of the course:

Knowledge and Skill:

Knowledge of different coordinate systems, Laplace's equation, conducting & non-conducting medium, basic definitions in magnetism, propagation of electromagnetic waves, plasma.

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works and also insist them to check the Books for References and web resources.

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

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

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	3	2	3	2	3	2
CO3	3	3	3	2	3	2
CO4	2	2	2	2	2	2
CO5	2	2	2	2	2	2

1-Basic Level 2- Intermediate Level 3.Advanced Level

Annexure - 7

LESSON PLAN: TOTAL HOURS (90 Hrs)

Unit	Description	Hours	Mode
I	**ELECTROSTATICS** Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems. Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion.	18	Chalk & Talk, Seminar and Group Discussion
II	**MAGNETOSTATICS** Biot-Savart's Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magneto static energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetized sphere.	18	Chalk & Talk, Seminar and Group Discussion
III	**MAXWELL EQUATIONS** Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem - Lorentz force - Conservation laws for a system of charges and electromagnetic fields.	18	PPT, Chalk & Talk, Seminar and Group Discussion
IV	**Electromagnetic waves** The wave equation in one-dimension – Sinusoidal waves- Boundary conditions –Polarization- The wave equation for E and B –Monochromatic plane waves in vacuum – Energy and momentum of EM waves – Propagation in linear media – Reflection and transmission at normal incidence and oblique incidence- Electromagnetic waves in conductor-Refelection at a conducting surface.	18	Chalk & Talk, Seminar and Group Discussion
V	**Electromagnetic radiation and relativity** Dipole radiation — Electric dipole radiation – Magnetic dipole radiation – Radiation from arbitrary Source.– Power radiated by a point charge- Radiation reaction – Magnetism as a relativistic phenomenon – The transformation of fields- Relativistic mechanics-Proper time and Proper velocity-Relativistic energy and momentum-The field tensor.	18	Chalk & Talk, Seminar and Group Discussion

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
III	Core	23OPPH3P	Practical-III Numerical methods and Computer programming	4	6	40	60	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

1. To familiarize the numerical methods used in computation and programming using any high level language such as C.
2. To equip the computational skill using various mathematical tools.
3. To apply the software tools to explore the concepts of physical science.
4. To approach the real time activities using physics and mathematical formulations.

List of Experiments: (Any Twelve Experiments)

1. Lagrange interpolation with Algorithm, Flow chart and output.
2. Newton forward interpolation with Algorithm, Flow chart and output.
3. Newton backward interpolation with Algorithm, Flow chart and output.
4. Curve-fitting: Least squares fitting with Algorithm, Flow chart and output.
5. Numerical integration by the trapezoidal rule with Algorithm, Flow chart and output.
6. Numerical integration by Simpson's rule with Algorithm, Flow chart and output.
7. Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart and output.
8. Numerical solution of ordinary first-order differential equations by the Runge- Kutta method with Algorithm, Flow chart and output.
9. Finding Roots of a Polynomial - Bisection Method
10. Finding Roots of a Polynomial - Newton Raphson Method
11. Solution of Simultaneous Linear Equation by Gauss elimination method.
12. Solution of Ordinary Differential Equation by Euler
13. Runge Kutta Fourth Order Method for solving first order Ordinary Differential Equations.
14. Newton's cotes formula.

15. Trapezoidal rule
16. Simpson's 1/3 rule
17. Simpson's 3/8 rule
18. Boole's rule
19. Gaussian quadrature method (2 point and 3 point formula)
20. Giraffe's root square method for solving algebraic equation

Book for Study:

1. Numerical methods using Matlab – John Mathews & Kurtis Fink, Prentice Hall, New Jersey 2006.
2. Numerical methods in Science and Engineering - M.K. Venkataraman, National Publishing Co. Madras, 1996.
3. V. Rajaraman, 1993, Computer Oriented Numerical Methods, 3rd Ed. (Prentice-Hall, New Delhi.
4. M.K. Jain, S.R. Iyengar and R.K. Jain, 1995,Numerical Methods for Scientific and Engineering Computation, 3rd Ed. New Age International, New Delhi.
5. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi.

Book for Reference:

1. S.D. Conte and C. de Boor, 1981, Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., International Ed. (McGraw-Hill).
2. B.F. Gerald and P.O. Wheately, 1994, Applied Numerical Analysis, 5th Edition, Addison Wesley, Reading, MA.
3. B. Carnahan, H.A. Luther and J.O. Wikes, 1969, Applied Numerical Methods (Wiley, New York.
4. S.S. Kuo, 1996, Numerical Methods and Computers, Addison - Wesley, London.
5. V. Rajaraman,Programming in FORTRAN/ Programming in C, PHI, New Delhi.

