Sri Meenakshi Government Arts College for Women (Autonomous), Madurai-2

M.Sc. PHYSICS SYLLABUS FOR THE ACADEMIC YEAR 2021-2022

Reaccredited with "A" by NAAC

DEPARTMENT OF PHYSICS

CHOICE BASED CREDIT SYSTEM

Sri Meenakshi Government Arts College for Women (Autonomous), Madurai-2

M.Sc. PHYSICS – PROGRAMME STRUCTURE

The Department of Physics has structured the PG Courses with the aim of enabling our students to clear the CSIR –NET examination. The syllabi of core courses have been designed keeping in line with the syllabus of CSIR – NET.

SEM	COURSE		Cr.	Hrs./ Week	Int.	Ext.	Total
	Subject code	Name					
I	QA1	Core-I – Mathematical Physics-I	5	6	25	75	100
	QA2	Core-II – Classical&Statistical Mechanics	5	6	25	75	100
	QA3	Core – III – Advanced Electronics	5	6	25	75	100
	QL1	Core – IV–Physics Practical – I	3*	3+3	40	60	100
	EQA1	Elective – I Microprocessor	5	6	25	75	100
	EQA2	Elective – 1Electronic Instrumentation					
		TOTAL	**23**	**30**	**-**	**-**	**500**
II	QB1	Core V– Mathematical Physics-II	5	6	25	75	100
	QB2	Core-VI – Quantum Mechanics-I	5	6	25	75	100
	QB3	Core – VII – Electromagnetic Theory	5	6	25	75	100
	QL2	Core – VIII– Physics Practical–II	3	3+3	40	60	100
	EQB1	Elective – II – Programming in C++	4	6	25	75	100
	EQB2	Elective – II Energy Technology					
		TOTAL	**22**	**30**	**-**	**-**	**500**
III	QC1	Core-IX – Solid state Physics –I	5	6	25	75	100
	QC2	Core-X– Quantum Mechanics-II	5	6	25	75	100
	QC3	Core – XI – Molecular Spectroscopy	4	5	25	75	100
	QL3	Core – XII – Physics Practical – III	3*	3+3	40	60	100
	EQC1	Elective –III Crystal Growth and Thin Films	4	5	25	75	100
	EQC2	Elective –III Astrophysics					
	NMPP	Batteries and their applications	2	2	25	75	100
		TOTAL	**23**	**30**	**-**	**-**	**500**
IV	QD1	Core-XIII – Solid state Physics – II	5	6	25	75	100
	QD2	Core-XIV -Nuclear Physics	5	6	25	75	100
	QL4	Core – XV-– Physics Practical – IV	3	6	40	60	100
	QPW	Core -XVI–Project	4	3+3	-	100	100
	EQD1	Elective-IV- Laser and non linear optics	5	6	25	75	100
	EQD2	Elective-IV- Nanophysics					
		TOTAL	**22**	**30**	**-**	**-**	**500**

*Credit will be awarded at the end of the academic year.

Programme : M.Sc **Part III: Core paper**
Semester : I **Hours : 6 P/W 90Hrs P/S**
Sub. Code :QA1 **Credits : 5**
TITLE OF THE PAPER: Mathematical Physics I

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDOES/TUTORIAL	ICT
	6	4	-	2	-

PREAMBLE: The purpose of the *course* is to introduce students to *methods* of *mathematical physics* and to develop required *mathematical* skills to solve problems in quantum mechanics, electrodynamics and other fields of *theoretical physics*.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
UNIT 1 CO1: describe the Vector analysis (UI)	1	18
UNIT 2 CO2: solve the problems using Matrices (PR)	2	18
UNIT 3 CO3: apply the Group theory (PI)	3	18
UNIT 4 CO4: interpret the Beta, Gamma and Dirac delta function (UR)	4	18
UNIT 5 CO5: solve the problems using Laplace and Fourier transform (PI)	5	18

SYLLABUS

UNIT I: VECTORS

Introduction - Scalar and vector products with examples in Physics - multiple products-vector derivatives - the gradient of scalar field - concept of Divergence and Gauss' theorem - curl of a vector field and Stoke's theorem - Successive applications of the operator▼ – the classification of vector field - curvilinear co-ordinates - application to hydrodynamics - equation of heat flow in solids.

UNIT II: MATRICES

Introduction - basic concepts - addition and multiplication of matrices - special matrices - solution of linear equations - vector spaces - linear transformations-unitary and orthogonal transformations - Eigen values, vectors - characteristic equation.

UNIT III: GROUP THEORY

Concept of Group – the cyclic Group – The Group multiplication table Sub groups – conjugate sub groups – isomorphism and Homomorphism – representation of Groups – reducible and irreducible representations – Orthogonality theorem - Character of representation - unit group - point group.

UNIT IV: FACTORIALS AND RELATED FUNCTIONS

Introduction – Factorial function – gamma functions – the beta function – derivatives of gamma function – Stirling's formula for large n – Dirac delta function – derivatives of delta function – three dimensional delta function – few simple illustrations of delta functions.

UNIT V: INTEGRAL TRANSFORMS

Introduction - Laplace transform and its properties - the inverse Laplace transform - simple applications of Laplace transform - the Fourier sine and cosine transform - the convolution or Faltung theorem for Fourier transform-Fourier sine and cosine transform of derivatives - some applications of Fourier transform.

TEXT BOOKS:

S.L. Kakani, C. Hemrajani. Mathematical Physics 2nd Edition CBS Publishers &Distributors Pvt.. LTD.,2010.

Unit - I Ch.1 (sec. 1.1 - 1.6, 1.8 - 1.16)
Unit - II Ch.2 (sec. 2.1 - 2.4, 2.8 - 2.12)
Unit - IV Ch.4 & 5 (sec. 4.1 - .4.3, 4.5, 4.7, 4.8 , 5.1- 5.4)
Unit - V Ch.8 (sec. 8.1, 8.2, 8.4, 8.9 -8.13)
Unit - III Ch.13 (sec. 13.1, 13.4, 13.5, 13.7, 13.12, 13.13, 13.18, 13.19, 13.21, 13.22, 13.25, 13.26) in Satyaprakash ,Mathematical Physics with classical mechanics 6th edition Sultan Chand & Sons, 2013.

REFERENCES:

1. B. D. Gupta, Mathematical Physics 4th edition Vikas Publishing House Pvt. Ltd. 2013
2. Satyaprakash, Mathematical Physics with classical mechanics 6th edition Sultan Chand &Sons, 2013
3. E. Balagurusamy, Numerical methods Tata McGraw – Hill Publishing company Ltd., 1999
4. Arkfen &Weber, Essential Mathematical Methods for Physicists, Academic Press, 2005.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
	Introduction - Scalar and vector products with examples in Physics - multiple	6	Lecture & Tutorial

UNIT I	products-vector derivatives - the gradient of scalar field		
	concept of Divergence and Gauss' theorem - curl of a vector field and Stoke's theorem - Successive applications of the operator ▼	6	Lecture & Tutorial
	the classification of vector field - curvilinear co-ordinates - application to hydrodynamics - equation of heat flow in solids.	6	Lecture & Tutorial
UNIT II	Introduction - basic concepts - addition and multiplication of matrices - special matrices	6	Lecture & Tutorial
	solution of linear equations - vector spaces - linear transformations-unitary and orthogonal transformations	6	Lecture & Tutorial
	Eigen values, vectors - characteristic equation.	6	Lecture & Tutorial
UNIT III	Concept of Group – the cyclic Group – The Group multiplication table Sub groups – conjugate sub groups	6	Lecture & Tutorial
	isomorphism and Homomorphism –	6	Lecture & Tutorial

	representation of Groups – reducible and irreducible representations		
	Orthogonality theorem - Character of representation - unit group - point group.	6	Lecture & Tutorial
UNIT IV	Introduction – Factorial function – gamma functions – the beta function – derivatives of gamma function	6	Lecture & Tutorial
	Stirling's formula for large n – Dirac delta function – derivatives of delta function	6	Lecture & Tutorial
	three dimensional delta function – few simple illustrations of delta functions	6	Lecture & Tutorial
UNIT V	Introduction - Laplace transform and its properties - the inverse Laplace transform - simple applications of Laplace transform	6	Lecture & Tutorial
	the Fourier sine and cosine transform - the convolution or Faltung theorem for Fourier transform	6	Lecture & Tutorial
	Fourier sine and cosine transform of derivatives - some applications of Fourier transform	6	Lecture & Tutorial

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	

										COs
CO1	4	5	3	4	4	3	3	3	4	5	3.8
CO2	4	4	3	3	3	4	5	4	3	4	3.7
CO3	3	3	4	5	4	5	4	5	5	3	4.1
CO4	4	3	3	4	3	5	3	4	4	3	3.6
CO5	3	4	3	3	4	3	3	3	4	3	3.3
Mean Overall score											3.7

Result: The Score for this Course is 3.7 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Mean Score of COs = Total of Value / Total No. of Pos & PSOs			Mean Overall Score of COs = Total of Mean Score / Total No. of COs		

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	30%	30%
UNDERSTANDING	30%	30%
APPLY	40%	40%

Course Designer: M.Mahalakshmi Department of Physics.

Programme : M.Sc., PHYSICS **CORE PAPER**

Semester : I **Hours : 6 P/W 90Hrs P/S**

Sub. Code : QA2 **Credits : 5**

TITLE OF THE PAPER: CLASSICAL AND STATISCAL MECHANICS

Pedagogy per unit	Hours	Lecture	Peer Discussion/Teaching	GD/VIDOES/TUTORIAL	ICT
	18	6	10	1	1

PREAMBLE: Understanding and acquire the prerequisite concepts to the inadequacy in classical mechanics so that we can transit from classical to quantum mechanics which gives an insight into the interesting correlation.
Understanding and applying the connection between the theory and experiment.

COURSE OUTCOME	Unit	Hrs P/S

At the end of the Semester, the Students will be able to		
UNIT 1 CO1: To describe prerequisite concepts to the inadequacy in classical mechanics so that we can transit from classical to quantum mechanics this gives an insight into the interesting correlation.	1	18 hrs
UNIT 2 CO2: To describe the transformation to laboratory coordinates.	2	18 hrs
UNIT 3 CO3: To explain the principle axis transformation and to obtain frequencies of free vibration and normal coordinates.	3	18 hrs
UNIT 4 CO4: To obtain the Hamiltonians canonical equations of motion and hence to deduce canonical equation from a variational principles and apply to solve harmonic oscillator problem by Hamilton- Jacobi method. To compare the three types of ensembles and to study trans-relational functions and entropy.	4	18 hrs
UNIT 5 CO5: To compare the three statistics (MB, BE and FD) and to apply to derive the expression for blackbody radiation and Fermi gas.	5	18 hrs

SYLLABUS: CLASSICAL AND STATISTICAL MECHANICS

UNIT I: SURVEY OF FUNDAMENTAL PRINCIPLES

Mechanics of a particle and system of particles – Conservation of laws – Constraints – D'Alemberts principle and Lagrange's equations of motion – Conservation theorem and symmetry properties – Reduction to the equivalent one- body problem – Equations of motion – scattering in a central force field – Transformation to laboratory coordinates.

Unit II: SMALL OSCILLATIONS

Formulation of the problem – The Eigen value equation and the principal axis transformation-Frequencies of free vibration and normal co-ordinates – Free vibrations of a linear tri atomic molecule - Forced vibration and the effect of dissipative forces.

Unit III: HAMILTON'S FORMULATION OF MECHANICS

View point of new development - Phase space and the motion of the system-Hamiltonian - Hamilton's canonical equations of motion - Physical significance of H – Advantage of Hamiltonian approach - Deduction of canonical equations from a variational principle– Application of Hamilton's equations of motion - Hamilton-Jacobi method –Solution of harmonic oscillator problem by Hamilton-Jacobi method - Poisson brackets & Lagrange's brackets (qualitative).

Unit IV: PHASE SPACE AND ENSEMBLES

Partition function – Partition function of a single molecule – Translational partition function – Translational thermodynamic functions – Rotational partition functions – Rotational thermodynamic functions –Applications-Excitation of solid(only)- Ensemble - canonical ensembles – Entropy and other thermodynamic functions – The grand canonical ensemble (definition and essential features) – The micro canonical ensemble (definition) - The comparison of three types of ensembles.

Unit V: QUANTUM STATISTICS

Introduction - Basic Concepts of Quantum Mechanics – Postulates of Quantum Mechanics – Symmetric and Antisymmetric Wave Functions (Definition) – Bose Einstein Statistics : Bose Einstein Distribution Law – Fermi-Dirac Statistics : Fermi Dirac Distribution Law – Maxwell-Boltzmann Statistics : Maxwell's Boltzmann's Distribution Law – Results and Comparision of Three Statistics – Black-Body Radiation and the Planck Radiation Law – Electron Gas in Metals

Text books:

1. Herbert Goldstein **- Classical Mechanics** – II Edn. – Narosa Publishing House pvt Ltd, New Delhi-2

Unit I. Ch. 1 (1-1 to 1-4, 2-6, 3-1, 3-2, 3-10, 3-11)

Unit II. Ch.6 (6-1 to 6-5)

No problem in Unit I &II

2. Gupta, Kumar & Sharma , **Classical Mechanics**- 9th Edn.- Pragathi Prakashan, Meerut-1987

Unit III. Ch 3. (pg.No.-101 to 107, 110, 132, 140, 146, 177)

Problems (pg. No – 133, 135, 136, 166, 167)

3. S.L. Kakani, **Heat, Thermodynamics & Statistical physics**, II Edn. Sulthan Chand and sons, 2009

Unit IV. Ch.13 (13.4, 13.5, 13.5.1, 13.5.2, 13.5.3, 13.5.4, 13.6, 13.6.1, 13.6.3, 13.6.4, (defn) & 13.6.5 (defn) & Table 13.4,

Problems pg.no: 468 (Eg. 1, 2, 3, 4, 7, 8)

4. Sathya Prakash, **Statistical Mechanics,** Kedar Nath Ramnath, Meerut, Delhi ,2011

Unit V. Ch .8. (8.1, 8.2, 8.3), 8.5(defn) (8.12, 8.13, 8.14, 8.16, 8.17, 8.22,)

Problems (Pg no.380 to 385), problems(Pg. no. 408 to 411)

REFERENCE BOOKS : 1.J.C. Upadhyaya - **Classical Mechanics,** Himalayan publishing

2. https://www.britannica.com/science/classical-mechanics

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT 1 **SURVEY OF FUNDAMENTAL PRINCIPLES**			
	Mechanics of a particle and system of particles –	**3 hrs**	Motivation by asking questions – peer group discussion and by lecturing

	Conservation of laws – Constraints		through ICT (power point presestation)
	D'Alemberts principle and Lagrange's equations of motion	**3 hrs**	Lecturing – deriving the expression by group discussion
	Conservation theorem and symmetry properties	**2 hrs**	Peer group teaching and lecturing
	Reduction to the equivalent one- body problem	**4 hrs**	Lecturing with discussion and deriving the expression along with example problems
	Equations of motion – scattering in a central force field	**3 hrs**	Lecturing – deriving the expression by group discussion
	Transformation to laboratory coordinates	**3 hrs**	Lecturing – deriving the expression by peer group teaching.
UNIT II **SMALL OSCILLATIONS**			
	Formulation of the problem – The Eigen value equation and the principal axis transformation	**5 hrs**	Lecturing – deriving the expression by group discussion
	Frequencies of free vibration and normal co-ordinates	**4 hrs**	Lecturing – deriving the expression by group discussion
	Free vibrations of a linear tri atomic molecule	**4 hrs**	Lecturing – deriving the expression by group discussion
	Forced vibration and the effect of dissipative forces	**5 hrs**	Lecturing – deriving the expression by group discussion
UNIT III **HAMILTON'S FORMULATION OF MECHANICS**			
	View point of new development - Phase space and the motion of the system-Hamiltonian	**2 hrs**	Motivation by asking questions – peer group discussion and by lecturing

			through ICT (power point presestation)
	Hamilton's canonical equations of motion - Physical significance of H	**3 hrs**	Lecturing – deriving the expression by group discussion and emphasizing the importance of H
	Advantage of Hamiltonian approach - Deduction of canonical equations from a variational principle	**4 hrs**	Peer group teaching and discussion.
	Application of Hamilton's equations of motion	**3 hrs**	Lecturing with discussion and deriving the expression along with example problems.
	Hamilton-Jacobi method –Solution of harmonic oscillator problem by Hamilton-Jacobi method	**4 hrs**	Lecturing – deriving the expression by group discussion.
	Poisson brackets & Lagrange's brackets (qualitative)	**2 hrs**	Lecturing and solving the expression by group teaching and discussion.
UNIT IV **PHASE SPACE AND ENSEMBLES**			
	Partition function – Partition function of a single molecule – Translational partition function	**4 hrs**	Motivation by asking questions – peer group discussion and by lecturing through ICT (power point presestation)
	Translational thermodynamic functions – Rotational partition functions – Rotational thermodynamic functions	**4 hrs**	Lecturing – deriving the expression by group discussion and emphasizing the importance of thermodynamic functions
	Applications-Excitation of solid(only)-	**3 hrs**	Peer group discussion and lecturing

	Ensemble - canonical ensembles		
	Entropy and other thermodynamic functions – The grand canonical ensemble (definition and essential features)	**4 hrs**	Lecturing with discussion and expressing the essential features
	The micro canonical ensemble (definition) - The comparison of three types of ensembles	**3 hrs**	Lecturing and comparing the types of ensembles through peer teaching.
UNIT V **QUANTUM STATISTICS**			
	Introduction - Basic Concepts of Quantum Mechanics – Postulates of Quantum Mechanics – Symmetric and Antisymmetric Wave Functions (Definition)	**2 hrs**	Motivation by asking questions – peer group discussion and by lecturing through ICT (power point presestation)
	Bose Einstein Statistics : Bose Einstein Distribution Law	**4 hrs**	Lecturing – deriving the expression by group discussion
	Fermi-Dirac Statistics : Fermi Dirac Distribution Law	**4 hrs**	Peer group discussion and deriving the expression
	Maxwell-Boltzmann Statistics : Maxwell's Boltzmann's Distribution Law	**4 hrs**	Lecturing with discussion and deriving the expression along with example problems
	Results and Comparision of Three Statistics – Black-Body Radiation and the Planck Radiation Law	**2 hrs**	Lecturing – deriving the expression by peer teaching.