Pedagogy: Demonstration and practical sessions

COURSE OUTCOMES:

On the successful completion of the course. Students will be able to

CO	Course Outcomes	K Level
CO1	Program with the C Program/ FORTRAN with the C or any other high level language	Upto K5
CO2	Use various numerical methods in describing/solving physics problems.	Upto K5
CO3	Solve problem, critical thinking and analytical reasoning as applied to scientific problems.	Upto K5
CO4	To enhance the problem-solving aptitudes of students using various numerical methods.	Upto K5
CO5	To apply various mathematical entities, facilitate to visualise any complicate tasks.	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	2	2
CO2	2	2	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	3	3	3	3	3

1-Basic Level 2- Intermediate Level 3.Advanced Level

LESSON PLAN: TOTAL HOURS (90 Hrs)

Unit	Description	Hours	Mode
I	1. Lagrange interpolation with Algorithm, Flow chart and output. 2. Newton forward interpolation with Algorithm, Flow chart and output. 3. Newton backward interpolation with Algorithm, Flow chart and output. 4. Curve-fitting: Least squares fitting with Algorithm, Flow chart and output.	18	Demonstration and practical sessions
II	5. Numerical integration by the trapezoidal rule with Algorithm, Flow chart and output. 6. Numerical integration by Simpson's rule with Algorithm, Flow chart and output. 7. Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart and output.	18	Demonstration and practical sessions

	8. Numerical solution of ordinary first-order differential equations by the Runge- Kutta method with Algorithm, Flow chart and output.		
III	9. Finding Roots of a Polynomial - Bisection Method 10. Finding Roots of a Polynomial - Newton Raphson Method 11. Solution of Simultaneous Linear Equation by Gauss elimination method. 12. Solution of Ordinary Differential Equation by Euler	18	Demonstration and practical sessions
IV	13. Runge Kutta Fourth Order Method for solving first order Ordinary Differential Equations 14. Newton's cotes formula 15. Trapezoidal rule 16. Simpson's 1/3 rule	18	Demonstration and practical sessions
V	17. Simpson's 3/8 rule 18. Boole's rule 19. Gaussian quadrature method (2 point and 3point formula) 20. Giraffe's root square method for solving algebraic equation	18	Demonstration and practical sessions

Annexure - 7

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
III	DSEC	23OPPHDSE3A	Numerical Methods and Computer Programming	3	3	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

1. To make students to understand different numerical approaches to solve a problem.
2. To Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods, their limitations.
3. To Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations.
4. To understand the basics of programming.
5. To Understand the basics of C-programming and conditional statements **.**

Course content:

Unit	Course Content	Hrs	K -Level	CLO
I	**SOLUTIONS OF EQUATIONS:** Zeros or Roots of an equation - Non-linear algebraic equation and transcendental equations - Zeros of polynomials –Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods – Convergence of solutions in Bisection and Newton-Raphson methods – Limitations of Bisection and Newton-Raphson methods.	9	Upto K5	CLO1
II	**LINEAR SYSTEM OF EQUATIONS:** Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations – Gaussian elimination method – Gauss Jordan method – Inverse of a matrix by Gauss elimination method - Eigen values and eigenvectors of matrices – Direct method - Power method and Jacobi Method to find the Eigen values and Eigen vectors.	9	Upto K5	CLO2
III	**INTERPOLATION AND CURVE FITTING:** Interpolation with equally spaced points - Newton forward and backward interpolation - Interpolation with unevenly spaced points - Lagrange interpolation – Curve fitting – Method of least squares – Fitting a polynomial.	9	Upto K5	CLO3
IV	**DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS:** Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule – Error estimates – solution of ordinary differential equations – Euler and RungaKutta methods.	9	Upto K5	CLO4
V	**PROGRAMMING WITH C:** Introduction – Reading a Character – Writing a Character – Formatted input – Formatted output. - simple if statement -The if …else statement -Nesting of if …else statements — The switch statement -The while statement – The do Statement – The for statement - Definition of functions – return values and their types – Function Call – Function Declaration.	9	Up to K5	CLO5

Book for study:

1. S. S. Sastry, Introductory Methods of Numerical analysis, PHI, New Delhi.
2. Arumugam .S, Thangapandi Issaac .A, Somasundaram .A, Numerical methods, Scitech Publications (India) PVT Ltd, Chennai, 2002.
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw Hill Company, New Delhi, 8th Edition,2019.

Books for Reference:

1. S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis-an algorithmic approach, 3rd Edition, McGraw Hill,)
2. B. F. Gerald, and P. O. Wheatley, 1994, Applied Numerical analysis, 5th Edition, Addison-Wesley, MA.
3. B. Carnagan, H. A. Luther and J. O. Wilkes, 1969, Applied Numerical Methods, Wiley, New York.
4. S. S. Kuo, 1996, Numerical Methods and Computers, Addison-Wesley.
5. V. Rajaraman, Programming in FORTRAN / Programming in C, PHI, New Delhi
6. M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi
7. F. Scheid, 1998, Numerical Analysis, 2nd Edition, Schaum's series, McGraw Hill, New York
8. W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, 1992, Numerical Recipes in FORTRAN, 2nd Edition, Cambridge Univ. Press

Web Resources/ e-Books:

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

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for Nature of the course:

The students will able to learning various programming techniques and applying these techniques to solve numerical based problems.

Activities to be given:

The students solve the various mathematical problems using numerical techniques with the Programming language.