	Electron Gas in Metals	**2 hrs**	Lecturing – deriving the expression by group discussion

Course Outcomes (Cos)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						Mean scores of Cos
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	4	3	3	3	3	4	4	3	3	3	3.27
CO2	3	3	4	4	3	3	3	3	3	4	3	3.27
CO3	3	4	3	3	3	4	3	4	3	3	3	3.27
CO4	3	3	3	4	3	4	3	4	3	3	4	3.36
CO5	4	3	4	4	4	3	4	4	4	3	4	3.73
Mean Overall Score												3.38

Result: The Score for this Course is 3.38 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Mean Score of COs = Total of Value / Total No. of Pos & PSOs			Mean Overall Score of COs = Total of Mean Score / Total No. of COs		

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	40%	40%
UNDERSTANDING	30%	30%
APPLY	30%	30%

Course Designer : Dr. Mrs. SANTHI. Department of PHYSICS

Programme : M.Sc **Part III: Core**
Semester : I **Hours : 6 P/W 90Hrs P/S**
Sub. Code : QA3 **Credits: 5**

TITLE OF THE PAPER: ADVANCED ELECTRONICS

Pedagogy	Hours	Lecture	Peer Teaching	GD/ Videos/Tutorial	ICT
	6	4	-	1	1

PREAMBLE: The purpose of the course is to provide a thorough knowledge for the students about the fundamental principles and applications of FET, Operational amplifiers, Registers, counters and digital integrated circuits in advanced electronics.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
CO 1: explain the principle and classification of JFET	1	18
CO 2:understand the fundamental concept and application of operational amplifier	2	18
CO 3: describe the design concepts of counters and shift	3	18
CO 4:explain the various techniques to develop A/D and D/A converters	4	18
CO 5: know the fundamental characteristics of switching circuits	5	18

SYLLABUS

UNIT – I: SEMICONDUCTOR DEVICES

The ideal voltage controlled current Source-The junction Field Effect Transistor (JFET)- The JFET Volt Ampere characteristics- JFET Transfer characteristics- MESFET- - MOSFET- Enhancement MOSFET volt ampere characteristics Depletion MOSFET - MOSFET circuit symbols- FET as a Switch -FET as an Amplifier.

UNIT II : AMPLIFIER CIRCUITS AND SYSTEMS

Differential Amplifier-Analysis Of Differential Amplifiers-The Operational Amplifier-Measurement of Op-amp Parameters- Elementary Op-amp Applications- Adder- non inverting summing -Voltage to Current converter and Current to Voltage converter- Integrators-phase shift oscillator-wien bridge oscillator

UNIT III : REGISTERS AND COUNTERS

Types of registers-Serial in-Serial Out-Serial in Parallel- Out-Parallel in-Serial Out- Parallel in-Parallel Out -Asynchronous Counters- Decoding Gates-Synchronous Counters-Decade Counters.

UNIT IV: D/A CONVERSION AND A/D CONVERSION

Variable, Resistor Networks -Binary Ladders-D/A Converters-D/A Accuracy and Resolution- A/D Converter- simultaneous conversion- A/D Converter –counter method- A/D Techniques- - A/D Accuracy and Resolution.

UNIT V: DIGITAL INTEGRATED CIRCUITS

Switching Circuits-7400 TTL-TTL Parameters-TTL Overview- Open-Collector Gates - Three state TTL Devices –External drive for TTL loads -TTL Driving External loads -74C00 CMOS-CMOS Characteristics -TTL to CMOS Interface-CMOS To TTL Interface.

TEXT BOOKS:

1.JacobMillman & Arvin Grabel, Microelectronics, Second edition, Tata Mc Graw Hill Book company,2009.

UNIT I- Ch. 4(sec-4.1,-.,4.9,4.12- 4.13)

UNIT II- Ch. 10 (sec-10.18,10.19,10.21,10.22)

Ch. 15 (sec.15.2,15.3)

2. Donald P Leach, Albert Paul Malvino Goutam Saha, Digital Principles and Applications, Seventh edition , Mc Graw Hill companies, 2011.

UNIT III- Ch. 9 (sec-9.1-9.5)

Ch.10 (sec-10.1-10.3,10.5,)

UNIT IV- Ch. 12(sec.12.1-12.6, &12.10)

UNIT V-Ch.14 (sec.14.1-14.12)

BOOKS FOR REFERENCE :

1. Jacob Millman,Christos C.Halkias, Satayabrata Jit, Electronic devices and circuits Third Edition,Tata Mc. Graw Hill Education, 2010.
2. Herbert Taub Donald Schilling,Digital Integrated electronics, Mc Graw Hill International editions, 1987.
3. William Stanley, Operational Amplifier with linear integrated circuits, CBS Publishers,1988.
4. Robert L.Boylestad Louis Nashelsky, Electronic devices and circuit Theory,Tenth Edition, Pearson education ,2009.
5. R.P.Jain, Modern Digital Electronics-Tata Mc Graw Hill,2010.
6. A.P.Godse. D.A. Godse, Digital Electronics, Third revised edition,Technical Publications, 2008.
7. S.Salivanan, N.Suresh Kumar,A.Vallavaraj, Electronic devices and circuits, Second Edition, Tata Mc Graw Hill companies, 2008.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I	The ideal voltage controlled current Source-The junction Field Effect Transistor (JFET)- The JFET Volt Ampere characteristics- JFET Transfer characteristics	6	Lecture & Tutorial&ICT
	MESFET- - MOSFET- Enhancement MOSFET volt ampere characteristics	6	Lecture & Tutorial
	Depletion MOSFET - MOSFET circuit symbols- FET as a Switch -FET as an Amplifier.	6	Lecture & Tutorial&ICT
UNIT II	Differential Amplifier-Analysis Of DifferentialAmplifiers-The Operational Amplifier-Measurement of Op-amp Parameters-	6	Lecture & Tutorial&ICT
	Elementary Op-amp Applications-Adder- non inverting summing	6	Lecture & Tutorial&ICT
	Voltage to Current converter and Current to Voltage converter-Integrators-phase shift oscillator-wien bridge oscillator	6	Lecture & Tutorial&ICT
UNIT III	Types of registers-Serial in-Serial Out-Serial in Parallel- Out-Parallel in-Serial Out- Parallel in- Parallel Out	9	Lecture & Tutorial&ICT
	Asynchronous Counters- Decoding Gates-Synchronous Counters-Decade Counters.	9	Lecture & Tutorial&ICT
UNIT IV	Variable, Resistor Networks -Binary Ladders-D/A Converters-D/A Accuracy and Resolution- A/D Converter-	9	Lecture & Tutorial&ICT
	simultaneous conversion- A/D Converter –counter method- A/D	9	Lecture & Tutorial&ICT

	Techniques- - A/D Accuracy and Resolution.		
UNIT V	Switching Circuits-7400 TTL-TTL Parameters-TTL Overview-Open-Collector Gates	6	Lecture & Tutorial&ICT
	Three state TTL Devices –External drive for TTL loads -TTL Driving External loads	6	Lecture & Tutorial&ICT
	74C00 CMOS-CMOS Characteristics -TTL to CMOS Interface-CMOS To TTL Interface.	6	Lecture & Tutorial&ICT

Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean scores of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	4	4	3	3	3	4	3	3	2	2	3	3.4
CO2	4	4	3	3	2	4	4	3	2	2	4	3.5
CO3	3	4	3	3	3	4	4	2	3	4	3	3.6
CO4	3	3	3	3	2	4	4	2	3	2	3	3.2
CO5	3	4	3	3	3	4	4	2	2	3	4	3.5
Mean Overall Score												3.44

Result: The Score for this Course is 3.44 (High Relationship)

Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean scores of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	4	3	3	3	4	3	3	2	3	3.5
CO2	4	4	3	3	2	4	4	3	2	4	3.3
CO3	3	4	3	3	3	4	4	2	3	3	3.2
CO4	4	4	3	3	2	4	4	2	3	3	3.4
CO5	3	4	3	3	3	4	4	3	3	4	3.4
Mean Overall Score											3.36

Result: The Score for this Course is 3.36 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Total of Value Mean Score of COs = ------------------------ Total No. of Pos& PSOs			Total of Mean Score Mean Overall Score of COs =------------------------ Total No. of COs		

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	40%	40%
UNDERSTANDING	40%	40%
APPLY	20%	20%

Course Designer: Dr. Mrs. N.NAGARANI

Programme : M.Sc. **Elective I**
Semester : I **Hours : 6 P/W 90 Hrs P/S**
Sub. Code : EQA1 **Credits : 5**

TITLE OF THE PAPER: MICROPROCESSOR

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDOES/TUTORIAL	ICT
	6	3	1	1	1

PREAMBLE: To understand the basics, internal architecture, languages, instruction sets and operations involved in microprocessor. To describe counter and analog to digital and digital to analog converters, successive approximation methods and to develop programming skill.

COURSE OUTCOME At the end of the semester, the students will be able to	Unit	Hrs P/S
CO1:list the basics of microprocessor, architecture, memory and input/output	1	18
CO2: classify the languages and instruction sets in microprocessor	2	18
CO3: analyze the various operations involved in microprocessor	3	18
CO4: design a counter with time delay using subroutine and develop programming skill	4	18
CO5:discuss about the types of converters	5	18

SYLLABUS

UNIT I:MICROPROCESOR ARCHITECTURE AND MICROCOMPUTER SYSTEMS

Microprocessor Architecture and its operations-Microprocessor initiated operations and 8085 Bus organization - Internal Data operations and the 8085 registers -Peripheral or Externally initiated operations - Memory - Flip flop or Latch as a storage element - Memory map and Addresses - Memory Address Range of a 1K memory chip - Memory address lines - Memory word size - Memory and Instruction Fetch - Memory classification - Example of a Microcomputer system.

UNIT II: INTRODUCTION TO 8085 ASSEMBLY LANGUAGE PROGRAMMING

Machine language - 8085 Machine language - 8085 Assembly langugae - writing and Executing an Assembly language Program - High level languages- The 8085 programming model - 8085 Hardware Model - 8085 programming model - Instruction classification - The 8085 Instruction set - Instruction, Data format and storage - Instruction word size - Opcode format - Data Format - Instruction and Data Storage Memory - How to write, Assemble and execute a simple program - Illustrative program - Adding two Hexadecimal Numbers.

UNIT III: INTRODUCTION TO 8085 INSTRUCTIONS

Data transfer (copy) operations - Addressing Modes - Illustrative program - Data transfer from Register to output Port - Arithmetic operations - Addition - Subtraction - Illustrative program -Logic operations - Logic AND - Illustrative program Data Masking with AND - OR, Exclusive OR AND, NOT - Setting and resetting specific bits - Illustrative program ORing Data from two input ports - Branch operations - Unconditional Jump - Conditional Jumps - Debugging a program.

UNIT IV:COUNTERS, STACK AND SUBROUTINES

Counters and Time delays - Time delay using one register - Time delay using a Register pair - Stack - Subroutine - Illustrative program: Traffic signal controller - subroutine Documentation and Parameter passing - Restart (RST) instruction - conditional call and return instructions.

UNIT V:INTERRUPTS AND INTERFACING DATA CONVERTERS

Interrupts - The 8085 interrupt - RST 7.5, 6.5 and 5.5, - Interfacing Data converters - Digital to Analog (D/A) converters - Basic concepts - D/A converter circuits - Illustration Interfacing an 8 bit D/A converter with 8085 - Analog to Digital (A/D) converters - Basic concepts - Successive approximation A/D converter - Interfacing 8 bit A/D converter.

TEXT BOOKS:

Ramesh S.Gaonkar, Microprocessor Architecture program and Application with the 8085, 5th Edition, Penram International Publishing Pvt Ltd, 2013.

Unit I: Ch. 3(Sec.3.1 , 3.1.1 , 3.1.2 , 3.1.3 , 3.2 , 3.2.1 to 3.2.7 , 3.4)

Unit II : Ch.1 & 2 (Sec.1.2.1 , 1.2.2 , 1.2.3, 1.2.5, 1.2.6, 2.1, 2.1.1 , 2.1.2 ,2.2 , 2.2.1, 2.3 , 2.3.1, 2.3.2,- 2.3.3 , 2.3.4 , 2.4 , 2.4.1)

Unit III : Ch.6(Sec. 6.1 , 6.1.1, 6.1.2 , 6.2 , 6.2.1 - 6.2.3, 6.3, 6.3.1, 6.3.2 , 6.3.3 , 6.3.4, 6.3.5, 6.4 , 6.4.1, 6.4.3 , 6.6)

Unit IV: Ch. 8 &9(Sec. 8.1 , 8.1.1 , 8.1.2 , 9.1, 9.2 , 9.2.1 , 9.2.2, 9.3, 9.3.1, 9.3.2.)

Unit V : Ch.12 & 13(Sec. 12.1 , 12.1.1, 12.2, 12.2.1 , 12.2.2 , 13.1 , 13.1.1 , 13.1.2 , 13.1.3 , 13.2 ,13.2.1 , 3.2.2 , 13.2.3)

REFERENCE BOOKS:

1. B.Ram, Microprocessor and its applications,Dhanpat Rai publications.

2. Aditya P.Mathur,.Introduction to Microprocessors, , 2nd Edition, Tata Mc Graw Hill Ltd, 1985.

3.Barry B.Bray, The Intel Microprocessor Architecture Programming and Interfacing, 8th Edition, Dorling kindersley (India) Pvt. Ltd, Pearson Education, 2009

UNITS	**TOPIC**	**LECTURE HOURS**	**MODE OF TEACHING**
UNIT I			
	Microprocessor Architecture and its operations-Microprocessor initiated	6	Lecture , peer teaching,GD &ICT

	operations and 8085 Bus organization- Internal Data operations and the 8085 registers		
	Peripheral or Externally initiated operations - Memory - Flip flop or Latch as a storage element - Memory map and Addresses	6	Lecture , peer teaching,GD & ICT
	Memory Address Range of a 1K memory chip - Memory address lines - Memory word size - Memory and Instruction Fetch - Memory classification - Example of a Microcomputer system	6	Lecture , peer teaching,GD & ICT
UNIT II			
	Machine language - 8085 Machine language - 8085 Assembly langugae - writing and Executing an Assembly language Program - High level languages	6	Lecture , peer teaching,GD & ICT
	The 8085 programming model - 8085 Hardware Model - 8085 programming model - Instruction classification - The 8085 Instruction set - Instruction, Data format and storage	6	Lecture , peer teaching,GD & ICT
	Instruction word size - Opcode format - Data Format - Instruction and Data Storage Memory - How to write, Assemble and execute a simple program - Illustrative program - Adding two Hexadecimal Numbers.	6	Lecture , peer teaching,GD & ICT
UNIT III			
	Data transfer (copy) operations - Addressing Modes - Illustrative program - Data transfer from Register to output Port	6	Lecture , peer teaching,GD & ICT
	Arithmetic operations - Addition - Subtraction - Illustrative program -Logic operations - Logic AND - Illustrative program Data Masking with AND - OR, Exclusive OR AND, NOT	6	Lecture , peer teaching,GD & ICT
	Setting and resetting specific bits - Illustrative program ORing Data from two input ports - Branch operations - Unconditional Jump - Conditional Jumps - Debugging a program Artificial heart valves,	6	Lecture , peer teaching,GD & ICT

	Heart – Lung machine – Kidney machine (Block diagram only)		
UNIT IV			
	Counters and Time delays - Time delay using one register - Time delay using a Register pair	6	Lecture , peer teaching,GD & ICT
	Stack - Subroutine - Illustrative program: Traffic signal controller	6	Lecture , peer teaching,GD & ICT
	subroutine Documentation and Parameter passing - Restart (RST) instruction - conditional call and return instructions	6	Lecture , peer teaching,GD & ICT
UNIT V			
	Interrupts - The 8085 interrupt - RST 7.5, 6.5 and 5.5, - Interfacing Data converters - Digital to Analog (D/A) converters	6	Lecture , peer teaching,GD & ICT
	Basic concepts - D/A converter circuits - Illustration Interfacing an 8 bit D/A converter with 8085	6	Lecture , peer teaching,GD & ICT
	Analog to Digital (A/D) converters - Basic concepts - Successive approximation A/D converter - Interfacing 8 bit A/D converter	6	Lecture , peer teaching,GD & ICT

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	4	3	4	3	3	3	5	3.4
CO2	3	4	3	4	3	4	3	3	3	5	3.5
CO3	3	3	4	4	4	4	3	3	3	5	3.6
CO4	3	3	3	4	3	4	3	3	3	5	3.4
CO5	3	3	3	4	3	4	3	3	3	5	3.4
Mean Overall Score											3.46

Result: The Score for this Course is 3.46 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Mean Score of COs =			Mean Overall Score of COs =		

Total of Value Total No. of Pos & PSOs	Total of Mean Score Total No. of COs

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	30%	30%
UNDERSTANDING	30%	30%
APPLY	40%	40%

Course Designer: G.Selvarani Department of Physics

Programme : M.Sc **Part III: Core paper**
Semester : II **Hours : 6 P/W 90Hrs P/S**
Sub. Code :QB1 **Credits : 5**

TITLE OF THE PAPER: Mathematical Physics II

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDOES/TUTORIAL	ICT
	6	4	-	2	-

PREAMBLE: The student shall have gained a broad knowledge of the scientific theories and methods of her field of study and they know how to apply her knowledge on new subject areas within Mathematics and physics.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
UNIT 1 CO1: analyze the types of tensors (AI)	1	18
UNIT 2 CO2: predict the complex integration, Taylor's and Laurent's series (UI)	2	18
UNIT 3 CO3: define polynomials of differential equation (KI)	3	18
UNIT 4 CO4: apply the Partial differential equation in physics (PI)	4	18
UNIT 5 CO5: solve the problems using Numerical methods (PI)	5	18

SYLLABUS

UNIT I: TENSORS

Introduction - Quotient Law - Symmetric and anti Symmetric Tensors - Invariant Tensor – Fundamental tensor - Transformation of Christofells 3 index symbols - Covariant derivative of an invariant - Tensor notation and form of Gradient : Divergence, Laplacian, Curle.

UNIT II: COMPLEX VARIABLES

Introduction - some definition - Regular functions - Derivative of f(z) and analyticity complex integration - Cauchy's integral theorem and its consequences - Cauchy's integral formulae - Infinite series -Taylor's and Laurent's series - common techniques for the construction of Taylor's and Laurent's series - Zeros and Singularities - Calculus of Residue – Rectangular Contours.

UNIT III: POLYNOMIALS OF DIFFERENTIAL EQUATIONS

Legendre equation – Generating function Pn(X) – Orthogonality of functions - Orthogonality of Legendre's polynomials – recurrence relations for Pn(X) – Bessel's differential equations – Bessel's functions of the third kind (Hankel function) – Generating function for Jn(X) - Recurrence relation for Jn(X) – Orthogonality of Bessel's functions

UNIT IV: PARTIAL DIFFERENTIAL EQUATIONS

Introduction - Partial differential equation in Physics – Laplace's equation in 3 dimension and its solutions - wave equation in three dimension and its solutions - Green's function - Solution of Poisson's equation using Green's function

UNIT V: NUMERICAL METHODS

Newton's forward and backward difference formula to compute derivatives- numerical integration -The Trapezoidal rule and Simpson's rule - C program to evaluate integrals using Trapezoidal and Simpsons rules - Euler's method – Runge - Kutta method- second , third order and fourth order for solving first order differential equation - C program for solving ordinary differential equation using Euler's method and Runge-Kutta method.

TEXT BOOKS:

1.Mathematical Physics by S.L. Kakani ,C.Hemrajani. II Edition CBS Publishers &Distributors Pvt.. LTD.,2010.

Unit - I Ch.3 (sec. 3.1, 3.12, 3.14, 3.15, 3.19, 3.23, 3.29, 3.30 & 3.31)

Unit - II Ch.6 (sec. 6.1 - 6.4, 6.6 , 6.8, 6.9, 6.11-6.15)

Unit - III Ch.7 (sec. 7.5, Pg.,673 to 687, 688 to 696, sec.7.7, Pg.710 to 720, 722 to 727)

Ch.4 & 5 (sec. 4.1 - .4.3, 4.5, 4.7, 4.8 , 5.1- 5.4)

Unit - IV Ch.9 (sec. 9.1-9.6, 9.9 -9.10)

Unit - V Ch. 8, 10 & 12 (sec. 8.1, 8.2, 8.5, 10.3, 10.4, 12.19, 12.20, 12.21, 12.22) in

S. Arumugam, A. Thangapandi Isaac and A. Somasundaram, Numerical Methods 2nd Edition Scitech Publications (India) Pvt., Ltd, 2005

REFERENCES:

1. B. D. Gupta, Mathematical Physics 4th edition Vikas Publishing House Pvt Ltd reprint 2013

2. Suresh Chandra, Mohit kumar Sharma, An Introduction to Mathematical Physics Narosa Publishing House 2013.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
	Introduction - Quotient Law - Symmetric and anti Symmetric Tensors - Invariant Tensor – Fundamental tensor	6	Lecture & Tutorial

UNIT I	Transformation of Christofells 3 index symbols - Covariant derivative of an invariant	6	Lecture & Tutorial
	Tensor notation and form of Gradient : Divergence, Laplacian, Curle	6	Lecture & Tutorial
UNIT II	Introduction - some definition - Regular functions - Derivative of f(z) and analyticity complex integration	6	Lecture & Tutorial
	Cauchy’s integral theorem and its consequences - Cauchy’s integral formulae - Infinite series -Taylor’s and Laurent’s series	6	Lecture & Tutorial
	common techniques for the construction of Taylor’s and Laurent’s series - Zeros and Singularities - Calculus of Residue – Rectangular Contours.	6	Lecture & Tutorial
UNIT III	Legendre equation – Generating function Pn(X) – Orthogonality of functions - Orthogonality of Legendre’s polynomials	6	Lecture & Tutorial
	recurrence relations for Pn(X) – Bessel’s	6	Lecture & Tutorial

	differential equations – Bessel's functions of the third kind (Hankel function)		
	Generating function for Jn(X) - Recurrence relation for Jn(X) – Orthogonality of Bessel's functions	6	Lecture & Tutorial
UNIT IV	Introduction - Partial differential equation in Physics – Laplace's equation in 3 dimension and its solutions	8	Lecture & Tutorial
	wave equation in three dimension and its solutions - Green's function	6	Lecture & Tutorial
	Solution of Poisson's equation using Green's function	4	Lecture & Tutorial
UNIT V	Newton's forward and backward difference formula to compute derivatives	4	Lecture & Tutorial
	numerical integration -The Trapezoidal rule and Simpson's rule - C program to evaluate integrals using Trapezoidal and Simpsons rules	4	Lecture & Tutorial
	Euler's method – Runge - Kutta method- second , third order and fourth order for solving first order differential equation -	10	Lecture & Tutorial

	C program for solving ordinary differential equation using Euler's method and Runge-Kutta method.		

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	3	4	4	4	3	3	3	5	3.6
CO2	5	3	4	4	5	3	3	4	3	4	3.8
CO3	3	3	4	3	3	3	5	4	3	3	3.4
CO4	3	3	4	3	3	3	5	4	3	4	3.5
CO5	4	3	3	4	4	3	3	5	4	3	3.6
Mean Overall score											3.58

Result: The Score for this Course is 3.58 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Mean Score of COs = Total of Value / Total No. of Pos & PSOs

Mean Overall Score of COs = Total of Mean Score / Total No. of COs

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	30%	30%
UNDERSTANDING	30%	30%
APPLY	40%	40%

Course Designer: M.Mahalakshmi Department of Physics.

Programme : M.Sc., PHYSICS **CORE PAPER Semester :II**

Hours : 6 P/W 90Hrs P/S

Sub. Code : QB2 **Credits : 5**

TITLE OF THE PAPER: QUANTUM MECHANICS I

Pedagogy per unit	Hours	Lecture	Peer Discussion/Teaching	GD/VIDOES/TUTORIAL	ICT
	18	6	10	1	1

PREAMBLE: Understanding the postulates of quantum mechanics, admissible conditions on the wave functions, and trial function linear in variational parameter and hydrogen molecule with perturbation theory.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
UNIT 1 CO1: To list the Bohr's postulates and exhibit the main characteristics features of quantum system with the aid of simple examples and to show how these features arise from the conditions on the Schrodinger wave function.	1	18 hrs
UNIT 2 CO2: To motivate the background to the basic postulates of quantum mechanics.	2	18 hrs
UNIT 3 CO3: To obtain admissible conditions on the wave functions to derive the time-independent Schrodinger equation and hence apply to study a particle in a square well potential.	3	18 hrs
UNIT 4 CO4: To obtain trial function linear in variational parameter and hydrogen molecule with perturbation theory. To know quantum states, the Hilbert space of state vectors and wave functions, degeneracy and transformations and symmetries.	4	18 hrs
UNIT 5 CO5: To obtain spin angular momentum and Clebsch –Gordan coefficients.	5	18 hrs

SYLLABUS: QUANTUM MECHANICS – I

UNIT I: INADEQUACY OF CLASSICAL CONCEPTS

Bohr's postulates-Bohr theory of the Hydrogen spectrum- Bohr-Sommerfeld quantum rules; Degeneracy- space quantization- limitations of the old quantum theory- De Broglie's hypothesis- the motion of a free wave packet; classical approximation and the Uncertainty Principle- the formulation of quantum mechanics.

UNIT II: THE SCHRODINGER EQUATION AND STATIONARY STATES

Normalization and probability interpretation- non-normalizable wave functions and box normalization- conservation of probability- expectation values; Ehrenfest's theorem- Admissibility condititions on the wave function- stationary states; the time independent Schrodinger equation- A particle in a square well potential- bound states in a sqaure well ($E<0$)- The square well- Non localized state ($E > 0$)-the Schrodinger equation and energy eigen values.

UNIT III: APPROXIMATION METHODS FOR STATIONARY STATES

Equations in various orders of perturbation theory- The non-degenerate case- The degenerate case- Removal of degeneracy- the effect of an electric field on the energy levels of an atom(Stark Effect)- Upper bound on ground state energy- Application to excited states- Trial function linear in variational parameters & hydrogen molecule.

UNIT IV: QUANTUM STATES REPRESENTATION, TRANSFORMATION AND SYMMETRIES

Quantum states ; state vectors and wave functions- the Hilbert space of state vectors;Dirac notation- Dynamical variables and linear operators- representations- continuous basis- The Schrodinger representation- degeneracy; labelling by commuting observables- symmetries and conservation laws- space inversion- time reversal.

UNIT V:ANGULAR MOMENTUM

The Angular momentum operators- Angular momentum in stationary states with spherical symmetry -The Eigenvalue spectrum- Matrix representation of J in the l jm > basis- spin angular momentum- nonrelativistic Hamiltonian with spin- diamagnetism- addition of angular momenta- Clebsch- Gordan coefficients(J1=J2=1/2)

TEXT BOOKS

1. P.M.Mathews, K.Venkatesan, **A text book of Quantum Mechanics,** TMH, New Delhi, 2012.
   - Unit - I Ch. 1 (sec 1.8 - 1.14 & 1.19)
   - Unit - II Ch. 2 & 4 (sec 2.4 - 2.11, 2.12, 4.1)
   - Unit - III Ch. 5 (sec 5.1 – 5.4, 5.6-5.9)
   - Unit - IV Ch. 7 (sec 7.1 – 7.6& 7.12-7.14)
   - Unit - V Ch. 4 (4.6 & 4.12) Ch. 8 (sec 8.1 - 8.6)

REFERENCE BOOKS:

1. S.L.Kakani, H.M.Chandalia, **Quantum Mechanics theory and problems ,** 4th edition,Sultan chand & Sons, 2012

2. Satyaprakash & Swati Satya, **Quantum Mechanics,** Kedar Nath Ram Nath & Co., 2006.

3. Aruldhas.J, **Quantum Mechanics,** Prentice Hall of India, 2012.

4. Merzbacher.E , **Quantum Mechanics** ,John Wiley, 2004.

5. Ghatak.A, **Introduction to Quantum Mechanics,** Macmilan, 1996.

6. J.J.Sakurai, **Modern Quantum Mechanics,** Addison Wesley,1994.

7. J.J.Sakurai, **Advanced Quantum Mechanics,** Addison Wesley,1994.

8. Leonard I.Schiff, **Quantum Mechanics,** 3rd edition, TMH, New Delhi, 1968

9.http://physics .mq.edu.au/~jcresser/phys304/Handouts/QuantumPhysicsNotes.pdf

10. http://quantumphysics.iop.org

UNITS	**TOPIC**	**LECTURE HOURS**	**MODE OF TEACHING**
UNIT 1 **UNIT I: INADEQUACY OF CLASSICAL CONCEPTS**			
	Bohr's postulates-Bohr theory of the Hydrogen spectrum	**4 hrs**	Motivation by asking questions – peer group discussion and by lecturing through ICT (power point presestation)
	Bohr-Sommerfeld quantum rules; Degeneracy- space quantization	**5 hrs**	Lecturing – deriving the condition by group discussion
	limitations of the old quantum theory- De Broglie's hypothesis-	**5 hrs**	Peer group teaching and lecturing

	the motion of a free wave packet		
	classical approximation and the Uncertainty Principle- the formulation of quantum mechanics.	**4 hrs**	Lecturing with discussion and deriving the expression along with example problems
UNIT II: THE SCHRODINGER EQUATION AND STATIONARY STATES			
	Normalization and probability interpretation- non-normalizable wave functions and box normalization- conservation of probability	**5 hrs**	Lecturing – deriving the expression by group discussion
	expectation values; Ehrenfest's theorem- Admissibility condititions on the wave function- stationary states;	**4 hrs**	Lecturing – deriving the theorem by group discussion
	the time independent Schrodinger equation- A particle in a square well potential- bound states in a sqaure well (E<0)	**4 hrs**	Lecturing – deriving the expression by group discussion
	The square well- Non localized state (E > 0)-the Schrodinger equation and energy eigen values.	**5 hrs**	Lecturing – deriving the expression by group discussion
UNIT III: APPROXIMATION METHODS FOR STATIONARY STATES			
	Equations in various orders of perturbation theory	**3 hrs**	Motivation by asking questions – peer group discussion and by lecturing through ICT (power point presestation)

	The non-degenerate case- The degenerate case- Removal of degeneracy	**3 hrs**	Lecturing – by group discussion and emphasizing the importance of degeneracy
	the effect of an electric field on the energy levels of an atom(Stark Effect)	**4 hrs**	Peer group teaching and discussion.
	Upper bound on ground state energy- Application to excited states	**4 hrs**	Lecturing with discussion and deriving the condition along with example problems.
	Trial function linear in variational parameters & hydrogen molecule.	**4 hrs**	Lecturing – deriving the expression by group discussion.
UNIT IV: QUANTUM STATES REPRESENTATION, TRANSFORMATION AND SYMMETRIES			
	Quantum states ; state vectors and wave functions- the Hilbert space of state vectors;	**4 hrs**	Motivation by asking questions – peer group discussion and by lecturing through ICT (power point presestation)
	Dirac notation- Dynamical variables and linear operators representations	**4 hrs**	Lecturing –explaining the variable and operators by group discussion and emphasizing the importance of operators
	continuous basis- The Schrodinger representation	**3 hrs**	Peer group discussion and lecturing
	degeneracy; labelling by commuting observables- symmetries and conservation laws	**4 hrs**	Lecturing with discussion and expressing the essential features of conservation laws
	space inversion- time reversal.	**3 hrs**	Lecturing by peer teaching.
UNIT V:ANGULAR MOMENTUM			
	The Angular momentum operators	**2 hrs**	Motivation by asking questions – peer group discussion and by lecturing through ICT (power point presestation)

	Angular momentum in stationary states with spherical symmetry -The Eigenvalue spectrum	**4 hrs**	Lecturing – deriving the expression by group discussion
	Matrix representation of J in the l jm > basis-spin angular momentum	**3 hrs**	Peer group discussion and deriving the expression
	nonrelativistic Hamiltonian with spin-diamagnetism	**3 hrs**	Lecturing with discussion.
	addition of angular momenta	**2 hrs**	Lecturing – deriving the expression by peer teaching.
	Clebsch- Gordan coefficients(J1=J2=1/2)	**4 hrs**	Lecturing – deriving the expression by group discussion and solving problem.

Course Outcomes (Cos)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						Mean scores of Cos
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	4	3	3	3	3	4	4	3	3	3	3.27
CO2	3	3	4	4	3	3	3	3	3	4	3	3.27
CO3	3	4	3	3	3	4	3	4	3	3	3	3.27
CO4	3	3	3	4	3	4	3	4	3	3	4	3.36
CO5	4	3	4	4	4	3	4	4	4	3	4	3.73
Mean Overall Score												3.38

Result: The Score for this Course is 3.38 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Mean Score of COs = Total of Value / Total No. of Pos & PSOs			Mean Overall Score of COs = Total of Mean Score / Total No. of COs		

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	40%	40%
UNDERSTANDING	30%	30%
APPLY	30%	30%

Course Designer : Dr. Mrs. SANTHI. Department of PHYSICS

Programme : M..Sc CORE VII

Semester :II Hours : 6 P/W 90Hrs P/S

Credits : 5 Sub. Code : QB3

TITLE OF THE PAPER: ELECTROMAGNETIC THEORY

Pedagogy	**Hours**	**Lecture**	**Peer Teaching**	**GD/ Vedos/Tutorial**	**ICT**
	6	4	-	1	1

PREAMBLE: To understand the basic principles of electrostatics and magnetostatics and their applications and electromagnetic wave propagation.

COURSE OUTCOME At the end of the semester, the students will be able to	**Unit**	**Hrs P/S**
CO 1 : understand the fundamental principles and laws of electrostatics and their applications	1	18
CO 2: know the principles of magnetostatics and their applications	2	18
CO 3: explain the phenomenon of electromagnetic induction and apply Maxwell's equations to specific physical situations	3	18
CO 4: acquire knowledge in deriving wave equations and discuss the propagation of electromagnetic wave in different media	4	18

CO 5: discuss the importance of scalar and vector potentials	5	18

SYLLABUS

UNIT I - ELCTROSTATICS

Electric charge-Coulombs law -Electric field - Electrostatic potential- Gauss's Law-Applications of Gauss's Law-electric dipole-multipole expansion of electric fields- Poisson's equation - Laplace equation-Laplace equation in one independent variable-solutions to Laplace equation in spherical coordinates- Polarization -Field outside of a Dielectric medium -The electric field inside a dielectric-Gauss law in dielectric- The electric displacement – electric susceptibility and dielectric constant

UNIT II - MAGNETOSTATICS

Magnetic Field-Magnetic induction- force on a current carrying conductor- Biot-Savart Law-Application of Biot-Savart Law-Ampere's circuital law - Magnetic vector potential-magnetic field of a distant circuit- Magnetic Scalar potential-magnetic flux-Magnetization –Magnetic field produced by magnetized material -Magnetic scalar potential and magnetic pole density

UNIT III - ELECTRODYNAMICS

Electromagnetic induction-Faradays Law – The induced electric field – Energy in magnetic fields -Maxwell's equations- electrodynamics Before Maxwell – How Maxwell fixed Ampere's law - Maxwell's equations –Magnetic charge Maxwell's equations in matter - Boundary Conditions .

UNIT-IV-ELECTROMAGNETIC WAVES

Waves in one dimension –Thewave equation – sinusoidal waves -Electromagnetic waves in vacuum-The wave equation for E and B-Monochromatic plane waves –energy and momentum in electromagnetic waves- electromagnetic waves in Matter- propagation in linear media – reflection and transmission at normal incidence- absorption and dispersion - electromagnetic waves in conductors.

UNIT-V –POTENTIALS AND FIELDS

The Potential formulation - Scalar and Vector Potentials- Gauge Transformation - Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form – continuous distributions – retarded potentials –Jefimenko's equations – point charge - Lienard-Wiechert potentials

Text Book :

1.John R.Reitz, Fredrick J.Milford, Robert W.Christy, Foundations of Electromagnetic theory ,Third edition,Norosa Publishing House,New Delhi,1989.

UNIT – I Ch.2 (2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 2.9, 3.1,3.2, 3.3, 3.4.4.1-4.5)

UNIT – II Ch.8 (8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9,9.1,9.2,9.3)

2.David J.Griffiths,Introduction to Electrodynamics, Third edition, PHI Learning Private Limited,2012.