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

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

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	2
CLO2	2	3	3	3	3	2
CLO3	3	3	3	2	2	2
CLO4	3	3	3	3	2	2
CLO5	3	2	3	3	2	2

1-Basic Level 2- Intermediate Level 3.Advanced Level

Annexure - 7

LESSON PLAN: TOTAL HOURS (45 Hrs)

Unit	Description	Hours	Mode
I	**SOLUTIONS OF EQUATIONS:** Zeros or Roots of an equation - Non-linear algebraic equation and transcendental equations - Zeros of polynomials –Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods – Convergence of solutions in Bisection and Newton-Raphson methods – Limitations of Bisection and Newton-Raphson methods.	9	Chalk & Talk, Seminar and Group Discussion
II	**LINEAR SYSTEM OF EQUATIONS:** Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations – Gaussian elimination method – Gauss Jordan method – Inverse of a matrix by Gauss elimination method - Eigen values and eigenvectors of matrices – Direct method - Power method and Jacobi Method to find the Eigen values and Eigen vectors.	9	Chalk & Talk, Seminar and Group Discussion
III	**INTERPOLATION AND CURVE FITTING:** Interpolation with equally spaced points - Newton forward and backward interpolation - Interpolation with unevenly spaced points - Lagrange interpolation – Curve fitting – Method of least squares – Fitting a polynomial.	9	PPT, Chalk & Talk, Seminar and Group Discussion
IV	**DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS:** Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule – Error estimates – solution of ordinary differential equations – Euler and RungaKutta methods.	9	Chalk & Talk, Seminar and Group Discussion
V	**PROGRAMMING WITH C:** Introduction – Reading a Character – Writing a Character – Formatted input – Formatted output. - simple if statement -The if …else statement -Nesting of if …else statements — The switch statement -The while statement – The do Statement – The for statement - Definition of functions – return values and their types – Function Call – Function Declaration.	9	Chalk & Talk, Seminar and Group Discussion

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
III	DSEC	23OPPHDSE3B	General Relativity and Cosmology	3	3	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

1. To Skillfully handle tensors
2. To Understanding of the underlying theoretical aspects of general relativity and cosmology
3. To Gain knowledge on space time curvature
4. To Equipped to take up research in cosmology
5. To Confidently solve problems using mathematical skills

Course content:

Unit	Course Content	Hours	K Level	CLO
I	**TENSORS** Tensors in index notation - Kronecker and Levi Civita tensors - inner and outer products - contraction - symmetric and antisymmetric tensors - quotient law - metric tensors - covariant and contravariant tensors - vectors - the tangent space - dual vectors - tensors - tensor products - the Levi-Civita tensor - tensors in Riemann spaces	9	Upto K5	CLO 1
II	**TENSORS FIELD** Vector-fields, tensor-fields, transformation of tensors - gradient and Laplace operator in general coordinates - covariant derivatives and Christoffel connection - Elasticity: Field tensor - field energy tensor - strain tensor - tensor of elasticity- curvature tensor	9	Upto K5	CLO 2
III	**GENERAL RELATIVITY** The spacetime interval - the metric - Lorentz transformations - space-time diagrams - world-lines - proper time - energy-momentum vector - energy-momentum tensor - perfect fluids - energy-momentum conservation - parallel transport - the parallel propagator - geodesics - affine parameters - the Riemann curvature tensor - symmetries of the Riemann tensor - the Bianchi identity	9	Upto K5	CLO 3

IV	**TENSOR IN RELATIVITY** Ricci and Einstein tensors - Weyl tensor - Killing vectors - the Principle of Equivalence - gravitational redshift - gravitation as space-time curvature - the Newtonian limit - physics in curved space-time - Einstein's equations - the Weak Energy Condition - causality - spherical symmetry - the Schwarzschild metric - perihelion precession	9	Upto K5	CLO 4
V	**COSMOLOGY** Expansion of the Universe - thermal history - and the standard cosmological model - Friedmann - Robertson-Walker type models of the Universe - Primordial inflation and the theory of cosmological fluctuations - Theory and observations of the cosmic microwave background and of the large-scale structure of the Universe - Dark matter and dark energy - theoretical questions and observational evidence - inflation - origin of galaxies and other open problems	9	Upto K5	CLO 5

Book for study:

1. M. R. Spiegel, Vector Analysis, Schaum’a outline series, McGraw Hill, New York, 1974.
2. James Hartle, Gravity: An introduction to Einstein's general relativity, San Francisco, Addison-Wesley, 2002
3. Sean Carroll, Spacetime and Geometry: An Introduction to General Relativity, (Addison-Wesley, 2004).
4. Jerzy Plebanskiand Andrzej Krasinski, An Introduction to General Relativity and Cosmology, Cambridge University Press 2006.
5. Meisner, Thorne and Wheeler: Gravitation W. H. Freeman & Co., San Francisco 1973.

Books for Reference:

1. Robert M. Wald: Space, Time, and Gravity: the Theory of the Big Bang and Black Holes, Univ. of Chicago Press.
2. J. V. Narlikar, Introduction to Cosmology, Jones &Bartlett 1983
3. Steven Weinberg, Gravitation and Cosmology, New York, Wiley, 1972.
4. Jerzy Plebanski and Andrzej Krasinski, An Introduction to General Relativity and Cosmology, Cambridge University Press 2006.
5. R Adler, M Bazin& M Schiffer, Introduction to General Relativity.

Web Resources/ e-Books:

1. http://www.fulviofrisone.com/attachments/article/486/A%20First%20Course%20In%20General%20Relativity%20-%20Bernard%20F.Schutz.pdf
2. https://link.springer.com/book/9780387406282
3. https://ocw.mit.edu/courses/8-962-general-relativity-spring-2020/resources/lecture-18-cosmology-i/
4. https://arxiv.org/abs/1806.10122
5. https://uwaterloo.ca/applied-mathematics/future-undergraduates/what-you-can-learn-applied-mathematics/relativity-and-cosmology

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for Nature of the course:

Knowledge and Skill:

This course can able to give an introduction to students in the areas of general relativity and cosmology.

Activities to be given:

We will be providing students with the Lectures, Online Seminars

Webinars on Industrial Interactions/Visits to enhance the knowledge of the paper.

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

CO	Course Outcome	K-level
CO1	Skillfully handle tensors	Upto K5
CO2	Understanding of the underlying theoretical aspects of general relativity and cosmology	Upto K5
CO3	Gain knowledge on space time curvature	Upto K5
CO4	Equipped to take up research in cosmology	Upto K5
CO5	Confidently solve problems using mathematical skills	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	3	2	3	2	3	2
CO3	3	3	3	2	3	2
CO4	2	2	2	2	2	2
CO5	2	2	2	2	2	2

1-Basic Level 2- Intermediate Level 3.Advanced Level

LESSON PLAN: TOTAL HOURS (45 Hrs)

Unit	Description	Hours	Mode
I	**TENSORS** Tensors in index notation - Kronecker and Levi Civita tensors - inner and outer products - contraction - symmetric and antisymmetric tensors - quotient law - metric tensors - covariant and contravariant tensors - vectors - the tangent space - dual vectors - tensors - tensor products - the Levi-Civita tensor - tensors in Riemann spaces	9	Chalk & Talk, Seminar and Group Discussion
II	**TENSORS FIELD** Vector-fields, tensor-fields, transformation of tensors - gradient and Laplace operator in general coordinates - covariant derivatives and Christoffel connection - Elasticity: Field tensor - field energy tensor - strain tensor - tensor of elasticity- curvature tensor	9	Chalk & Talk, Seminar and Group Discussion
III	**GENERAL RELATIVITY** The spacetime interval - the metric - Lorentz transformations - space-time diagrams - world-lines - proper time - energy-momentum vector - energy-momentum tensor - perfect fluids - energy-momentum conservation - parallel transport - the parallel propagator - geodesics - affine parameters - the Riemann curvature tensor - symmetries of the Riemann tensor - the Bianchi identity	9	PPT, Chalk & Talk, Seminar and Group Discussion
IV	**TENSOR IN RELATIVITY** Ricci and Einstein tensors - Weyl tensor - Killing vectors - the Principle of Equivalence - gravitational redshift - gravitation as space-time curvature - the Newtonian limit - physics in curved space-time - Einstein's equations - the Weak Energy Condition - causality - spherical symmetry - the Schwarzschild metric - perihelion precession	9	Chalk & Talk, Seminar and Group Discussion
V	**COSMOLOGY** Expansion of the Universe - thermal history - and the standard cosmological model - Friedmann - Robertson-Walker type models of the Universe - Primordial inflation and the theory of cosmological fluctuations - Theory and observations of the cosmic microwave background and of the large-scale structure of the Universe - Dark matter and dark energy - theoretical questions and observational evidence - inflation - origin of galaxies and other open problems.	9	Chalk & Talk, Seminar and Group Discussion

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
III	SEC	23PPHSEC3	Medical physics	2	3	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
	✓	

Objective:

1. To Know about the system of human body
2. To Understand the concepts of diagnostic X-ray
3. To Gain knowledge about the medical instruments
4. To Study the type of medical equipment's
5. To Learn about advanced bio-medical instrumentation

Unit	Course Contents	Hours	K Level	CLO
I	**Human physiological systems** Introduction-Cells and their structures-nature of cancer cells-Transport of ion through the cell membrane-Resting and action potential-Bioelectric potential-Nerve tissues and organs-Different system of human body.	9	Upto K2	CLO1
II	**Bio Potential Recorders:** Characteristics of the recording system-Electrocardiography(ECG)-Electroretinography(ERG)&Electrooculography(EOG)-Recorders with high accuracy- Recorders for off line analysis. Physiological Assist Devices: Pacemakers	9	Upto K3	CLO2
III	**Operation Theatre Equipments** Surgical diathermy -Ultrasonic Diathermy- Therapeutic effect of heat-Ventilators-Anesthesia machine-Blood flowmeters-Cardiac output Measurements -Blood gas analysers -Oxymeters-Elements of intensive care monitoring.	9	Upto K4	CLO3
IV	**Specialised Medical Equipment** Blood cell Counter-Electron Microscope-Radiation detectors-Digital thermometer-Audiometers-X-ray tube-X-ray machine-Radiography and fluoroscopy-Image Identifiers-Angiography-Application of X-ray examination.	9	Upto K4	CLO4
V	**Advances in Biomedical Instrumentation** Computers in Medicine-Lasers in Medicine-Endoscopes-Cryogenic Surgery-Nuclear Imaging techniques-Computer tomography-Thermography -Magnetic resonance imaging-Positron emission tomography.	9	Upto K4	CLO5

Book for study

1. Arumugam.M, Biomedical Intrumentation,Anuradha Publications, Kumbokonam,Second Edition,2007.

Reference Books

1. Anadanatarajan, Biomedical instrumentation and Measurements, PHIlearning private Limited, NewDelhi, FirstEdition, 2007.
2. Arora.M.P, Biophysics, Himalaya publishing House, Mumbai, First Edition,2011.
3. Cromwell.L,Pfeiffer.E.A,Weibell.F.J, Biomedical Instrumentation and Measurements,Prentice Hall of India Pvt Ltd,2006, New Delhi, Second Edition.