UNIT – III Ch.7 (7.2.1,7.2.2, 7.2.4,7.3.1-7.3.6)

UNIT – IV Ch.9 (9.1.1,9.1.2 ,9.2.1-9.2.3,9.3.1,9.3.2 &9.4.1)
UNIT – V Ch.10 (10.1.1 -10.1.4 10.2.1,10.2.2 ,10.3.1)

Reference Books:

1. Paul Lorrain and Dale Corson, Electromagnetic Fields and waves,.2 nd Edition, CBS Publishers & distributors,1986
2. Edward C.Jorden, Keith, G.Balmin,Electromagnetic waves and Radiating systems, Edward, Prentice-Hall of India.,New Delhi,1988.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I	Electric charge-Coulombs law -Electric field - Electrostatic potential- Gauss's Law-Applications of Gauss's Law-	5	Lecture, ICT&Tutorial
	electric dipole-multipole expansion of electric fields- Poisson's equation - Laplace equation-Laplace equation in one independent variable-solutions to Laplace equation in spherical coordinates-	6	Lecture, ICT&Tutorial
	Polarization -Field outside of a Dielectric medium -The electric field inside a dielectric-Gauss law in dielectric- The electric displacement – electric susceptibility and dielectric constant Pendulum	7	Lecture, ICT&Tutorial
UNIT II	Magnetic Field-Magnetic induction-force on a current carrying conductor-Biot-Savart Law-Application of Biot-Savart Law-Ampere's circuital law -	8	Lecture, ICT&Tutorial
	Magnetic vector potential-magnetic field of a distant circuit- Magnetic Scalar potential-magnetic flux-Magnetization –Magnetic field produced by magnetized material -Magnetic scalar potential and magnetic pole density	10	Lecture, ICT&Tutorial

UNIT III	Electromagnetic induction-Faradays Law – The induced electric field – Energy in magnetic fields -	6	Lecture, ICT&Tutorial
	Maxwell's equations- electrodynamics Before Maxwell – How Maxwell fixed Ampere's law -.	6	Lecture, ICT&Tutorial
	Maxwell's equations –Magnetic charge Maxwell's equations in matter - Boundary Conditions	6	Lecture, ICT&Tutorial
UNIT IV	Waves in one dimension –Thewave equation – sinusoidal waves -Electromagnetic waves in vacuum-The wave equation for E and B-Monochromatic plane waves –energy and momentum in electromagnetic waves-	9	Lecture, ICT&Tutorial
	electromagnetic waves in Matter-propagation in linear media – reflection and transmission at normal incidence-absorption and dispersion - electromagnetic waves in conductors.	9	Lecture, ICT&Tutorial
UNIT V	The Potential formulation - Scalar and Vector Potentials- Gauge Transformation - Coulomb Gauge and Lorentz Gauge –	9	Lecture, ICT&Tutorial
	Lorentz force law in potential form – continuous distributions – retarded potentials –Jefimenko's equations – point charge - Lienard-Wiechert potentials	9	Lecture, ICT&Tutorial

Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean scores of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	3	3	3	4	4	3	3	3	4	3.4
CO2	4	3	3	3	4	4	3	3	3	4	3.4

CO3	4	3	3	3	3	4	3	3	3	3	3.2
CO4	4	3	3	3	4	4	4	3	3	3	3.4
CO5	4	3	3	3	4	4	3	3	3	4	3.4
Mean Overall Score											3.3

Result: The Score for this Course is 3.3 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Total of Value Mean Score of COs = ------------------------ Total No. of Pos& PSOs			Total of Mean Score Mean Overall Score of COs =------------------------ Total No. of COs		

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	40%	40%
UNDERSTANDING	40%	40%
APPLY	20%	20%

Course Designer: G.KRISHNA BAMA Department of Physics

Programme : M.Sc.
Semester : II
Sub. Code : EQB1

Elective – II
Hours :6P/W 90Hrs P/S
Credits : 4

TITLE OF THE PAPER: Programming in C++

Pedagogy	Hours	Lecture	Peer Teaching	GD/ Vedos/Tutorial	ICT
	6	4	-	1	1

PREAMBLE: This course helps to provide the fundamental knowledge of a programming language and its features which enhances the user to write general purpose application programs.

COURSE OUTCOME At the end of the Semester, the students will be able to	**Unit**	**Hrs P/S**
CO1: identify the basic concepts needed to develop a program	1	18
CO2: list the features of object oriented programming	2	18
CO3: discuss the concept of object oriented programming**.**	3	18
CO4: use array and structure to handle volume of data	4	18
CO5: apply advanced programming concepts	5	18

SYLLABUS

UNIT I: INTRODUCTION

Identifiers & keywords - Literals – Operators – Type Conversion – Declaration of variables – Statements – Simple C++ program – Features of iostream.h – Manipulator Functions – Conditional Expressions – Switch Statement – Loop Statements - Breaking Control Statements.

UNIT II: FUNCTIONS, PROGRAM STRUCTURES & ARRAYS

Defining a function – Return statement – Types of functions – Actual and Formal Arguments – Local and Global variables – Default Arguments – Structure of the C++ program – Header files – Array Notation – Array Declaration- Array Initialization – Processing with Array – Arrays & Functions – Multidimensional Arrays – Character Array.

UNIT III : POINTERS, STRUCTURES & UNIONS

Pointer Declaration – Pointer Arithmetic – pointers and Functions – Pointers and Arrays – Pointers and Strings -Array of Pointers – Pointers to pointers – Declaration of Structure – Initialization of Structures – Arrays of Structures – Arrays within a Structure – Structures within a Structure (Nested Structure) Pointers & Structures – Unions

UNIT IV: CLASSES AND OBJECTS

Introduction – Structures and classes – Declaration of class – Member Functions – Defining the object of a class – Accessing a member of class – Array of class objects – Pointers and classes – Unions and classes – Classes within classes (nested class) – Constructors- Destructors

UNIT V : INHERITANCE AND POLYMORPHISM

Introduction – Single Inheritance – Types of Base Classes- Type of Derivation – Ambiguity in Single Inheritances- Multiple Inheritance – Polymorphism – Early Binding – Polymorphism with pointers – Virtual Functions – Constructors under Inheritance.

TEXT BOOK:

D. Ravichandran, Programming with C++ , Third edition,Tata McGraw Hill Publishing Company Ltd.,2011.
Unit I-Ch.3, 4 &5 (Sec.3.1, 3.4, 3.7-3.14, 4.2, 4.4, 4.6, 4.8, 5.1., 5.1.1. - 5.1.3., 5.2, 5.4)
Unit II-Ch. 6 & 7 (Sec.6.2 – 6.9, 6.18, 7.2 – 7.8)
Unit III-Ch.8 & 9 (Sec.8.1 - 8.3, 8.6 – 8.9, 9.2, 9.4, 9.6 - 9.10)
Unit IV-Ch.10 & 11 (Sec.10.1 – 10.10, 11.2, 11.3)
Unit V-Ch.12 & 14 (Sec.12.1 – 12.5, 12.7, 14.1 -14.4, 14.8)

REFERENCE BOOKS:

1. Yashavant Kanettkar, Let us C++, 2nd edition, BPB Publications, 2013.
2. E. Balagurusamy, Object Oriented Programming with C++ , 6th edition,

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I	Identifiers & keywords - Literals – Operators – Type Conversion – Declaration of variables – Statements – Simple C++ program	6	Lecture & ICT
	Features of iostream.h – Manipulator Functions – Conditional Expressions	6	Lecture & ICT
	Switch Statement – Loop Statements - Breaking Control Statements	6	Lecture & ICT
UNIT II	Defining a function – Return statement – Types of functions – Actual and Formal Arguments – Local and Global variables – Default Arguments	6	Lecture & ICT
	Structure of the C++ program – Header files	6	Lecture & ICT
	Array Notation – Array Declaration- Array Initialization – Processing with Array – Arrays & Functions – Multidimensional Arrays – Character Array.	6	Lecture & ICT
UNIT III	Pointer Declaration – Pointer Arithmetic – pointers and Functions – Pointers and Arrays – Pointers and Strings -Array of Pointers – Pointers to pointers	9	Lecture & ICT
	Declaration of Structure – Initialization of Structures – Arrays of Structures – Arrays within a Structure – Structures	9	Lecture & ICT

	within a Structure (Nested Structure) Pointers & Structures – Unions		
UNIT IV	Introduction – Structures and classes – Declaration of class – Member Functions	6	Lecture & ICT
	Defining the object of a class – Accessing a member of class – Array of class objects	6	Lecture & ICT
	Pointers and classes – Unions and classes – Classes within classes (nested class) – Constructors- Destructors	6	Lecture & ICT
UNIT V	Introduction – Single Inheritance – Types of Base Classes- Type of Derivation – Ambiguity in Single Inheritances- Multiple Inheritance	6	Lecture & ICT
	Polymorphism – Early Binding – Polymorphism with pointers	6	Lecture & ICT
	Virtual Functions – Constructors under Inheritance.	6	Lecture & ICT

Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean scores of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	4	2	3	3	4	3	3	2	4	3.2
CO2	4	3	2	2	4	4	3	3	2	4	3.1
CO3	4	4	3	3	3	4	3	3	3	3	3.3
CO4	4	3	2	3	3	4	3	2	3	3	3.0
CO5	4	4	3	3	4	4	3	3	2	4	3.4
Mean Overall Score											3.16

Result: The Score for this Course is3.16 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Total of Value Mean Score of COs = ------------------------ Total No. of Pos & PSOs	Total of Mean Score Mean Overall Score of COs =------------------------ Total No. of COs

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	30%	30%
UNDERSTANDING	30%	30%
APPLY	40%	40%

Course Designer: Mrs. K.Lilly Mary Eucharista Department of Physics

PHYSICS PRACTICAL - I

(NON ELECTRONICS)

CORE IV

Code:QL1 **Credit:3**

10Hrs/week

Any 15 experiments

1. Dielectric constant
2. Spectrometer Cauchy's constant
3. Owen's bridge
4. Boltzmann's constant
5. Maxwell's bridge
6. Elliptical fringes

7. Hyperbolic fringes
8. Photoelectric effect –Solar cell characteristics
9. Determination of Planck's constant
10. To verify inverse square law of radiation using a photoelectric cell
11. Anderson's bridge
12. Ultrasonic interferometer for liquids
13. Specific rotatory power – Polarimeter
14. Diffraction of a beam over a single slit (Laser)
15. Diffraction of a beam over a double slit (Laser)
16. Diffraction at circular aperture
17. Biprism – Optic Bench
18. Four probe method – Band energy gap
19. Constant deviation spectrometer- Arc spectrum
20. Solar spectrum

PHYSICS PRACTICAL - II

(ELECTRONICS)

CORE VIII

Code:QL2 **Credit:3**

10Hrs/week

Any 15 experiments

1. UJT characteristics
2. UJT Relaxation oscillator
3. Two stage amplifier with feedback
4. Series and shunt regulation with Zener diode
5. Phase – shift oscillator using Op – Amp
6. Wien's Bridge oscillator Op - Amp

7. Signal generator using Op – Amp
8. Astable Multivibrator using IC 741
9. Thermistor characteristics
10. OP – amp adder, subtractor, integrator and differentiator
11. MOSFET – characteristics
12. Astable Multivibrator using transistor
13. FET Amplifier
14. Astable Multivibrator using 555 Timer
15. Simpson's rule using C – programme
16. Trapezoidal rule using C – programme
17. Gyrator
18. Newton - Raphson method using C - programme
19. Euler's method using C – programme
20. Dual power supply
21. Solving Simultaneous Equation
22. Monostable Multivibrator using IC 741
23. D/A Converter (4 bit Binary weighted register method using IC741)
24. Monostable Multivibrator using 555 Timer

Programme : M.Sc **Part III: Core paper**
Semester : III **Hours : 6 P/W 90Hrs P/S**
Sub. Code :QC1 **Credits : 5**
TITLE OF THE PAPER: Solid state physics I

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDOES/TUTORIAL	ICT
	6	3	-	2	1

PREAMBLE: This course will expose the students to basic concepts in solid state physics, along with relevant experimental details. By the end of this course students will be able to understand the concepts of crystal binding, Fermi surface, phonons and semiconductors. Students will also learn to evaluate advanced research articles and effectively communicate scientific ideas via writing and speaking.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S

UNIT 1 CO1: explain about the crystal structure (AI)	1	18
UNIT 2 CO2: predict about Crystal binding and Elastic constant (UI)	2	18
UNIT 3 CO3: demonstrate about phonons, Debye and Einstein model of density of state, Anharmonic crystal interactions, Thermal resistivity of phonon gas (PR)	3	18
UNIT 4 CO4: explain about free electron & nearly free electron model, kronig penny model and bloch theorem (EI)	4	18
UNIT 5 CO5: interpret the semiconductors, Fermi surfaces and metals (UI)	5	18

SYLLABUS:

UNIT I : CRYSTAL PHYSICS

Periodic arrays of atoms: Lattice Translation vectors – Basis and the Crystal Structure – Primitive lattice cell – Fundamental types of lattices :Two and three dimensional lattice types – Miller indices of Crystal Planes – Simple crystal structures : NaCl, hcp – Diffraction of waves by crystals- Bragg law — Reciprocal Lattice Vectors – Laue equations – quasi crystals.

UNIT II: CRYSTAL BINDING AND ELASTIC CONSTANTS

Crystals of inert gases (Vander walls – London interaction) – Ionic Crystals (Madelung Constant) – Covalent crystals - Metals – Hydrogen bonds – Atomic Radii — Elastic Compliance and Stiffness Constants – Elastic waves in cubic crystals.

UNIT III :PHONONS

Quantization of Elastic waves (phonons) – phonon momentum – Inelastic scattering by phonons – phonon heat capacity – plank distribution- Density of states in one and three dimension – Debye and Einstein model of density of state– Anhamonic crystal interactions – Thermal resistivity of phonon gas – umklapp processes.

UNIT IV : FREE ELECTRON FERMI GAS

Free electron gas in three dimensions – Heat capacity of the electron gas- Electrical conductivity and ohms law– Hall effect – Wiedmann Franz law, Nearly Free Electron Model : Origin and Magnitude of energy gap – Bloch functions – Kronig Penny Model – wave equation of an electron in a periodic potential : Bloch theorem-crysatal momentum of an electron.

UNIT V: SEMI CONDUCTORS, FERMI SURFACES AND METALS

Band gap – Equations of Motions – Effective Mass –physical inter pretation of the effective mass- Fermi Surface and Metals : Reduced Zone Scheme – Periodic Zone Scheme – Construction of Fermi Surfaces- Fermi surface of Cu - Calculation of energy band : Tight binding method - Wigner Seitz method –Idea of de Has Van Alphen Effect

TEXT BOOKS:

Charles Kittel, Introduction to Solid State Physics VII Edition Wiley India Pvt. Ltd., 2011.

Unit I-Ch. 1& 2 (pg3-19, 29-34, 36,37,48,49)
Unit II-Ch. 3 (pg55-62, 66-79, 83-90)
Unit III-Ch. 4 & 5(pg107-111, 117-130, 133-137)
Unit IV-Ch. 6 & 7(146-155, 156-159, 164-167, 176-186)
Unit V-Ch.8 & 9. (pg199-206, 209-212, 235-242, 244-252,262)

REFERENCE BOOKS:

1. S.O.Pillai ,Solid state physics - V Edition New Age Int. Ltd.
2. J.P.Srivastava, Elements of Solid state physics- Prentice-Hall of India Pvt. Ltd.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I	Periodic arrays of atoms: Lattice Translation vectors – Basis and the Crystal Structure – Primitive lattice cell	6	Lecture, Tutorial & ICT
	Fundamental types of lattices :Two and three dimensional lattice types – Miller indices of Crystal Planes	5	Lecture, Tutorial & ICT
	Simple crystal structures : NaCl, hcp – Diffraction of waves by crystals- Bragg law — Reciprocal Lattice Vectors – Laue equations – quasi crystals.	7	Lecture, Tutorial & ICT
UNIT II	Crystals of inert gases (Vander walls – London interaction) –	6	Lecture, Tutorial & ICT

	Ionic Crystals (Madelung Constant)		
	Covalent crystals - Metals – Hydrogen bonds – Atomic Radii	6	Lecture, Tutorial & ICT
	Elastic Compliance and Stiffness Constants – Elastic waves in cubic crystals.	6	Lecture, Tutorial & ICT
UNIT III	Quantization of Elastic waves (phonons) – phonon momentum – Inelastic scattering by phonons	5	Lecture, Tutorial & ICT
	phonon heat capacity – plank distribution- Density of states in one and three dimension – Debye and Einstein model of density of state–	8	Lecture, Tutorial & ICT
	Anhamonic crystal interactions – Thermal resistivity of phonon gas – umklapp processes.	5	Lecture, Tutorial & ICT
UNIT IV	Free electron gas in three dimensions – Heat capacity of the electron gas- Electrical conductivity and ohms law	7	Lecture, Tutorial & ICT
	Hall effect – Wiedmann Franz law, Nearly Free Electron Model : Origin and	6	Lecture, Tutorial & ICT

	Magnitude of energy gap – Bloch functions		
	Kronig Penny Model – wave equation of an electron in a periodic potential : Bloch theorem-crysatal momentum of an electron.	5	Lecture, Tutorial & ICT
UNIT V	Band gap – Equations of Motions – Effective Mass –physical inter pretation of the effective mass-	6	Lecture, Tutorial & ICT
	Fermi Surface and Metals : Reduced Zone Scheme – Periodic Zone Scheme – Construction of Fermi Surfaces- Fermi surface of Cu	6	Lecture, Tutorial & ICT
	Calculation of energy band : Tight binding method - Wigner Seitz method –Idea of de Has Van Alphen Effect	6	Lecture, Tutorial & ICT

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	3	4	3	3	3	3	3	5	3.4
CO2	5	3	4	3	5	3	3	4	3	4	3.7
CO3	3	3	3	3	3	3	5	4	3	4	3.4

CO4	3	3	4	3	3	3	5	4	3	4	3.5
CO5	4	3	3	4	4	3	3	4	4	3	3.5
Mean Overall score											3.5

Result: The Score for this Course is 3.5 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Mean Score of COs = Total of Value / Total No. of Pos & PSOs			Mean Overall Score of COs = Total of Mean Score / Total No. of COs		

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	30%	30%
UNDERSTANDING	30%	30%
APPLY	40%	40%

Programme :M.Sc PHYSICS **PART III : Core**
Semester : III **Hours : 6 P/W, 90 Hrs P/S**
Sub code : QC2 **Credits : 5**
TITLE OF THE PAPER : QUANTUM MECHANICS - II

Pedagogy	**Hours**	**Lecture**	**Peer teaching**	**TUTORIAL**	**ICT**
	6	**3**	**1**	**1**	**1**

PREAMBLE :

The aim of this course is to give a reasonably comprehensive introduction to the fundamental concepts, mathematical formalism and methodology of quantum mechanics. Effort has been taken to make this course more upto date with latest developments in quantum mechanics.