Web Resources / e-book

1. https://www.medphysics.wisc.edu/graduate/documents/handbook_june_2014.pdf
2. http://www.almhnds.com/7/Medical_Physics/1.pdf
3. https://en.wikipedia.org/wiki/Medical_physics
4. https://avantehs.com/learn/equipment-checklists/operating-room-equipment-checklist
5. https://www.sciencedirect.com/topics/engineering/biopotential
6. https://books.google.co.in/books?id=I5598H1Nx70C&printsec=frontcover&redir_esc=y#v=onepage&q&f=false
7. https://pdfcoffee.com/biomedical-instrumentation-and-measurements-pdf-free.html
6. https://www.acsce.edu.in/acsce/wp-content/uploads/2020/03/Biomedical-Sensors-Instruments.pdf

Pedagogy:

Chalk and Talk, Seminar, Quiz, Group Discussion, PPT.

Rationale for Nature of the course:

This course is mainly work-related skill and essential technically principle of radiation and its achieve in the medical field

Activities to be given:

1. Train the students to handle the medical equipment.
2. Practice the students to analyze the system of human body.

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

CO	Course Outcome	K-level
CO1	Gained knowledge in solid waste management	Upto K5
CO2	Equipped to take up related job by gaining industry exposure	Upto K5
CO3	Develop entrepreneurial skills	Upto K5
CO4	Will be able to analyze and manage the status of the solid wastes in the nearby areas	Upto K5
CO5	Adequately sensitized in managing solid wastes in and around his/her locality	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	3	2	3	2	3	2
CO3	3	3	3	2	3	2
CO4	2	2	2	2	2	2
CO5	2	2	2	2	2	2

1-Basic Level 2- Intermediate Level 3.Advanced Level

Annexure - 7

LESSON PLAN: TOTAL HOURS (45 Hrs)

Unit	Description	Hours	Mode
I	**Human physiological systems** Introduction-Cells and their structures-nature of cancer cells-Transport of ion through the cell membrane-Resting and action potential-Bioelectric potential-Nerve tissues and organs-Different system of human body.		Chalk & Talk, Seminar
II	**Bio Potential Recorders:** Characteristics of the recording system-Electrocardiography(ECG)-)Electromyography(EMG)-Electroretinography(ERG)&Electrooculography(EOG)-Recorders with high accuracy- Recorders for off line analysis. Physiological Assist Devices: Pacemakers		Chalk & Talk, Seminar
III	**Operation Theatre Equipments** Surgical diathermy-Shortwave diathermy –Microwave diathermy-Ultrasonic - Diathermy- Therapeutic effect of heat-Ventilators-Anesthesia machine-Blood flowmeters-Cardiac output Measurements -Blood gas analysers -Oxymeters-Elements of intensive care monitoring.		PPT, , Seminar and Group Discussion
IV	**Specialised Medical Equipment** Blood cell Counter-Electron Microscope-Radiation detectors-Digital thermometer-Audiometers-X-ray tube-X-ray machine-Radiography and fluoroscopy-Image Identifiers-Angiography-Application of X-ray examination.		Chalk & Talk, Seminar and Group Discussion
V	**Advances in Biomedical Instrumentation** Computers in Medicine-Lasers in Medicine-Endoscopes-Cryogenic Surgery-Nuclear Imaging techniques-Computer tomography-Thermography -Magnetic resonance imaging-Positron emission tomography-Digital substra0ction angiography-Biofeedback instrumentation		Chalk & Talk, Seminar and Group Discussion

Annexure - 7

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
IV	Core	23OPPH41	Nuclear and Particle Physics	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

1. To gain the Knowledge of basic structure of atom and nuclear models.
2. To Imparts an in-depth knowledge on the nuclear force, experiments to study it
3. To understand the types of nuclear reactions and their principles.
4. To study the details of nuclear decay with relevant theories.
5. To learn the Standard Model of Elementary Particles and Higgs boson.

Course content:

Unit	Course Content	Hours	K Level	CLO
I	**NUCLEAR MODELS** :**Liquid drop model** – Introduction-Plot of B/A against A-Weizacker semiemprical mass formula – Isobaric mass parabola –Bohr Wheeler theory of fission – **shell model** – Introduction-Evidence-electric Quadrapole moment – Main assumptions of the single particle shell model- spin-orbit coupling of an electron bound in an atom -collective model (theory)	18	Upto K5	CLO 1
II	**NUCLEAR FORCES** : Introduction- properties of nuclear forces – The ground state of deuteron – central and Non central forces(Tensor force)-Exchange Forces - Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering	18	Upto K5	CLO 2
III	**NUCLEAR REACTIONS**: Types of nuclear reactions – conservation laws-Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nucleus –Breit Wigner dispersion formula –Nuclear Chain reaction – four factor formula.	18	Upto K5	CLO 3
IV	**NUCLEAR DECAY** **Alpha decay-** Range of α particles- Alpha decay paradox-Barrier penetration .**Beta decay** – Continuous Beta ray spectrum – Pauli's neutrino hypothesis-Fermi theory of beta decay - Comparative Half-life –Fermi Kurie Plot – Helicity. **Gamma decay** – Gamma ray emission-selection rules- - internal conversion – nuclear isomerism	18	Upto K5	CLO 4
V	**ELEMENTARY PARTICLES-**Introduction-Classification of Elementary Particles – Fundamental interaction - conservation laws – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks - Gell Mann Nishijima formula-Quark Model	18	Upto K5	CLO 5

Book for study:

1. D. C. Tayal – Nuclear Physics – Himalaya Publishing House (2011)
2. S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011)

Books for Reference:

1. L. J. Tassie – The Physics of elementary particles – Prentice Hall Press (1973)
2. H. A. Enge – Introduction to Nuclear Physics – Addison Wesley, Publishing Company. Inc. Reading. New York, (1974).
3. Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002)
4. Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001)
5. B.L. Cohen, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.
6. K. S. Krane – Introductory Nuclear Physics – John Wiley & Sons (2008)
7. R. Roy and P. Nigam – Nuclear Physics – New Age Publishers (1996)
8. S. Glasstone – Source Book of Atomic Energy – Van Nostrand Reinhold Inc.,U.S.- 3rd Revised edition (1968)

Web Resources/ e-Books:

1. http://bubl.ac.uk/link/n/nuclearphysics.html
2. http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdfhttp://www.scholarpedia.org/article/Nuclear_Forces
3. https://www.nuclear-power.net/nuclear-power/nuclear-reactions/
4. http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.html
5. https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.html.

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for Nature of the course:

Knowledge and Skill: Knowledge of basic structure of atom and nucleus.

Activities to be given:

Students able to understand the different models of the nucleus in a chronological order

Lectures, Online Seminars and Webinars

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

CO	Course Outcome	K-level
CO1	Gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion.	Upto K5
CO2	Demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter.	Upto K5
CO3	Use the different nuclear models to explain different nuclear phenomena and the concept of resonances through Briet-Weigner single level formula	Upto K5
CO4	Analyze data from nuclear scattering experiments to identify different properties of the nuclear force.	Upto K5
CO5	Summarize and identify allowed and forbidden nuclear reactions based on conservation laws of the elementary particles.	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	3	3
CO2	2	2	2	3	3	3
CO3	3	2	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	3	3	3	3	3

1-Basic Level **2- Intermediate Level** **3.Advanced Level**

Annexure - 7

LESSON PLAN: TOTAL HOURS (90 Hrs)

Unit	Description	Hours	Mode
I	**NUCLEAR MODELS** :**Liquid drop model** – Introduction-Plot of B/A against A-Weizacker semiemprical mass formula – Isobaric mass parabola –Bohr Wheeler theory of fission – **shell model** – Introduction-Evidence-electric Quadrapole moment – Main assumptions of the single particle shell model- spin-orbit coupling of an electron bound in an atom -collective model (theory)	**18**	Chalk & Talk, Seminar and Group Discussion
II	**NUCLEAR FORCES** : Introduction- properties of nuclear forces – The ground state of deuteron – central and Non central forces(Tensor force)-Exchange Forces - Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering	18	Chalk & Talk, Seminar and Group Discussion
III	**NUCLEAR REACTIONS** : Types of nuclear reactions – conservation laws-Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nucleus – Breit Wigner dispersion formula –Nuclear Chain reaction – four factor formula.	18	PPT, Chalk & Talk, Seminar and Group Discussion
IV	**NUCLEAR DECAY** **Alpha decay-** Range of α particles- Alpha decay paradox-Barrier peneration **Beta decay** – Continuous Beta ray spectrum – Pauli's neutrino hypothesis-Fermi theory of beta decay - Comparative Half-life –Fermi Kurie Plot – Helicity **Gamma decay** – Gamma ray emission-selection rules- - internal conversion – nuclear isomerism	18	Chalk & Talk, Seminar and Group Discussion
V	**ELEMENTARY PARTICLES-**Introduction-Classification of Elementary Particles – Fundamental interaction - conservation laws – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks -Gell Mann Nishijima formula-Quark Model	18	Chalk & Talk, Seminar and Group Discussion

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
IV	Core	23OPPH42	Spectroscopy	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

1. To comprehend the theory behind different spectroscopic methods
2. To know the working principles along with an overview of construction of different types of spectrometers involved
3. To explore various applications of these techniques in R&D.
4. Apply spectroscopic techniques for the qualitative and quantitative analysis of various molecules.
5. To Learn the electronic transitions caused by absorption of radiation using NMR and ESR technique.

Course content:

Unit	Course Content	Hours	K Level	CLO
I	**MICROWAVE SPECTROSCOPY:** Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - Effect of isotopic substitution - Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric top-asymmetric top molecules - Hyperfine structure - Stark effect - Instrumentation techniques.	18	Upto K5	CLO 1
II	**INFRA-RED SPECTROSCOPY:** Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator-Fundamental modes of vibration of H_2O and CO_2 - IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy .	18	Upto K5	CLO 2
III	**RAMAN SPECTROSCOPY:** Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- Raman activity of H_2O and CO_2 -Mutual exclusion principle- Instrumentation technique and block diagram.	18	Upto K5	CLO 3
IV	**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 – Rotational fine structure of electronic vibration transitions – the Fortrat diagram – Pre dissociation.	18	Upto K5	CLO 4

V	**Resonance Spectroscopy**: Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession-Relaxation times - Instrumentation techniques of NMR spectroscopy. **Electron Spin Resonance:** Basic principle –Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) – Hyperfine Structure (Hydrogen atom) –g-factors.	18	Upto K5	CLO 5

Book for study:

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

Books for Reference:

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

Web Resources/ e-Books:

1. https://www.youtube.com/watch?v=0iQhirTf2PI
2. https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5
3. https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee
4. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
5. https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for Nature of the course:

Knowledge and Skill: Understanding of electromagnetic spectrum, mathematical abilities, knowledge of molecules, their structure, bond nature, physical and chemical behavior.

Activities to be given:

Students able to correlate mathematical process of Fourier transformations with instrumentation.