COURSE OUTCOME At the end of the Semester, the students will be able to	**UNIT**	**Hrs P/S**
UNIT 1 CO1 : SCATTERING **PROGRAMME OUTCOME :**	1	19

PART – A 1. acquire knowledge about types of scattering.(K) 2. list types of cross sections. (K) 3. understand the concepts of scattering amplitude.(U) 4. solve the problems related to the properties of scattering wave.(P) 5. analyse the scattering mechanism.(A) 6. design a schematic representation for any scattering event.(S) 7. develop skills in solving any quantum mechanical problem.(C) 8. assess the properties of a beam.(E) **PART – B** 1. acquire knowledge about the concept of scattering cross section.(K) 2. understand different types of scattering cross section.(U) 3. understand the various factors related to the flux of a scattered beam(U) 4. understand momentum transfer during scattering process.(U) 5. apply Green's function for deriving the expression for scattering amplitude.(P) 6. analyse the radial and angular part of a wave.(A) 7. integrate the mathematical equations related to the scattering wave.(S) 8. develop skills in doing any mathematical problems related to linear algebra and probability determination of any scattering wave.(C) 9. assess the asymptotic behaviour of a wave. (E) **PART – C** 1. acquire knowledge about kinematics of scattering process.(K) 2. understand the derivation of scatting amplitude.(U) 3. determine the phase shifts produced by any given potential during scattering.(P) 4. analyse wave mechanical picture of scattering.(A) 5. modify, substitute and rearrange any mathematical wave equations and can able to derive new one.(S) 6. design an equation by solving any scattering equations.(C) 7. explain the validity of Born approximation using the concept of Born approximation.(E) **PROGRAMME SPECIFIC OUTCOME** : At the end of the semester , the students will able to **PART - A** 1. define angle of scattering.[K(I)]		

2. know what is plane of scattering[K(I)]
3. understand what is scattering amplitude.[U(I)]
4. understand what is flux of a scattered beam. [U(I)]
5. determine the incident flux of a particle travelling with the particular velocity.[P(I)]
6. analyse the relation between scattering amplitude and proportionality factor.[A(I)]
7. analyse the relation between number of particles scattered and incident flux.[A(I)]
8. assess the variation of differential scattering cross section with scattering angle.[E(I)]
9. assess the relation between proportionality factor and scattered flux.[E(I)]
10. modify the distortion equation to derive the eqution for validity of Born approximation.[S(I)]
11. develop the skill of determining the properties of a wave.[C(I)]
12. explain what is Green fuction.[E(I)]
13. explain what is optical theorem.[K(R)]

PART – B

1. acquire knowledge about what is cross section, differential cross section and total scattering cross section.[K(R)]
2. discuss Born approximation in detail.[U(M)]
3. apply Born approximation, inorder to calculate differential and total scattering cross section for scatter of a particles of mass m of the f-function potential V=gf(v).[P(M)]
4. analyse the expression for total scattering cross section interms of scattering angle. [A(R)]
5. substitute green's function to derive the expression for scattering amplitude.[S(R)]
6. prove optical theorem.[K(M)]
7. develop the skills of integrating the scattering equations.[C(R)]
8. explain the asymptotic form of radial equations.[E(M)]
9. evaluate the phase shift produced by a given potential .[E(M)]
10. analyse the asymptotic behaviour of partial waves.[A(M)]

PART – C

1. acquire knowledge about the kinematics of scattering process.[K(M)]
2. discuss wave mechanical picture of scattering and to derive the expression for scattering amplitude.[U(M)]
3. apply the theory of Born approximation and to discuss its validity for the scattering by a potential.[P(M)]
4. analyse the partial wave, asymptotic form of radial equation and asymptotic behaviour of partial waves to derive the expression for phase shift. [A(M)]

5. evaluate the scattering cross section in the Born approximation for scattering by a screened coulomb potential.[E(M)] 6. derive the expression for scattering amplitude interms of phase shift.[S(M)] 7. explain optical theorem using differential and total scattering cross section.[E(M)]		
UNIT 2 CO2 : PERTURBATION THEORY **PROGRAMME OUTCOME :** **PART - A** 1. acquire knowledge about what is propagator.(K) 2. know about sudden approximation.(K) 3. understand the concept of retarded propagators.(U) 4. understand exchange effect.(U) 5. determine the propagator for a free particle.(P) 6. analyse the operators.(A) 7. design a schematic diagram for first order transition.(S) 8. develop the skills to derive quantum mechanical equations.(C) 9. explain the concept of transition.(E) **PART – B** 1. know the time dependant and time independent Schrodinger equation.(K) 2. understand the selection rules.(U) 3. discuss different types of perturbations.(U) 4. solve the Heisenberg equations in motion for a harmonic oscillator.(P) 5. analyse the transitions.(A) 6. differentiate and integrate any mathematical quantum equations of quantum mechanics.(S) 7. develop skills in deriving quantum equations.(C) 8. explain path integral representation for propagators.(E) **PART – C** 1. know the general concepts of path integrals in quantum mechanics.(K) 2. understand the role of alteration of Hamiltonian.(U) 3. calculate the probability for spontaneous radiative transitions.(P)	2	20

4. analyse the perturbation theory for time evolution problem.(A).
5. modify any new quantum mechanical equations by substituting and rearranging the equations.(S)
6. design propagator for a free particle by path integral approach.(C)
7. explain perturbative solutions for transition amplitude.(E)

PROGRAMME SPECIFIC OUTCOME :

PART – A

1. define perturbation.[K(M)]
2. define harmonic perturbation.[K(I)]
3. understand what is propagator.[U(I)]
4. understand what is sudden approximation.[U(M)]
5. understand what is exchange effect.[U(I)]
6. apply transition amplitude inorder to write the expression for sudden approximation.[P(M)]
7. analyse transition amplitude.[A(R)]
8. analyse the difference between first order and second order transition.[A(I)]
9. design retarded green's function using green's function.[C(R)]
10. compare propagator and retarded propagator.[E(R)]

PART – B

1. discuss about propagators.[U(M)]
2. acquire knowledge about the concept of sudden approximation.[K(M)]
3. discuss the selection rules for allowed and forbidden transition.[U(R)]
4. show that the operator of a Green's function G'(xx':w)= (-2im/t)1/4*3.14e-x(x-x')/(x-x').[P(I)]
5. analyse path integrals in quantum mechanics.[A(M)]
6. synthesize perturbation method for solving time evolution problem.[S(M)]
7. derive solution to Schrodinger equation.[S(R)]
8. explain how sudden approximation alter the Hamiltonian of the system during transition.[E(M)]
9. explain first order transition by constant perturbation.[E(M)]
10. assess second order transition by constant perturbation.[E(M)]
11. explain exchange effect.{E(M)]

PART – C

<table>
<tr><td>1. acquire brief knowledge about the concept of propagators.[K(M)]
2. discuss the first order time dependant perturbation theory and derive the Fermi-Golden rule for transition rate from a given initial state to a final state continuum.[U(M)]
3. derive perturbative solution for transition amplitude.[P(M)]
4. analyse the relation between retarded propagator and green’s function of a time independent Schrodinger equation. [A(M)]
5. synthesize path integral representation for a propagator.[S(M)]
6. explain Aharonov-Bohm effect in detail.[E(M)]
7. explain first order transition by constant perturbation.[E(M)]
8. explain harmonic perturbation.[E(M)]</td><td></td><td></td></tr>
<tr><td>UNIT 3 CO3 : RELATIVISTIC WAVE EQUATION
PROGRAMME OUTCOME :
PART – A
1. recollect Schrodinger equation.(K)
2. understand charge density.(U)
3. understand the non-relativistic limit(U)
4. apply Schrodinger equation to write Klien -Gordan equation.(P)
5. analyse the particles related to Klien-Gordan equation.(A)
6. synthesize relativistic equation.(S)
7. develop the skills in writing mathematical expression for relativistic equation.(C)
8. assess the Schrodinger equation and relativistic equation.(E)
PART – B
1. know relativistic equation and non-relativistic equation.(K)
2. understand the derivation of Klien-Gordan equation.(U)
3. understand the merits and demerits of relativistic equation.(U)
4. apply wave function to solve Klien-Gordan equation.(P)
5. analyse the Schrodinger equation.(A)
6. derive the equations of energy level.(S)
7. develop skills to solve the mathematical equations.(C)
8. assess the exact radial functions.(E)</td><td>3</td><td>17</td></tr>
</table>

PART – C

1. know the generalization of Schrodinger equation.(K)
2. understand the energy level determination.(U)
3. obtain eigen function from a Klien-Gordan equation.(P)
4. analyse non-relativistic limit.(A)
5. derive charge density and expectation value.(S)
6. develop skills to find exact radial functions.(C)
7. assess the interaction of hydrogen like atoms with electromagnetic field.(E)

PROGRAMME SPECIFIC OUTCOME :

PART – A

1. know the relativistic expression for energy.[K(I)]
2. understand about operators.[U(I)]
3. write the schrodinger wave equation for a particle travelling at the speed of light[K(I)
4. differentiate charge and current density.[U(M)]
5. understand what is non-relativistic limit.[U(M)]
6. analyse continuity equation.[A(I)]
7. modify schrodinger equation into Klien-Gordan equation.[S(I)]
8. decide which type of particles associated with Klien-Gordan equation.[C(I)]
9. explain what is fine structure constant.[E(I)]
10. assess the change in energy for non-relativistic case.[E(I)]

PART – B

1. acquire knowledge about non-relativistic limit.[K(M)]
2. understand the concept behind the need to convert Schrodinger equation to relativistic equation.[U(M)]
3. understand the merits and demerits of Klien-Gordan equation[U(M)]
4. show that the commutator [Nx,Nz] = 0 for a system of bosons.[P(M)]
5. analyse fine structure constant.[A(M)]
6. derive solution of radial function.[S(M)]
7. convert the Schrodinger equation into Klien-Gordan equation.[C(M)]
8. explain how Klien-Gordan equation is used to determine charge and current density.[E(M)]

PART – C

1. acquire knowledge about the concept of exact solutions of relativistic radial wave functions and to compare them with non-relativistic case.[K(M)]

2. understand the concept of generalization of Schrodinger wave equation.[U(M)] 3. Determine Schrodinger wave eigen functions of the Klien-Gordan equation for a particle in a three dimensional square well potential with V(r) = -V0 for r<a & V(r) = 0 for r>a.[P(M)] 4. analyse the interaction of hydrogen like atom with electromagnetic field.[A(M)] 5. obtainKlien-Gordan equation for a charged particle in an electromagnetic field. Show that is equation reduces to the Schrodinger equation of motion for the particle in an electromagnetic field in the non-relativistic limit.[C(M)] 6. derive the expression for energy value due to the interaction of hydrogen atom with electromagnetic field.[S(M)] 7. evaluate the quantized energy value of hydrogen atoms. [E(M)]		
UNIT 4 CO4 :THE DIRAC EQUATION **PROGRAMME OUTCOME :** **PART – A** **1.** acquire knowledge about relativistic wave equation.(K) **2.** acquire knowledge about expectation value.(K) 3. differentiate Dirac Hamiltonian and classical Hamiltonian(U) 4. show that any Dirac matrix must be of even order.(P) 5. analyse the expectation value.(A) 6. modify Schrodinger equation into Dirac equation.(S) 7. design a 2*2 Dirac matrix which obeys the constraints on alpha and beta.(C) 8. explain what is position probability density.(E) 9. explain what is probability current density. (E) **PART – B** 1. know the constriction on alpha and beta.(K) 2. understand the derivation of Dirac Hamiltonian from first order Schrodinger equation.(U) 3. show that the two matrices anticommute with each other.(P) 4. analyse the Dirac matrix.(A) 5. synthesize any new Dirac matrix.(S) 6. develop the skill of solving Dirac equation.(C) 7. assess the role of negative energy states.(E) **PART – C** 1. know the relation between quantum mechanics and linear algebra.(K)	4	17

2. know the significance of negative energy states.(K) 3. understand the concept of Dirac particle in electromagnetic field.(U) 4. solve any Schrodinger equation by themselves for simple systems.(P) 5. analyse the concept of angular momentum and spin of an electron.(A) 6. derive the expression for position probability density, current density and expectation value from Dirac equation.(S) 7. solve any plane wave equation.(S) 8. develop the ability for solving any quantum mechanical problems.(C) 9. evaluate the eigen value and eigen functions of any wave equations.(E) **PROGRAMME SPECIFIC OUTCOME :** **PART – A** 1. acquire knowledge about first order Schrodinger equation.[K(I)] 2. recollect what is hole[K(I)] 3. differentiate electron and positron.[U(I)] 4. understand the assumptions made by Dirac.[U(I)] 5. show the given matrices are Dirac's matrices.[P(R)] 6. analyse the constrictions on alpha and beta .[A(R)] 7. modify the classical Hamiltonian into Dirac's Hamiltonian using the assumptions given by Dirac.[S(M)] 8. design a Dirac matrix which suits for a particle having spin ½.[C(I)] 9. prove that two matrices , commute with each other.[E(I)] 10. explain what are negative energy states.[E(I) **PART – B** 1. show that the electron is endowed with spin ½.[K(R)] 2. understand the method to find position probability density and expectation value.[U(M)] 3. show that the eigen values of number operator N are 0 and 1 for a system of fermions.[P(M)] 4. analyse the significance of negative energy states.[A(R)] 5. create Dirac equation using Schrodinger time dependent equation .[S(M)] 6. design the 4*4 Dirac matrix which satisfies the essential constraints on alpha and beta.[C(R)] 7. explain the existence of Dirac particle in electromagnetic field.[E(M)] 8. explain the method to find solution of plane wave equation.[E(M)]		

9. explain energy spectrum.{E(R)} **PART – C** 1. acquire knowledge about construction of any Dirac matrix using Pauli's matrices.[K(M)] 2. understand the significance of negative energy states and Dirac particle in electromagnetic field.[U(R)] 3. find the spin of Dirac particle.[P(M)] 4. Arrive the plane wave solutions of Dirac's relativistic equations for a free particle and give the reason for the existence of two energy solutions.[S(R)] 5. determine the eigen value and eigen functions of plane wave using Dirac's relativistic equation.[C(M)] 6. design any Dirac matrix using the matrics of alpha and beta and can able to prove the given matrices are Dirac matrices.[C(M)] 7. explain the method of deriving Dirac equation from first order schrodinger equation and to derive position probability density and expectation value.[E(M)]		
UNIT 5 CO5 : QUANTIZATION OF WAVE FIELDS **PROGRAMME OUTCOME :** **PART – A** 1. acquire knowledge about quantization.(K) 2. understand first quantization.(U) 3. understand second quantization(U) 4. prove the given operator is a creation operator.(P) 5. analyse the operators.(A) 6. modify any classical equation into first quantized equation.(S) 7. develop the skills to find the conjugate of any equation.(C) 8. explain the quantum equations.(E) 9. write the energy of quantized field.(S) **PART – B** 1. know about the conversion of classical equation into second quantized equation.(K) 2. understand the concept of Hamiltonian density and Lagrangian density.(U) 3. determine number operator.(P) 4. analyse the maxwell's equation in lagrangian form.(A) 5. design matrix elements for creation and destruction operator.(S) 6. derive any quantum mechanical equations using quantum equations.(C)	5	17

7. explain the method of converting Maxwell's equation into lagrangian equation.(E) **PART – C** 1. acquire knowledge about quantum equations.(K) 2. understand about creation, destruction and number operators.(U) 3. determine the second quantized equation for any classical equations.(P) 4. analyse the quantization of fields.(A) 5. synthesize quantum equations from Maxwell's equation in vacuum.(S) 6. develop skills in solving the quantized equations and to determine the physical parameters.(C) 7. explain the determination of energy of quantized field.(E) **PROGRAMME SPECIFIC OUTCOME :** **PART – A** 1. list basic quantum equations.[K(R)] 2. list the basic Maxwell's equation for a particle in electromagnetic field.[K(I)] 3. define Lagrangian density.[K(I)] 4. understand Hamiltonian density.[U(I)] 5. differentiate first quantization and second quantization.[U(R)] 6. apply wave equation to find number operator.[P(I)] 7. analyse the destruction operator.[A(R)] 8. modify classical equation into first quantized equation.[S(R)] 9. determine the energy of quantized field[S(I)] 10. design the Maxwell's equation in quantum form.[C(M)] 11. explain what is number operator.[E(R)] **PART – B** 1. acquire knowledge about use of quantum equations in solving various quantum mechanical equations.[K(M)] 2. understand electromagnetic fields in vacuum and in media.[U(I)] 3. determine the number operator using any given wave functions.[P(R)] 4. analyse the difference between quantized equations and classical equations.[A(M)] 5. modify Lagrangian density and Hamiltonian density equations into Lagrangian and Hamiltonian equations.[S(M)] 6. design the matrix elements for creation and destruction operator.[C(M)] 7. assess the difference between creation and destruction operator.[E(M)]		

8. explain how energy value of quantized field can be determined.[E(M)]

PART – C

1. acquire knowledge briefly about all quantum equations .[K(M)]
2. understand the concept of quantization of non-relativistic schrodinger equation.[U(M)]
3. apply the concept of quantization to find first quantized and second quantized equations for the given classical equations.[P(M)]
4. analyse the functions of creation, destruction and number operators .[A(M)]
5. modify the Maxwell's equation in classical form into Lagrangian and quantum form.[S(M)]
6. derive the expression for energy value of quantized field.[C(M)]
7. explain the concept of quantization of fields.[E(M)]

SYLLABUS

SEMESTER III

CORE X

QUANTUM MECHANICS-II

Credit:5
Code: QC2
6Hrs/week

UNIT-I:SCATTERING

Kinematics of the scattering process; differential and total cross section-wave mechanical picture of scattering; the scattering amplitude- Green's function; formal expression for scattering amplitude –the Born approximation-validity of the Born approximation- asymptotic behavior of partial waves; phase shifts- the scattering amplitude in terms of phase shifts - the differential and total cross sections; optical theorem

UNIT-II: PERTURBATION THEORY

The Schrodinger equation general solution-propagators-relation of retarded propagator to the Green's function of the time independent Schrodinger equation-alteration of Hamiltonian;transitions;sudden approximation-path integrals in Quantum mechanics-Aharonov-Bohm effect-perturbative solutions for transition amplitude, selection rule, First order transition – constant perturbation - exchange effects-harmonic perturbations.

UNIT-III: RELATIVISTIC WAVE EQUATION

Generalization of the Schrodinger equation-plane wave solutions;charge and current densities-Interaction with electromagnetic fields;Hydrogen-like atom-non relativistic limit-determination of the energy levels-exact radial wave functions;comparition to non relativistic case.

UNIT-IV: THE DIRAC EQUATION

Dirac Relativistic Hamilton-Position Probability Density;Expectation Values-Dirac Matrices-Plane Wave solutions of the Dirac equations-energy spectrum-the spin of the Dirac particle-significance of negative energy states;Dirac particle in electromagnetic field.

UNIT-V: THE QUANTIZATION OF WAVE FIELDS

Quantization of the nonrelativistic Schrodinger equation-Quantum Equations-Creation,Destruction and Number Operators-Electromagnetic Field in Vacuum(Lagrangian&Quantum Equations)-Quantized Field Energy- Quantization of the Fields.