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

CO	Course Outcome	K-level
CO1	Comprehend the theory behind different spectroscopic methods	Upto K5
CO2	Know the working principles along with an overview of construction of different types of spectrometers involved	Upto K5
CO3	Explore various applications of these techniques in R &D.	Upto K5
CO4	Apply spectroscopic techniques for the qualitative and quantitative analysis of various molecules.	Upto K5
CO5	To Learn the electronic transitions caused by absorption of radiation using NMR and ESR technique.	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	3	3
CO2	2	2	2	3	3	3
CO3	3	2	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	3	3	3	3	3

1-Basic Level 2- Intermediate Level 3.Advanced Level

Annexure - 7

LESSON PLAN: TOTAL HOURS (90 Hrs)

Unit	Description	Hours	Mode
I	**MICROWAVE SPECTROSCOPY:** Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules - Hyperfine structure and quadrupole moment of linear molecules - Instrumentation techniques – block diagram - Stark effect- Problems.	18	Chalk & Talk, Seminar and Group Discussion
II	**INFRA-RED SPECTROSCOPY:** Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch- Fundamental modes of vibration of H_2O and CO_2 - IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy .	18	Chalk & Talk, Seminar and Group Discussion
III	**RAMAN SPECTROSCOPY:** Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- SR branch -Raman activity of H_2O and CO_2 .Mutual exclusion principle- determination of N_2O structure -Instrumentation technique and block diagram -structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy.	18	PPT, Chalk & Talk, Seminar and Group Discussion
I V	**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 – Rotational fine structure of electronic vibration transitions – the Fortrat diagram – Pre dissociation.	18	Chalk & Talk, Seminar and Group Discussion
V	**RESONANCE SPECTROSCOPY**: Nuclear and Electron spin- Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance- Chemical shift and its measurement - Instrumentation techniques of NMR spectroscopy. **Electron Spin Resonance:** Basic principle –Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors.	18	Chalk & Talk, Seminar and Group Discussion

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
IV	DSEC	23OPPH4P	Practical-IV Microprocessor 8085 and Microcontrollers 8051	3	6	40	60	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
	✓	

Course Objectives

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

List of Experiments: (Any Twelve Experiments)

1. 8-bit addition and subtraction, multiplication and division using microprocessor 8085
2. Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending orderusing microprocessor 8085
3. Code conversion (8-bit number): a) Binary to BCD b) BCD to binaryusing microprocessor 8085
4. Addition of multi byte numbers, Factorial using microprocessor 8085.
5. Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal Counters using microprocessor 8085
6. Interfacing of LED – Binary up/down counter, BCD up/down counter and N/2N up/down counter using microprocessor 8085
7. Interfacing of seven segment display using microprocessor 8085
8. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves .
9. DAC 0800/ DAC 1048 interface and wave form generation (unipolar / Bipolar output).
10. ADC 0809 interface.

11. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action using microprocessor 8085.
12. Interfacing of Temperature Controller and Measurement using microprocessor 8085
13. Water level detector
14. Elevator
15. Traffic level controller
16. Keyboard interface
17. Average of n-numbers
18. Factorial of a number
19. Fibonacci series of N terms
20. Multi byte Addition/ Subtraction Sorting
21. G in ascending and descending order- Picking up smaller and larger number
22. LED Interface- Binary up/down counter, BCD up/down counter, Ring and twisted ring counter.

Book for Study:

1. Electronic lab manual Vol I, K ANavas, Rajath Publishing
2. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
3. V.Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.

Book for Reference:

1. Advanced Practical Physics, S.P Singh, Pragati Prakasan
2. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
3. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
4. Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications.

Pedagogy: Demonstration and practical sessions

COURSE OUTCOMES:

On the successful completion of the course. Students will be able to

CO	Course Outcomes	K Level
CO1	Develop the programming skills of Microprocessor	Upto K5
CO2	Appreciate the applications of Microprocessor programming	Upto K5
CO3	Understand the structure and working of 8085 microprocessor and apply it.	Upto K5
CO4	Acquire knowledge about the interfacing peripherals with 8085 microprocessor.	Upto K5
CO5	Acquire knowledge about the interfacing 8051 microcontroller with various peripherals.	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	2	2
CO2	2	2	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	3	3	3	3	3

1-Basic Level 2- Intermediate Level 3.Advanced Level

LESSON PLAN: TOTAL HOURS (90 Hrs)

Unit	Description	Hours	Mode
I	1. 8-bit addition and subtraction, multiplication and division using microprocessor 8085 2. Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending order using microprocessor 8085 3. Code conversion (8-bit number): a) Binary to BCD b) BCD to binaryusing microprocessor 8085 4. Addition of multi byte numbers, Factorial using microprocessor 8085.	12	Demonstration and practical sessions
II	5. Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal Counters using microprocessor 8085	12	Demonstration and practical sessions

	6. Interfacing of LED – Binary up/down counter, BCD up/down counter and N/2N up/down counter using microprocessor 8085 7. Interfacing of seven segment display using microprocessor 8085 8. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves .		
II I	9. DAC 0800/ DAC 1048 interface and wave form generation (unipolar / Bipolar output). 10. ADC 0809 interface. 11. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action using microprocessor 8085. 12. Interfacing of Temperature Controller and Measurement using microprocessor 8085.	12	Demonstration and practical sessions
I V	13. Water level detector 14. Elevator 15. Traffic level controller 16. Keyboard interface 17. Average of n-numbers	12	Demonstration and practical sessions
V	18. Factorial of a number 19. Fibonacci series of N terms 20. Multi byte Addition/ Subtraction Sorting 21. G in ascending and descending order- Picking up smaller and larger number 22. LED Interface- Binary up/down counter, BCD up/down counter,Ring and twisted ring counter.	12	Demonstration and practical sessions