TEXT BOOKS:

1. P.M.Mathews, K.Venkatesan, **A text book of Quantum Mechanics,**TMH, New Delhi, 2012.
   Unit - I Ch. 6 (sec 6.1 – 6.5, 6.8 – 6.10)
   Unit - II Ch. 9 (sec 9.1 - 9.9, 9.14)
   Unit - III Ch.10 (sec 10.1 - 10.4, 10.14 & 10.15)
   Unit - IV Ch.10 (sec 10.5 - 10.10)
2. Leonard I.Schiff, **Quantum Mechanics,** 3rdedition,TMH, New Delhi, 1968.
   Unit - V (Pg. 498 – 500, 503, 508, 516, 525)

REFERENCE BOOKS:

1. S.L.Kakani, H.M.Chandalia, **Quantum Mechanics, theory and problems ,** 4th edition, Sultan chand& Sons, 2004 .
2. Satyaprakash& Swati Satya, **Quantum Mechanics,**KedarNath Ram Nath& Co., 2006.
3. Aruldhas.J, **Quantum Mechanics,** Prentice Hall of India, 2012
4. Merzbacher.E , **Quantum Mechanics** ,John Wiley, 2004.
5. Ghatak.A, **Introduction to Quantum Mechanics,**Macmilan, 1996.
6. J.J.Sakurai, **Modern Quantum Mechanics,** Addison Wesley,1994.
7. J.J.Sakurai, **Advanced Quantum Mechanics,** Addison Wesley,1994.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT – I	Kinematics of scattering process : differential and total scattering cross section	2	(L) , (I)
	Wave mechanical picture of scattering : the scattering amplitude	2	(L) , (I)
	Greens function : formal expression for scattering amplitude	3	(2L) , (T)
	The Born approximation	2	(L) , (P)
	Validity of Born approximation	3	(2L) , (T)
	Asymptotic behaviour of partial waves : phase shifts	3	(L) , (I),(T)
	The scattering amplitude interms of phase shifts	2	(L) , (P)
	The differential and total cross sections : optical theorem	2	(L) , (P)
UNIT –II	The Schrodinger equation :general solution	1	(L)
	Propagators	2	(L),(I)
	Relation of retarded propagator to the Green's function of the time independent Schrodinger equation	2	(L),(T)
	Alteration of Hamiltonian : transitions ; sudden approximation	2	(L),(T)
	Path integrals in quantum mechanics	2	(L),(I)
	Aharonov - Bohm effect	2	(L),(T)
	Perturbative solutions for transition amplitude	2	(L),(P)
	Selection rules	2	(L),(P)

	First order transition : constant perturbation	2	(L),(I)
	Inelastic scattering : exchange effect	1	(L)
	Harmonic perturbation	2	(L),(P)
UNIT-III	Generalization of Schrodinger equation	2	(L),(I)
	Plane wave solutions ; charge and current densities	3	(L),(I)(P)
	Interaction with electromagnetic fields ; Hydrogen-like atom	3	(2L),(T)
	Non-relativistic limit	2	(L),(I)
	Determination of the energy levels	3	(L),(T),(P)
	Exact radial wave functions; comparison to non-relativistic case	4	(2L),(T),(P)
UNIT-IV	Dirac relativistic Hamilton	2	(L),(P)
	Position probability density ; expectation values	2	(L),(T)
	Dirac matrices	3	(L),(P),(I)
	Plane wave solutions of Dirac equations ; energy spectrum	4	(2L)(T),(I)
	The spin of the Dirac particle	2	(L),(T)
	Significance of negative energy states	2	(L),(P)
	Dirac particle in electromagnetic field	2	(L),(I)
UNIT-V	Quantization of the non-relativistic Schrodinger equations	2	(L),(I)
	Quantum equations	3	(2L),(P)
	Creation, destruction and Number operators	2	(L),(I)
	Electromagnetic field in vacuum (Lagrangian& Quantum equations)	4	(2L),(T),(I)
	Quantized field energy	3	(L),(P),(T)
	Quantization of the fields	3	(L),(T),(P)

Cource outcomes (Cos)	**Programme Outcomes (Pos)**							**Programme Specific Outcomes (PSOs)**							**Mean scores of Cos**
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	
CO1	4	5	3	3	3	3	3	6	4	3	5	3	2	7	3.85
CO2	4	5	3	3	3	3	3	4	6	3	4	3	1	4	3.50
CO3	3	5	3	3	3	3	3	4	6	2	3	3	3	4	3.43
CO4	5	3	3	3	4	3	4	4	4	3	2	3	4	6	3.64
CO5	3	4	3	3	4	3	3	5	4	3	3	4	3	3	3.43

	Mean Overall Score	3.57

The Score for this course is 3.57 , Quality - High

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	50%	50%
UNDERSTANDING	30%	30%
APPLY	20%	20%

Course Designer : J.S.P.CHITRA , Department of PHYSICS

Programme : M.Sc **Part III: Core**
Semester : III **Hours : 5 Hrs /W 75 Hrs P/S**
Sub. Code : QC3 **Credits : 4**

TITLE OF THE PAPER: Molecular Spectroscopy

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDOES/TUTORIAL	ICT
	5	2	1	1	1

PREAMBLE: In depth knowledge and understanding of Molecular Spectroscopy and its applications.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
UNIT 1 CO1: understand the theory of rotational spectra of a rigid diatomic molecule and Stark effect.	1	15
UNIT 2 CO2: classify the vibrating diatomic molecule on the basis of its type of vibration. analyze the effect of rotation on the vibration (Vibrating rotator)	2	15
UNIT 3 CO3: associate rotation and vibration of the molecules with the electronic transition leading to electronic spectroscopy. discuss Raman Scattering with the effect of rotation and vibration of molecules.	3	15
UNIT 4 CO4: understand NMR and ESR with its applications.	4	15

UNIT 5 CO5: explain XRD, fluorescence and UV Spectroscopy.	5	15

SYLLABUS

UNIT I: Microwave Spectroscopy:

Introduction – Rotational spectra of Rigid Diatomic molecule – Isotope effect, Intensity of rotational lines – Non Rigid Rotator – Vibrational Excitation effect – Linear poly atomic molecules – Symmetric and Asymmetric Top molecules, Stark effect, Microwave spectrometer, Applications.

UNIT II: Infrared Spectroscopy

Vibrational energy of a diatomic molecule, vibrating diatomic molecule, diatomic vibrating Rotator, asymmetry of Rotation – Vibration band – Normal vibration of CO_2 and H_2O molecule, IR spectrophotometer, FTIS – Applications.

UNIT III: Electronic Spectroscopy of Molecules & Raman Scattering:

Introduction–Vibrational coarse structure, Franck-Condon Principle, Rotational fine structure of Electronic-Vibration spectra, Theory of Raman scattering, Rotational and vibrational Raman Spectra, Mutual Exclusion principle, Raman Spectrometer.

UNIT IV: Nuclear Magnetic Resonance & Electron spin Resonance

Magnetic properties of nuclei – Resonance condition, NMR instrumentation– Bloch equations,–NMR imaging. Principle of ESR, ESR spectrometer- Hamiltonian, Hyperfine structure.

UNIT V: XRD, Fluorescence Spectroscopy, UV Spectroscopy

X-Ray Diffraction Methods – Applications, Florescence methods, crystal Tonography, Origin and theory of UV Spectra, Types of transitions of Organic and Inorganic molecules, Uv absorption cuve shape, transition probability and choice of solvent.

TEXT BOOKS:

1. G Aruldhas **Molecular Structure and Spectroscopy** - II Edn. 2007 Prentice Hall of India
   Unit I. Ch. 6 (sec. 6.1 to 6.11, 6.14, 6.15)
   Unit II. Ch 7 (sec. 7.1 to 7.7, 7.16, 7.18, 7.19)
   Unit III. Ch 8 (sec.8.1 to 8.6) , Ch 9. (sec. 9.1, 9.2, 9.6, 9.7, 9.9, 9.10, 9.11)
   Unit IV. Ch 10 (sec. 10.1 to 10.3, 10.5 to 10.8, 10.19), Ch 11 (sec. 11.1 to 11.5)
2. Gurdeep R Chatwaal & Shyam K Anand **Spectroscopy –** V Edn. 2002 Himalaya Publishing house
   Unit V. Chapter 12. (sec. 12.7 to 12.10, 6.1 to 6.6, 6.10)

REFERENCES:

1. G.M.Barrow **Molecular Spectroscopy** International Student Edn. MC Graw Hill International Company 1984
2. C.N. Banwell **Introduction to Molecular Spectroscopy** III Edn

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT 1			
	Introduction – Rotational spectra of Rigid Diatomic molecule – Isotope effect, Intensity of rotational lines	5	Lecture, teaching, GD, ICT
	Non Rigid Rotator – Vibrational Excitation effect – Linear poly atomic molecules – Symmetric.	5	Lecture, teaching, GD, ICT
	Asymmetric Top molecules, Stark effect, Microwave spectrometer, Applications.	5	Lecture, teaching, GD, ICT
UNIT 11			
	Vibrational energy of a diatomic molecule, vibrating diatomic molecule,		Lecture, teaching, GD, ICT
	diatomic vibrating Rotator, asymmetry of Rotation – Vibration band –		Lecture, teaching, GD, ICT
	Normal vibration of CO_2 and H_2O molecule, IR spectrophotometer, FTIS – Applications.		Lecture, teaching, GD, ICT
UNIT III			
	Introduction–Vibrational coarse structure,		Lecture, teaching, GD, ICT

	Franck-Condon Principle,		
	Rotational fine structure of Electronic-Vibration spectra, Theory of Raman scattering,		Lecture, teaching, GD, ICT
	Rotational and vibrational Raman Spectra, Mutual Exclusion principle, Raman Spectrometer.		Lecture, teaching, GD, ICT
UNIT IV			
	Magnetic properties of nuclei – Resonance condition, NMR instrumentation–		Lecture, teaching, GD, ICT
	Bloch equations,–NMR imaging.		Lecture, teaching, GD, ICT
	Principle of ESR, ESR spectrometer-Hamiltonian, Hyperfine structure.		Lecture, teaching, GD, ICT
UNIT V			
	X-Ray Diffraction Methods – Applications,		Lecture, teaching, GD, ICT
	Florescence methods, crystal Tonography, Origin and theory of UV Spectra,		Lecture, teaching, GD, ICT
	Types of transitions of Organic and Inorganic molecules, UV absorption cuve shape, transition probability and choice of solvent.		Lecture, teaching, GD, ICT

Course Outcomes (Cos)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						Mean scores of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	4	4	3	3	4	4	4	4	3	3	3.54
CO2	3	4	4	3	3	4	4	4	4	3	3	3.54
CO3	3	4	4	3	3	4	4	4	4	3	3	3.54
CO4	3	4	4	3	3	4	4	4	4	3	3	3.54
CO5	3	4	4	3	3	4	4	4	4	3	3	3.54
Mean Overall Score												

Result: The Score for this Course is 3.54 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Mean Score of Cos = Total of Value / Total No. of Pos & PSOs	Mean Overall Score of Cos = Total of Mean Score / Total No. of Cos

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	30%	30%
UNDERSTANDING	30%	30%
APPLY	20%	20%
ANALYZE	20%	20%

Programme : M..Sc **ELECTIVE PAPER III**

Semester :III **Hours : 5 P/W 75 Hrs P/S**

Credits : 4 **Sub. Code : EQC1**

TITLE OF THE PAPERCRYSTAL GROWTH AND THIN FILMS

<table>
<tr><td rowspan="2">Pedagogy</td><td>Hours</td><td>Lecture</td><td>Peer Teaching</td><td>GD/ Vedos/Tutorial</td><td>ICT</td></tr>
<tr><td>5</td><td>3</td><td>-</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">PREAMBLE: To understand the theories of nucleation, various methods of crystallization and characterization techniques used for thin films</td></tr>
</table>

COURSE OUTCOME At the end of the Semester, the students will be able to	**Unit**	**Hrs P/S**
CO 1 : know the theories of nucleation and derive equations for various types of nucleus	1	15
CO 2: understand various methods of crystallization	2	15
CO 3:explain the principle and working of vapour and gel growth methods	3	15
CO 4:gain knowledge in various methods used for synthesis of thin films	4	15
CO 5:appreciate the various characterization techniques used for thin films	5	15

SYLLABUS

UNIT I: NUCLEATION

Theories of nucleation – Classical theory of nucleation– Gibbs Thomson equation for vapour, melt solution– Energy of formation of a nucleus–Spherical nucleus – Cylindrical nucleus–Heterogeneous Nucleation – Cap- shaped nucleus–Disc-shaped nucleus.

UNIT II: SOLUTION GROWTH

Low temperature solution growth –Solution, solubility and supersolubility–Expression of supersaturation– Methods of crystallization – Crystallization by slow cooling of solution–Crystallization by solvent evaporation–Temperature gradient method–Crystal growth system –Constant temperature bath

UNIT III : VAPOUR AND GEL GROWTH TECHNIQUES

Vapour Growth–Physical Vapour Deposition–Chemical Vapour Deposition–Advantages of CVD–Disadvantages of CVD–Chemical Vapour Transport–Gel Growth–Principle–Various Types ,Structure of gel–Growth of Crystals in gels–Experimental Procedure –Single and Double diffusion method–Chemical reduction method–Complex -decomplexion method–Solubility reduction method–Biological Crystallization.

UNIT IV: THIN FILMS

Introduction –Nature of Thin films —Electron beam method – Cathodic sputtering -Reactive sputtering- Radio Frequency Sputtering–Chemical vapour deposition –Pyrolysis- - vapour phase reaction-Chemical Deposition- electrodeposition –anodic oxidation- Electroless plating.

UNIT V CHARACTERIZATION TECHNIQUE

Crystallinity, Structural phase, Stress, Strain, Dislocation density, Characterisation using XRD–Fourier transform infrared analysis – Elemental analysis — Scanning Electron Microscopy (SEM) — Transmission Electron Microscope (TEM)- UV–Vis spectrometer—Photoluminescence spectrophotometer

TEXT BOOKS:

1. P.Shanthana Ragavan and P. Ramasamy ,**Crystal Growth Processes and Methods**, KRU Publications, 2001

Unit-I - Ch.2 (Sec. 2.2.2.1-2.2.2.6 , 2.2.3, 2.2.3.1 , 2.2.3.2)

Unit- II - Ch.4 (Sec.4.1,4.1.1- 4.1.3-4.1.3.3 4.2, 4.2.1)

Unit- III - Ch.5 (Sec.5.1, 5.1.1 , 5.1.2, 5.1.2.1 , 5.1.2.2 , 5.1.3, 5.1.3.1, 5.1.3.2 , 5.4.1-5.4.7

2. A. Goswami ,**Thin Film Fundamentals**, New age International Pvt, 2014.

Unit- IV-Ch. 1 (Sec.1,2, 5, 6, 6.3, 6.4 , 7,7.1,7.2, 8, 8.1, 8.2,8.3)

Unit-V - C.R.Brundle,C. A.Evans and S.Wilson (Edn)

Encyclopedia of materials characterization, London(1992).

REFERENCE BOOKS:

1. A.Holden and P.Singer **,Crystals and Crystal Growing**, - Valkis Feffer and Simons Pvt.
2. N.F.M.Henry, H.Lipson and W.A.Wooster **,The Interpretation of X - ray Diffraction Photographs**-,Macmillan & Co Ltd, 1969.

3. L.I.Maissel and R.Glang, **Handbook of Thin Film Technology**, McGraw Hill Book Company ,1970

4. K.L.Chopra ,**Thin Film Phenomena**, McGraw Hill Book Company , 1969.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I	Theories of nucleation – Classical theory of nucleation–	4	Lecture, ICT&Tutorial
	Gibbs Thomson equation for vapour, melt solution– Energy of formation of a nucleus–	4	Lecture, ICT&Tutorial
	Spherical nucleus – Cylindrical nucleus–Heterogeneous Nucleation – Cap- shaped nucleus–Disc-shaped nucleus.	7	Lecture, ICT&Tutorial
UNIT II	Low temperature solution growth –Solution, solubility and supersolubility–Expression of supersaturation–	6	Lecture, ICT&Tutorial
	Methods of crystallization – Crystallization by slow cooling of solution–Crystallization by solvent evaporation–Temperature gradient method–Crystal growth system –Constant temperature bath	9	Lecture, ICT&Tutorial
UNIT III	Vapour Growth–Physical Vapour Deposition–Chemical Vapour Deposition–Advantages of CVD–Disadvantages of CVD	4	Lecture, ICT&Tutorial
	Chemical Vapour Transport–Gel Growth–Principle–Various Types ,Structure of gel–Growth of Crystals in gels–	5	Lecture, ICT&Tutorial

	Experimental Procedure –Single and Double diffusion method–Chemical reduction method–Complex -decomplexion method–Solubility reduction method– Biological Crystallization.	6	Lecture, ICT&Tutorial
UNIT IV	Introduction –Nature of Thin films —Electron beam method – Cathodic sputtering -Reactive sputtering- Radio Frequency Sputtering–	8	Lecture, ICT&Tutorial
	Chemical vapour deposition –Pyrolysis- - vapour phase reaction-Chemical Deposition-electrodeposition –anodic oxidation-Electroless plating.	7	Lecture, ICT&Tutorial
UNIT V	Crystallinity, Structural phase, Stress, Strain, Dislocation density, Characterisation using XRD– Fourier transform infrared analysis – Elemental analysis	8	Lecture, ICT&Tutorial
	Scanning Electron Microscopy (SEM) — Transmission Electron Microscope (TEM)- UV–Vis spectrometer—Photoluminescence spectrophotometer	7	Lecture, ICT&Tutorial

Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean scores of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	3	3	4	3	3	4	3	2	3.2
CO2	4	4	3	3	4	3	3	3	3	4	3.4
CO3	4	4	3	3	3	4	3	3	3	3	3.3
CO4	4	4	3	3	4	4	4	3	3	4	3.6
CO5	4	4	3	3	4	4	3	3	3	4	3.6

Mean Overall Score	3.42

Result: The Score for this Course is 3.42 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Total of Value Mean Score of COs = ------------------------ Total No. of Pos& PSOs			Total of Mean Score Mean Overall Score of COs =------------------------ Total No. of COs		

BLOOM'S TAXANOMY	**INTERNAL**	**EXTERNAL**
KNOWLEDGE	40%	40%
UNDERSTANDING	40%	40%
APPLY	20%	20%

Course Designer: G.KRISHNA BAMA

Department of Physics

Programme : M.Sc **Part III: Core paper**
Semester : IV **Hours : 6 P/W 90Hrs P/S**
Sub. Code :QD1 **Credits : 5**
TITLE OF THE PAPER: Solid state physics II

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDOES/TUTORIAL	ICT
	6	3	-	2	1

PREAMBLE: The aim of this course is to give you an extended knowledge of the principles and techniques of solid state physics. The course covers the physical understanding of matter from an atomic view point. Topics covered include the superconductivity, dielectric and magnetic properties of matter. The course has a theoretical lecture component and makes extensive use of examples and exercises to illustrate the material.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
UNIT 1 CO1: explain about the Plasmons, Polaritons and Excitons (AI)	1	18
UNIT 2 CO2: predict about Superconductivity and its types (UI)	2	18
UNIT 3 CO3: interpret the dielectric and ferroelectric (UR)	3	18
UNIT 4 CO4: define the dia, para, ferro and antiferro magnetic properties of the crystal (KI)	4	18
UNIT 5 CO5: explain about the point defects in a crystals (AR)	5	18

SYLLABUS:

UNIT I: PLASMONS, POLARITONS AND POLARONS

Plasma optics, Disperson relation for EM waves—Transverse & Longitudinal mode of plasma oscillations-Plasmons – Polaritons – Electron-Electron interaction – Electron- Phonon Interaction - Polarons – Optical reflectance – Excitons - Frenkel excitons- weakly bound excitons

UNIT II: SUPERCONDUCTIVITY

Experimental survey – Occurrence of superconductivity- Destruction of superconductivity by magnetic fields-Meissner effect- Isotope effect - Theoretical survey: Thermodynamics of the super conducting transition – BCS theory of superconductivity -–Type II Superconductors-Josephson Superconductor Tunneling- High temperature Super conductors-Critical Fields and critical currents

UNIT III: DIELECTRICS AND FERROELECTRICS

Macroscopic electric field –Depolarisation Field-Local electric field of an atom- Dielectric constant and polarizability –Electronic polarizability- Structural phase transitions – Ferroelectric crystals-Classification of Ferroelectric Crystal.

UNIT IV : DIA, PARA, FERRO AND ANTIFERROMAGNETISM

Quantum theory of Dia, Para Magnetism-Hund rule-Ferromagnetic order-Curie point and the exchange integral - Magnons – Neutron Magnetic Scattering – Ferrimagnetic order – Antiferromagnetic order - Ferromagnetic Domains –Anisotropy Energy - single Domain Particles – Magnetic Bubble Domains.

UNIT V: POINT DEFECTS

Lattice Vacancies – Diffusion – Colour centers –F Centers- –Shear strength of single crystals – slip-dislocations- Burgers vector – Stress fields of dislocations – dislocation densities-Alloys-Hume Rothery Rule-Order –Disorder Transformation- -Kondo Effect.

TEXT BOOKS:

Charles Kittel, Introduction to Solid State Physics VII Edition Wiley India Pvt. Ltd., 2011.

Unit I-Ch.10& 11(pg272-279, 287-291, 294-299, 307,308, 312-319)

Unit II-Ch. 12 (pg335-342, 346-349, 354,355, 360-362, 366-369, 371-373)

Unit III-Ch. 13(pg380-413)

Unit IV-Ch. 14,15 (pg443-446, 450-454, 456-466, 468-472, 477,480)

Unit V-Ch. 18,20 &21(541-548, 587-595, 598, 611-618, 624-630)

REFERENCE BOOKS:

1. S.O.Pillai ,Solid state physics – 5th Edition New Age Int. Ltd.
2. M.A.Wahab, Solid state physics- 2nd Edition Narosa Publishing House Pvt. Ltd.
3. S.O. Pillai, Problems and Solutions in Solid State Physics, New Age International, New Delhi.,1994.
4. M. Ali Omar, Elementary Solid State Physics-Principles and Applications, Addison-Wesley, London, 1974.
5. H.P. Myers, Introductory Solid State Physics, 2nd Edition, Viva Book, New Delhi,1998.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I	Plasma optics, Disperson relation for EM waves—Transverse&Longitudinal mode of plasma oscillations	6	Lecture, Tutorial & ICT
	Plasmons – Polaritons – Electron-Electron	6	Lecture, Tutorial & ICT

	interaction – Electron-Phonon Interaction		
	Polarons – Optical reflectance – Excitons - Frenkel excitons- weakly bound excitons	6	Lecture, Tutorial & ICT
UNIT II	Experimental survey – Occurrence of superconductivity- Destruction of superconductivity by magnetic fields-Meissner effect- Isotope effect	6	Lecture, Tutorial & ICT
	Theoretical survey: Thermodynamics of the super conducting transition – BCS theory of superconductivity	6	Lecture, Tutorial & ICT
	Type II Superconductors-Josephson Superconductor Tunneling- High temperature Super conductors-Critical Fields and critical currents	6	Lecture, Tutorial & ICT
UNIT III	Macroscopic electric field –Depolarisation Field-Local electric field of an atom	6	Lecture, Tutorial & ICT
	Dielectric constant and polarizability –Electronic polarizability	6	Lecture, Tutorial & ICT
	Structural phase transitions – Ferroelectric crystals-Classification of Ferroelectric Crystal	6	Lecture, Tutorial & ICT

UNIT IV	Quantum theory of Dia, Para Magnetism-Hund rule-Ferromagnetic order-Curie point and the exchange integral -	7	Lecture, Tutorial & ICT
	Magnons – Neutron Magnetic Scattering – Ferrimagnetic order – Antiferromagnetic order -	6	Lecture, Tutorial & ICT
	Ferromagnetic Domains –Anisotropy Energy- - single Domain Particles – Magnetic Bubble Domains.	5	Lecture, Tutorial & ICT
UNIT V	Lattice Vacancies – Diffusion – Colour centers –F Centers - Shear strength of single crystals	6	Lecture, Tutorial & ICT
	slip- dislocations- Burgers vector – Stress fields of dislocations – dislocation densities	6	Lecture, Tutorial & ICT
	Alloys-Hume Rothery Rule-Order –Disorder Transformation- -Kondo Effect.	6	Lecture, Tutorial & ICT

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	3	4	3	3	4	3	3	5	3.5
CO2	5	3	4	3	5	4	3	4	3	3	3.7
CO3	3	3	4	3	3	3	4	4	3	4	3.4
CO4	3	3	4	3	3	3	5	4	3	4	3.5
CO5	4	3	3	4	4	3	3	4	4	3	3.5
Mean Overall Score											3.52

Result: The Score for this Course is 3.52 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Mean Score of COs = Total of Value / Total No. of Pos & PSOs			Mean Overall Score of COs = Total of Mean Score / Total No. of COs		

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	30%	30%
UNDERSTANDING	30%	30%
APPLY	40%	40%

Semester : IV **Hours : 6 P/W 90Hrs P/S**

Sub. Code : QD2 **Credits : 5**

TITLE OF THE PAPER: NUCLEAR PHYSICS

Pedagogy	Hours	Lecture	Peer Teaching	GD/ Vedos/Tutorial	ICT
	5	4	-	1	1

PREAMBLE: The course of nuclear physics imparts knowledge about nuclear structure, nuclear forces, and nuclear reactions with the help of nuclear models and explains the classification of elementary particles and their interactions.

COURSE OUTCOME At the end of the Semester, the Students will be able to	**Unit**	**Hrs P/S**
UNIT- 1 CO1:explain general properties of nucleus.	1	18
UNIT- 2 CO2:discuss about central and non centralnuclear forces.	2	18
UNIT - 3 CO3:describe the theories and models of nucleus.	3	18

UNIT - 4 CO4:list out the types of nuclear reactions and transmutations.	4	18
UNIT - 5 CO5:explain the concept of elementary particles.	5	18

SYLLABUS

UNIT I: GENERAL PROPERTIES OF ATOMIC NUCLEUS

Theories of nuclear composition - Binding Energy- Semi - emprical mass formula- Quantum numbers for individual nucleons - Independence of atomic and nuclear Properties - Quantum properties of nuclear States.

UNIT II: NUCLEAR FORCES

Introduction – Deuteron- Neutron-Proton Scattering at Low Energies - Saturation of Nuclear Force –Shape independent effective range theory in n-p scattering – neutron-neutron scattering Non Central Forces –meson theory of exchange forces.

UNIT III: NUCLEAR MODELS

Introduction - Fermi gas model - Liquid drop model - Shell model – Magic numbers – single particle model –Individual particle model - Unified model - Superconductivity model.

UNIT IV: NUCLEAR REACTION

Types of Nuclear Reactions - Conservation Laws - Nuclear Reaction- Kinematics- Nuclear transmutations - Nuclear Cross Section - Compound Nucleus – Compound nucleus reactions- Continuum Theory of Nuclear Reaction.

UNIT V: ELEMENTARY PARTICLES

Introduction - Classification of Elementary Particles - Fundamental Interactions -Conservation Laws - Parity, C.P- time & C.P.T. Electrons & Positrons – Protons & Antiprotons – Neutrons & Antineutrons – Neutrinos & Antineutrinos –Mesons, .

TEXT BOOKS:

1.D.C.Tayal, **Nuclear Physics** ,5th edition, Himalaya Publishing House, 2012.

REFERENCE BOOKS:

1. Irving Kaplan,**Nuclear Physics**,2nd edition,Narosa Publishing company, 1987.
2.S.B.Patel **,Nuclear Physics-An Introduction** , 2nd edition, Narosa International Publishers, 2011.
3. V.K.Mittal,R.C.Verma,S.C.Gupta **,Introduction to Nuclear and Particle Physics**, 2nd edition, PHI LearingPvt Ltd , 2011.
4. V.Devanathan **,Nuclear Physics**, 2nd edition , Narosa Publishing House, 2012.
5.JagdishVarma, Roop Chand Bhandari,D.R.S.Somayajulu, **Fundamendals of Nuclear**

Physics , CBS Publishers And Distributors Pvt Ltd , 2013.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I	Theories of nuclear composition - Binding Energy.	6	Lecture, G.D& ICT
	Semi - emprical mass formula- Quantum numbers for individual nucleons.	5	Lecture,G.D & ICT
	Independence of atomic and nuclear Properties - Quantum properties of nuclear States.	5	Lecture & ICT
	Problem discussion.	2	Group discussion
UNIT II	Introduction - Deuteron- Neutron-Proton Scattering at Low Energies .	6	Lecture,G.D & ICT

	Saturation of Nuclear Force –Shape independent effective range theory in n-p scattering – neutron-neutron scattering.	6	Lecture,G.D & ICT
	Non Central Forces –meson theory of exchange forces.	6	Lecture,G.D & ICT
UNIT III	Introduction - Fermi gas model - Liquid drop model.	6	Lecture,G.D & ICT
	Shell model – Magic numbers – single particle model	6	Lecture, G.D & ICT
	Individual particle model - Unified model - Superconductivity model.	6	Lecture,G.D & ICT
UNIT IV	Types of Nuclear Reactions - Conservation Laws - Nuclear Reaction- Kinematics.	6	Lecture, G.D & ICT
	Nuclear transmutations - Nuclear Cross Section.	5	Lecture, G.D & ICT
	Problem discussion	2	Group discussion
	Compound Nucleus - Compound nucleusreactions Continuum Theory of Nuclear Reaction.	5	Lecture, G.D & ICT
UNIT V	Introduction - Classification of Elementary Particles - Fundamental Interactions.	6	Lecture, G.D & ICT
	Conservation Laws - Parity, C.P- time & C.P.T.	5	Lecture, G.D & ICT
	Electrons & Positrons – Protons & Antiprotons – Neutrons & Antineutrons – Neutrinos & Antineutrinos –Mesons.	5	Lecture, G.D & ICT
	Problem discussion	2	Group discussion

Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean scores of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	4	2	3	3	4	3	3	2	4	3.2
CO2	4	3	2	2	4	4	3	3	2	4	3.1
CO3	4	4	3	3	3	4	3	3	3	3	3.3
CO4	4	3	2	3	3	4	3	2	3	3	3.0
CO5	4	4	3	3	4	4	3	3	2	4	3.4
Mean Overall Score											3.16

Result: The Score for this Course is3.16 (High Relationship)

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High
Total of Value Mean Score of COs = ------------------------ Total No. of Pos & PSOs			Total of Mean Score Mean Overall Score of COs =------------------------ Total No. of COs		

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	30%	30%
UNDERSTANDING	30%	30%
APPLY	40%	40%

Course Designer: R.Vijayalakshmi Department of Physics

Programme :M.Sc PHYSICS **PART III : ELECTIVE**

Semester : IV **Hours : 6 P/W, 90 Hrs P/S**

Sub code : EQD1 **Credits : 5**

TITLE OF THE PAPER : LASER AND NONLINEAR OPTICS

<table>
<tr><th rowspan="2">Pedagogy</th><th>Hours</th><th>Lecture</th><th>Peer teaching</th><th>TUTORIAL</th><th>ICT</th></tr>
<tr><th>6</th><th>3</th><th>1</th><th>1</th><th>1</th></tr>
<tr><td colspan="6">PREAMBLE :

The aim of this course is to give a reasonably comprehensive introduction to the fundamental concepts, mathematical formalism and methodology of quantum mechanics. Effort has been taken to make this course more upto date with latest developments in quantum mechanics.</td></tr>
<tr><td colspan="4">COURSE OUTCOME
At the end of the Semester, the students will be able to</td><td>UNIT</td><td>Hrs P/S</td></tr>
<tr><td colspan="4">UNIT 1 CO1- LASERS : I
PROGRAMME OUTCOME
PART – A
1. know the acronym of laser.(K)
2. know the medium producing laser action.(K)
3. know the three main components of laser.(K)
4. understand what is light amplification.(U)
5. understand threshold condition.(U)
6. understand what is line broadening.(U)
7. differentiate spontaneous and stimulated emission.(U)
8. understand population inversion.(U)
9. determine the ratio of number of spontaneous emission to stimulated emission.(P)
10. determine population inversion.(P)
11. analyse threshold condition.(A)
12. determine population inversion for any systems.(S)
13. determine the rate at which spontaneous emission occur.(C)
14. explain what is laser rate equation.(E)

PART – B
1. acquire knowledge about the condition for producing light amplification.(K)
2. understand the condition for producing spontaneous and stimulated emission.(U)</td><td>1</td><td>18</td></tr>
</table>

3. determine the absorption coefficient at the centre line and gain coefficient of any laser.(P)
4. analyse optimum output coupling.(A)
5. derive the expression for Einstein coefficient.(S)
6. determine the frequency of light emitted in two level system.(C)
7. explain Doppler broadening.(E)

PART – C

1. know the concept of Einstein coefficient.(K)
2. understand laser rate equation and to derive the laser rate equation.(U)
3. determine the collision time and time between collisions.(P)
4. analyse the difference between collision broadening and Doppler broadening.(A)
5. derive the condition for producing light amplification.(S)
6. develop the skill of calculating any problems related to laser production.(C)
7. explain variation of laser power around threshold.(E)

PROGRAMME SPECIFIC OUTCOME :

PART – A

The main objective of this topic is to make the students to

1. list the properties of laser beam.[K(I)]
2. discuss the condition for producing light amplification.[U(I)]
3. analyse the threshold conditions for the production of laser beam.[A(I)]
4. assess the role of population inversion for laser beam production.[E(I)]
5. explain what is line broadening.[E(R)]
6. understand the relation between rate of absorption and number of atoms in any level.[U(I)]
7. determine the spontaneous emission rate.[P(I)]
8. modify Einstein equation for producing spontaneous emission.[S(I)]
9. understand the relation between absorption coefficient and population inversion.
10. determine the gain of a beam.[P(I)]
11. know the way to improve output power of beam.[K(I)]
12. assess the relation between line broadening and operation characteristics of laser.[E(R)]

13. differentiate homogeneous broadening and inhomogeneous broadening.[U(M)] 14. explain the use of laser rate equation.[E(M)] 15. design a two level system which can produce light amplification.[C(M)] **PART – B** 1. analyse the threshold population inversion density required for the production of laser.[A(R)] 2. discuss about collision broadening.[U(R)] 3. explain light amplification and laser rate equation.[E(R)] 4. illustrate line broadening mechanism.[P(M)] 5. know how monochromacity can be improved through line broadening.[K(R)] 6. calculate the optimum reflectivity of one of the mirrors of resonator.[P(M)] 7. differentiate collision broadening and Doppler broadening based on homogeneity.[U(M)] 8. derive the expression for line shape function in natural broadening.[S(M)] 9. derive the expression for ratio between spontaneous to stimulated emission.[[S(M)] **PART – C** 1. analyse the variation of laser power in the laser transition as the pumping rate passes through threshold.[A(M)] 2. estimate the population inversion density and to obtain threshold pumping power required / unit volume of laser medium.[E(M)] 3. explain threshold condition and threshold population inversion. [K(R)] 4. derive the expression for number of stimulated absorption per unit time per unit volume.[S(M)] 5. discuss optimum output coupling and to derive the expression for optimum reflectivity.[U(M)] 6. know about laser rate equation.[K(M)] 7. design a system which can produce high output power.[C(M)] 8. modify the laser rate equation for producing high gain coefficient.[S(M)]		
UNIT 2 CO2- LASERS – II	2	18

PROGRAMME OUTCOME :

PART – A

1. know the condition for a medium to behave as an amplifier.(K)
2. know what is optical resonator.(K)
3. understand what is quality factor.(U)
4. determine resonator length.(P)
5. analyse the open and closed resonator.(A)
6. synthesize a medium for which the separation between two adjacent transition mode is much smaller than separation between two modes.(S)
7. develop the skills in removing losses in cavity.(C)
8. explain the factors affecting the quality.(E)

PART – B

1. know about peak power output of Q-switching.(K)
2. differentiate two types of mode selection.(U)
3. determine spontaneous emission line width of laser.(P)
4. analyse the ultimate line width of laser.(A)
5. derive the expression for calculating total energy of Q-switched laser.(S)
6. develop the skills in doing mathematical calculation.(C)
7. explain modes of confocal resonator system.(E)

PART – C

1. know about modes of a rectangular cavity.(K)
2. understand the working of Q-switching.(U)
3. determine duration of Q-switched pulse.(P)
4. analyse mode locking in laser.(A)
5. modify the working of medium by improving the Q-factor.(S)
6. develop the skills in deriving the expression for population inversion in Q-switching.(C)
7. explain the techniques for Q-switching.(E)

PROGRAMME SPECIFIC OUTCOME :

PART – A

1. differentiate open planar resonator and convocal resonator system.[U(R)]
2. analyse the role of quality factor.[A(R)]
3. compare transition and longitude mode.[E(R)]
4. discuss what is Q-switching.[U(M)]
5. define what is mode locking.[K(R)]
6. design an oscillator by modifiying amplifier.[S(M)]
7. understand what is open resonator system.[U(M)]
8. assess the role of plane mirror in forming optical resonator.[E(I)]
9. determine Q-factor by using energy stored in the mode and energy loss / unit volume.[C(R)]

10. explain what is mode of resonator.[E(M)] **PART – B** 1. explain the mode of a confocal resonator system and to compare the equation for the effect of lens.[E(I)] 2. design a laser with good quality factor.[U(M)] 3. analyse the techniques of Q – switching.[A(R)] 4. illustrate the observation mode by mode locking in lasers.[P(I)] 5. discuss the modes of a rectangular cavity.[U(M)] 6. determine the minimum path difference between the interfering beams.[P(R)] 7. knowledge about quality factor.[K(M)] **PART – C** 1. explain about transition and longitudinal mode selection.[E(R)] 2. evaluate the change in d3 required to change oscillation from one mode to another.[P(R)] 3. discuss the quality factor determined by cavity losses.[U(M)] 4. understand the importance of confocal resonator system.[U(I)] 5. assess mode locking in laser.[E(M)] 6. derive the expression for population inversion in Q-switching.[S(M)] 7. know about modes of open planar resonator system.[K(M)] 8. derive the expression for peak power , total energy and pulse duration in Q-switching and to design good quality Q-switching.[P(M)]		
UNIT 3 CO3- SOME LASER SYSTEMS **PROGRAMME OUTCOME :** **PART – A** 1. acquire knowledge about types of lasers.(K) 2. know the semiconductors and atoms used in various lasers.(K) 3. list the wavelength of various lasers.(K) 4. understand modes of CO2 laser.(U) 5. determine efficiency of any laser.(P) 6. analyse the type of semiconductors that can be used in semiconductor laser.(A) 7. modify the diffusion constant and to obtain qualitative information about motion of particles in photomultiplier tube.(S) 8. develop the skills in calculating wavelength of various lasers.(C) 9. explain the use of laser in counting of atoms.(E) **PART – B** 1. know about excimer laser.(K)	3	18