Department of Physics					Class: II M.Sc.,			
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Contact Hours / Week**	**CIA**	**SE**	**Total**
IV	SEC	23OPPHSEC4	Material Science	2	2	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives

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

Course content:

Unit	Course Content	Hours	K Level	CLO
I	**OPTOELECTRONIC MATERIALS:** Importance of optical materials – properties: Band gap and lattice matching –quasi-Fermi levels and recombination – optical absorption, loss and gain. Optical processes in quantum structures: Inter-band and intra-band transitions Organic semiconductors.	6	Upto K5	CLO 1
II	**CERAMIC MATERIALS:** Ceramic processing: powder processing, milling– structural ceramics: zirconia, almina, silicon carbide, tungsten carbide – electronic ceramics– glass and glass ceramics	6	Upto K5	CLO 2
III	**POLYMERIC MATERIALS:** Polymers, Structure and Properties, Addition and Condensation Polymerization, Polymer Types. **Applications of Polymers**: Applications of Polymers, Corrosion and Oxidation of Metals, Prevention.	6	Upto K5	CLO 3
IV	**COMPOSITE MATERIALS:** Introduction, Polymer-Matrix Composites, Cement-Matrix Composites, Carbon-Matrix Composites. **Applications of Composite Materials:** Applications, Structural, Electronic, Environmental, Biomedical.	6	Upto K5	CLO 4
V	**NEW MATERIALS:** Introduction – Metallic Glasses – Applications – Fiber reinforced plastics (FRP) and Fiber reinforced Metals (FRM) – Metal Matrix Composites (MMC).	6	Upto K5	CLO 5

Book for study:

1. M. Arumugam, 2002, Materials Science, 3rd revised Edition, Anuratha Agencies

Books for Reference:

1. B. S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday. Textbook of Nanoscience and Nanotechnology. Springer- Verlag, 2012.
2. K. Yamauchi, I. Ohkata, K. Tsuchiya and S. Miyazaki (Eds). Shape Memory and Super Elastic Alloys: Technologies and Applications. Wood head Publishing Limited, 2011.
3. Lawrence H. VanVlack, 1998. Elements of Materials Science and Engineering, 6th Edition, Second ISE reprint, Addison-Wesley.
4. H. Iabch and H. Luth, 2002, Solid State Physics – An Introduction to Principles of Materials Science, 2nd Edition, Springer.
5. D. Hull & T. W. Clyne, An introduction to composite materials, Cambridge University Press, 2008.

Web Resources/ e-Books:

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

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for Nature of the course:

Materials Science is a hybrid course that will give you a deep understanding of different materials for various applications.

Activities to be given:

1. Train the students to use the materials for bulletproof vests and scratch – resistant glass used on smartphones.
2. Enhancing the students study a variety of materials in order to create things that can solve problems for people.

Course Learning Outcome (CLOs)

On the successful completion of the course. Students will be able to

CO	Course Outcome	K-level
CO1	Acquire knowledge on optoelectronic materials	Upto K5
CO2	Be able to prepare ceramic materials	Upto K5
CO3	Be able to understand the processing and applications of polymeric materials	Upto K5
CO4	Be aware of the fabrication of composite materials	Upto K5
CO5	Be knowledgeable of shape memory alloys, metallic glasses and nanomaterials	Upto K5

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	2
CLO2	2	3	3	3	3	2
CLO3	3	3	3	2	2	2
CLO4	3	3	3	3	2	2
CLO5	3	2	3	3	2	2

1-Basic Level 2- Intermediate Level 3.Advanced Level

LESSON PLAN: TOTAL HOURS (60 Hrs)

Unit	Description	Hours	Mode
I	**OPTOELECTRONIC MATERIALS:** Importance of optical materials – properties: Band gap and lattice matching –quasi-Fermi levels and recombination – optical absorption, loss and gain. Optical processes in quantum structures: Inter-band and intra-band transitions Organic semiconductors.	6	Chalk & Talk, Seminar and Group Discussion
II	**CERAMIC MATERIALS:** Ceramic processing: powder processing, milling– structural ceramics: zirconia, almina, silicon carbide, tungsten carbide – electronic ceramics– glass and glass ceramics	6	Chalk & Talk, Seminar and Group Discussion
III	**POLYMERIC MATERIALS:** Polymers, Structure and Properties, Addition and Condensation Polymerization, Polymer Types. **Applications of Polymers**: Applications of Polymers, Corrosion and Oxidation of Metals, Prevention.	6	PPT, Chalk & Talk, Seminar and Group Discussion

IV	**COMPOSITE MATERIALS:** Introduction, Polymer-Matrix Composites, Cement-Matrix Composites, Carbon-Matrix Composites. **Applications of Composite Materials:** Applications, Structural, Electronic, Environmental, Biomedical.	6	Chalk & Talk, Seminar and Group Discussion
V	**NEW MATERIALS:** Introduction – Metallic Glasses – Applications – Fiber reinforced plastics (FRP) and Fiber reinforced Metals (FRM) – Metal Matrix Composites (MMC).	6	Chalk & Talk, Seminar and Group Discussion