2. know the use of laser in astronomy.(K)
3. understand the working of argon ion laser.(U)
4. determine the frequency of oscillation and intermode spacing.(P)
5. analyse the use of laser in thermonuclear fusion.(A)
6. design a system that can determine the Brownian motion of particles.(S)
7. develop skills in analysing various energy levels in lasers.(C)
8. explain the working of semiconductor laser(E)

PART – C

1. get knowledge about use of laser in determining ether drift.(K)
2. know the use of laser in isotope separation.(K)
3. understand the working of Neodymium based lasers.(U)
4. determine the wavelength and other properties of laser beam.(P)
5. give the application of laser in industry.(P)
6. analyse the type of laser that can be used in various applications.(A)
7. devised laser to determine electron densities temperature of gas discharge plasma and plasma angular frequency.(S)
8. develop the skills in designing laser medium(C)
9. explain the working of He-Ne laser.(E)
10. explain the use of laser in communication.(E)

PROGRAMME SPECIFIC OUTCOME :

PART – A

1. list the solid state lasers.[K(R)]
2. analyse the semiconductors that can be used in semiconductor lasers.[A(R)]
3. calculate the wavelength of the given laser using Bragg’s law.[P(I)]
4. compare the wavelength of various lasers.[E(M)]
5. summarize the applications of laser in various fields.[U(M)]
6. list of excimers used in excimer laser.[K(I)]
7. explain lasing medium in various types of lasers.[E(I)]
8. determine the frequency of oscillation of laser beam.[P(I)]
9. determine FWHM of laser beam.[P(R)]
10. explain the use of laser in astronomy.[E(M)]
11. assess the use of laser in counting number of atoms.[E(R)]

PART – B

1. explain the working of Neodymium based lasers.[U(I)]
2. illustrate the applications of laser in the determination of absolute rotation of earth [P(R)]

3. analyse the advantages of various lasers.[A(M)] 4. explain the energy level diagram of Ruby laser.[E(I)] 5. analyse the energy level diagram of He-Ne and Co2 laser and to the select the best one.[A(I)] 6. discuss the use of laser in atmospheric optics.[K(I)] 7. discuss the working of argon ion laser.[K(R)] 8. give the application of laser in chemistry and to find ether drift.[P(R)] 9. assess the production of laser due to the transition of atoms between energy levels in dye laser.[E(M)] 10. demonstrate the construction of ruby laser.[P(M)] 11. determine plasma angular frequency.[S(M)] 12. explain the application of laser in biology and medicine.[E(I)] **PART – C** 1. describe the experimental details of He-Ne laser and to explain the production of laser beam .[E(I)] 2. discuss the construction and working of semiconductor laser.[U(R)] 3. decide which type of laser can be used in industrial application, communication and biology.[C(R)] 4. explain how laser is used in the separation of isotopes ,ether drift and counting of atoms.[K(I)] 5. explain the application of laser in communication.[E(I)] 6. assess the application of laser in thermonuclear fusion.[E(I)] 7. analyse the application of laser in separating isotopes.{A(I)] 8. discuss the construction and working of CO2 laser.[U(I)]		
UNIT 4 CO4- NON LINEAR OPTICS **PROGRAMME OUTCOME :** **PART – A** 1. get knowledge about non-linear optics(K) 2. know about harmonics(K) 3. know what is phase matching.(K) 4. define coherent length.(K) 5. know what is parametric generation.(K) 6. know what is optical mixing.(K) 7. differentiate linear and nonlinear medium.(U) 8. calculate the coherent length of a medium(P) 9. analyse phase matching criterion interms of phase.(A) 10. derive equation for second harmonic wave.(S) 11. develop the skills in using algebrical formulae in deriving harmonic equations.(C) 12. explain dielectric susceptibility.(E) **PART – B** 1. know about second harmonic generation.(K)	4	18

2. differentiate second and third harmonics.(U)
3. calculate the polarization produced in crystals.(P)
4. analyse indicatrix for any negative uniaxial crystal.(A)
5. derive expression for parametric generation of light.(S)
6. determine the uses of optical mixing in various fields.(C)
7. explain harmonic generation.(E)

PART – C

1. know about self focussing of light.(K)
2. understand the production of harmonics and able to derive the expression for harmonics.(U)
3. determine the length at which self focussing will occur and also to determine the threshold value of intensity of any beam.(P)
4. analyse optical mixing.(A)
5. derive the expression for frequency mixed waves.(S)
6. draw indicatrix for various crystals.(C)
7. explain the concept of phase matching. (E)

PROGRAMME SPECIFIC OUTCOME :

PART – A

1. predict the expression for harmonic generation.[C(I)]
2. differentiate second harmonic generation and third harmonic generation.[U(M)]
3. understand what is parametric generation.[K(M)]
4. analyse optical mixing.[A(M)]
5. illustrate the condition for phase matching.[P(R)]
6. calculate the L value where self focusing of light will occur.[P(M)]
7. know what is non linear optics.[K(I)]
8. write the expression for second harmonics.[K(I)]
9. analylse the crystals which can produce second harmonics.[A(I)]
10. assess the coherence length.[E(I)]
11. explain the sum and difference of frequencies of light.[E(R)]

PART – B

1. derive the expression for second harmonic and third harmonic .[S(I)]
2. discuss about parametric generation of light.[U(M)]
3. analyse optical mixing and derive the expression for optical mixing.[A(M)]
4. survey about the use of optical mixing in various fields.[S(R)]
5. design a system that can produce maximum threshold intensity.[C(M)]

6. explain the types of crystals where phase matching condition is satisfied.[E(I)] 7. know about second harmonic generation.[K(M)] 8. application of optical mixing in various fields.[P(M)] **PART – C** 1. demonstrate the experimental details for the production of harmonics.[P(M)] 2. explain phase matching and derive the phase matching condition in various crystals.[S(M)] 3. explain self focussing of light and derive the expression for self focussing of light.[S(R)] 4. compare second harmonic generation and third harmonic generation and to derive the expression for second and third harmonics.[E(M)] 5. analyse optical mixing in detail and to derive the expression for sum and difference of frequencies.[A(M)] 6. derive the expression for parametric generation of light and to discuss parametric generation.[U(M)]		
UNIT 5 CO5- MULTIPHOTON PROCESS **PROGRAMME OUTCOME :** **PART – A** 1. know what is multiphoton process.(K) 2. know what is multiquantum photoelectric effect.(K) 3. know what is two photon process.(K) 4. list the crystals used in two photon process.(K) 5. understand what is phase conjugate optics.(U) 6. give the application of two photon process in Doppler free two photon spectroscopy.(P) 7. analyse the rate of absorption equation in multiphoton process.(A) 8. draw reflected wave fronts from conventional and conjugate mirror.(S) 9. explain violation of square law dependence(E) **PART – B** 1. know two photon process.(K) 2. understand frequency up conversion.(U) 3. give its application in second harmonic generation.(P) 4. analyse three photon process.(A) 5. illustrate the uses of two photon process.(S) 6. design phase conjugate mirror based on phase conjugate optics.(C) 7. explain two photon effect in semiconductors.(E) **PART – C** 1. know parametric generation of light.(K)	5	18

2. understand multiquantum photoelectric effect.(U)
3. demonstrate the experiment of parametric light oscillator.(P)
4. analyse phase conjugate optics.(A)
8. derive the theoretical expression for two photon process.(S)
5. design frequency up conversion devices.(C)
6. design phase conjugate mirror based on phase conjugate optics.(C)
7. explain the experiments in two photon process.(E)

PROGRAMME SPECIFIC OUTCOME :

PART – A

1. analyse the difference between photoelectric effect and multi photon photoelectric effect.[A(M)]
2. modify the equation representing photoelectric effect into multiphoton photoelectric effect.[S(I)]
3. design energy level diagram for two photon process and three photon process.[C(M)]
4. draw the diagram depicting the reflected wave fronts from the conventional and the conjugate mirror. [C(R)]
5. know virtual levels.[K(I)]
6. understand how multiphoton process decreases threshold frequency.[U(I)]
7. determine the threshold frequency of multiphoton.[p(I)]
8. differentiate linear and nonlinear medium.[U(I)]
9. explain what is frequency up conversion.[E(I)]
10. assess the production of two photon process in anthracene.[E(I)]
11. list the ions which can produce two photon process in anthracene.[K(I)]
12. assess what is phase conjugation.[E(I)]
13. analyse what is two photon ionisation.[A(I)]

PART – B

1. derive the expression for multi photon photoelectric effect .[S(M)]
2. demonstrate the experimental details of two photon processin KI crystals.[P(M)]
3. design energy level diagram for two photon and three photon process.[C(M)]
4. demonstrate and explain the experimental details of frequency up conversion.[E(M)]
5. discuss about parametric generation of light.[K(M)]
6. explain the production of two photon process in calcium fluoride crystal.[E(M)]

7. know the energy level diagram of cesium vapour and can discuss the production of two photon .[K(M)]
8. assess the production of two photon process in anthracene[E(M)]

PART – C

1. derive the theoretical expression for two photon process . [C(M)]
2. demonstrate the experimental details of parametric light oscillator and explain the parametric generation.[P(I)]
3. analyse phase conjugate optics.[A(R)]
4. analyse the experiments in two photon process carried out using various crystals[A(I)]
5. know multiphoton process and explain multiphoton photoelectric effect.[K(M)]
6. explain two and third photon process and to explain its production using energy level diagram.[E(M)]
7. understand second harmonic generation and parametric generation of light.[U(M)]
8. application of multiphoton process in frequency up conversion and phase conjugate optics.[P(M)]

SEMESTER IV
ELECTIVE IV
LASER AND NON LINEAR OPTICS

Code: EQD1 Credit: 5

UNIT I: LASERS: I **6 Hrs/week**

The Einstein coefficients - Light amplification - The threshold condition - Laser rate equations (derivation up to two level system) - Variation of laser power around threshold(qualitative) –
Optimum output coupling - Line broadening mechanisms(no derivation for collision broadening and Doppler broadening)

UNIT II: LASERS: II

Modes of a rectangular cavity and the open planar resonator – The quality factor – The ultimate line width of the laser – Mode selection – Q- switching (qualitative) – Techniques for Q-switching - Mode locking in lasers (no techniques) – Modes of Con focal Resonator system

UNIT III : SOME LASER SYSTEMS

Ruby lasers – Neodymium based Laser - He – Ne laser – CO_2 laser- Argon ion Laser – Dye lasers (Introduction only) – Excimer lasers – Semiconductor lasers.

APPLICATIONS OF LASER (WITHOUT EXPERIMENTAL PART)

Ether drift-Absolute rotation of the Earth-counting of atoms- Thermo nuclear fusion- -communication by laser- -Atmospheric Optics- Lasers in astronomy- Lasers in biology-Lasers in medicine- Lasers in industry (Qualitative only)

UNIT IV: NON LINEAR OPTICS

Harmonic generation-Second harmonic generation -phase matching-Third harmonic generation- Optical mixing-Parametric generation of light-Self -focusing of light.

UNIT V: MULTIPHOTON PROCESSES

Multi quantum photoelectric effect- Two photon processes- Theory of two photon processes- Experiments in two photon processes – Violation of the square law dependence – Doppler -free two -photon spectroscopy – Multi photon processes – Three photon processes- Second harmonic generation - Parametric generation of light - Parametric light oscillator – Frequency up conversion – Phase conjugate Optics.

TEXT BOOKS:

1.AjoyGhatak and K. Thyagarajan, O**ptical Electronics ,** Cambridge University press India Pvt. Ltd, New Delhi-2, 2011.

Unit I- Ch. 8 (Sec. 8.1 - 8.8),

Unit II- Ch.9 (Sec.9.1 - 9.8),

Unit III - Ch.10 (Sec.10.1 – 10.9)

2.B.B. Laud, **Lasers and non linearoptics ,**New Age International (P) Ltd ,2011.

Unit III - Ch.17 (Sec.17.2 - 17.5, 17.7, 17.9, 17.11-17.15)

Unit IV- Ch.13 (Sec.13.1 - 13.7)

Unit V - Ch.14 (Sec.14.1 - 14.13)

REFERENCE BOOKS:

1. K. Thyagarajan and A.K.Ghatak, **LASERS Fundamentals and Applications,** Macmillan publishers, 2011.

2. V.K. Jain**, Laser systems and Applications ,**Narosa publishing house,2013.

3. D.L. Mills, **Non linear optics- Basic concepts**, Springer, 1998.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT – I	The Einstein coefficients	2	L,P
	Light amplification	2	L,I
	The threshold condition	2	L,T
	Laser rate equations	2	L,I
	Variation of laser power around threshold (qualitative)	2	L,T
	Optimum output coupling	2	L,T
	Line broadening mechanism	2	L,I
	Collision broadening	2	L,P
	Doppler broadening	2	L,P
UNIT-II	Modes of rectangular cavity and the open planar resonator	4	2L,I,P
	The Quality factor	2	L,T
	The ultimate line width of the laser	2	L,P
	Mode of selection	2	L,I
	Q-switching	2	L,T
	Techniques for Q-switching	2	L,P
	Mode locking in lasers	2	L,I
	Modes of confocal resonator system	2	L,T
UNIT-III	Ruby lasers	2	L,I
	Neodymium based laser	2	L,I
	He-Ne laser	2	L,T
	CO2 laser	2	L,I
	Argon ion laser,dye laser, excimer lasers	2	L,P
	Semiconductor laser	2	L,T
	Ether drift, absolute rotation of earth , counting of atoms	2	L,P
	Thermonuclear fusion, communication by laser, atmospheric optics	2	L,T
	Lasers in astronomy, lasers in biology, lasers in medicine,industry	2	L,P
UNIT IV	Harmonic generation	2	L,T
	Second harmonic generation	2	L,I
	Phase matching	4	2L,T,P
	Third harmonic generation, optical mixing	4	2L,T,P
	Parametric generation of light	2	L,I
	Self focusing of light	4	2L,I,P

UNIT-V	Multiquantum photoelectric effect, two photon process	2	L,T
	Theory of two photon processes	2	L,P
	Experiments in two photon process	2	L,T
	Violation of square law dependence, Doppler free two photon spectroscopy	2	L,I
	Multiphoton process, three photon process	2	L,I
	Second harmonic generation, parametric generation	2	L,T
	Parametric light oscillator	2	L,P
	Frequency up conversion	2	L,I
	Phase conjugate optics	2	L,P

Cource outcomes (Cos)	**Programme Outcomes (Pos)**							**Programme Specific Outcomes (PSOs)**							**Mean scores of Cos**
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	
CO1	5	7	4	3	3	3	3	4	5	4	3	5	2	6	4.07
CO2	4	3	3	3	3	3	3	3	6	3	2	2	1	6	3.21
CO3	7	3	4	3	3	3	3	5	4	5	3	1	1	7	3.71
CO4	7	3	3	3	3	3	3	4	3	3	3	3	2	3	3.29
CO5	6	3	3	3	3	3	3	5	3	4	4	2	3	6	3.64
	Mean overall score														3.58

Result : The Score for this course is 3.58 - High

BLOOM'S TAXANOMY	INTERNAL	EXTERNAL
KNOWLEDGE	50%	50%
UNDERSTANDING	30%	30%
APPLY	20%	20%

Course Designer : J.S.P.CHITRA, Department of PHYSICS

Programme : M.Sc
Semester : III & IV
Sub. Code : QL3

Part III: Core paper
Hours : 10 P/W 90Hrs P/S
Credits : 3

TITLE OF THE PAPER: PHYSICS PRACTICAL - III

Pedagogy	Hours	Lab Experimentation	Peer Teaching	GD/VIDOES/TUTORIAL	ICT
	3+3	3+3	-	-	-

PREAMBLE: The purpose of the *course* is to make the students to construct electronic circuits using ICs and study their behavior. To make the students to know the applications of ICs by constructing adder, Subtractor, Multiplexer, De-multiplexer, and counters.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

CO1: construct electronic circuits using logic gates & ICs
CO2: perform arithmetic operations using ICs
CO3: construct different types of waveforms
CO4: understand the theoretical concepts by doing experiments
CO5: understand applications of ICs by doing experiments

S.NO	EXPERIMENT
1.	Full adder using IC 7400
2.	Full adder using IC 7402
3.	Active Filter
4.	Phase shift oscillator using IC 741
5.	Schmitt trigger using IC 7400
6.	IC-741 integrator, differentiator
7.	Multiplexer using IC 7400
8.	Demultiplexer using IC 7400
9.	Full adder using EX-OR
11.	De-multiplexer using IC 74139
12.	Full subtractor using IC 74139
13.	Half subtractor using IC 74139
14.	Parallel adder and subtractor
15.	Full subtractor using IC 7400

Programme : M.Sc **Part III: Core paper**
Semester : III & IV **Hours : 10 P/W 90Hrs P/S**
Sub. Code : QL4 **Credits : 3**

TITLE OF THE PAPER: PHYSICS PRACTICAL - IV

Pedagogy	**Hours**	**Lab Experimentation**	**Peer Teaching**	**GD/VIDOES/TUTORIAL**	**ICT**
	3+3	3+3	-	-	-

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDOES/TUTORIAL	ICT
	6	4	-	2	-

PREAMBLE: The purpose of the *course* is to make the students to construct electronic circuits using ICs and study their behavior and applications. Writing microprocessor program to solve mathematical and physical problems and test them in computer.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

CO1: construct electronic circuits using ICs.
CO2: perform arithmetic operations using microprocessor.
CO3: construct parity checker using ICs.
CO4: understand the theoretical concepts by doing experiments.
CO5: understand applications of microprocessor by solving problems.

S.NO	EXPERIMENT
1.	Magnitude comparator
2.	S-R flip flop using IC7400,IC7402
3.	4 x1 multiplexer using IC74153
4.	Four bit synchronous counter
5.	Four bit asynchronous counter
6.	Odd parity generator and checker (IC 7486,7404)
7.	Even parity generator and checker (IC 7486)
8.	Excess 3 to BCD conversion using (IC 7408, 7486, 7432, 7404)

9.Microprocessor Programme:

Hexadecimal addition of two numbers

Decimal addition of two decimal numbers

Add to sixteen bit number

Addition of eight bit numbers series neglecting the carry generator

To separate hexa decimal into two digit number

Programme to check the hexadecimal number stored in location 2010 for odd or even parity.

Timer Programme using 8085

Serial programme using 8085
