ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN (AUTONOMOUS)

CHINNAKALAYAMPUTHUR, PALANI – 624 615.

DEPARTMENT OF PHYSICS

SYLLABUS

M.Sc PHYSICS

UNDER CHOICE BASED CREDIT SYSTEM

2022

ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN PALANI

M.Sc Physics

MISSION

- To motivate the students to equip with modern trend technical knowledge
- To visit state of the Electrical Electronic Industries and Astronomical Research Centers
- To encourage and guide research oriented Higher Studies through enriched curriculum
- To introduce career oriented Electives and Project works.
- To inculcate scientific attitude among younger generation through Hands on Training and Science Exhibitions.
- To incorporate discipline, dedication and committed work culture through Value Education.
- To Empower Revolutionary Excellence in electronic intelligence.

VISION

- Up gradation of UG Department to PG Department
- Introduction of current trend Electronic Technical Know-Hows in Curriculum
- Preparing Industry ready citizens
- Promoting Academic Excellence with Discipline

ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN

Department of Physics

BOARD OF STUDIES MEETING

Date: 11.05.2022

The tenth Board of studies meeting was held on 11.05.2022 for UG and PG courses. The experts for the Board of studies are **Dr.H.B.Ramalingam**, Associate Professor & Head, Department of Physics, Government Arts College, Udumalpet, **Dr. S. Saravanan**, Associate Professor & Head, Department of Physics, GTN Arts College, Dindigual **Dr.(Mrs).K.Prabha**, Assistant Professor, Department of Physics, Mother Teresa Women's University, Kodaikanal, **Dr.M.Kavitha**, (Alumni) Assistant Professor, PG & Research Center, Department of Physics, The Madura College, Madurai, **Mrs. P.Umarani,** Associate Professor & Head, Department of Physics,, APAC(W), Palani **Dr.(Mrs).R.Valliammal,** Associate Professor, Department of Physics, APAC(W), Palani **Mrs. A.Santhi,** Associate Professor Department of Physics, APAC(W), Palani **Mrs. R.Arulmozhi,** Assistant Professor, Department of Physics, APAC(W), Palani and **Dr.(Mrs)T.M.SelvaKumari**, Assistant Professor, Department of Physics, APAC(W), Palani, participated in the meeting. The CBCS syllabus for the year (2022-2025) for

(i) The Core, Core elective, Core practicals, ancillary courses, Skill Based Courses, Extra credit courses and Value added courses under Autonomous status for UG Degree (2022-2025) and

(ii) Core, Core Elective and Core practical courses under Autonomous status for PG Degree for the year (2022-2024)

under TANSCHE were studied and the suggestions given by the board were carried out. It is resolved to approve the syllabi for UG& PG.

These syllabi come into effect from the academic year 2022- 23.

External Board Members : **Dr.(Mr). H.B.Ramalingam,**
Associate Professor & Head, Department of Physics,
Govt. Arts College, Udumelpet.

Dr. S. Saravanan,
Associate Professor & Head, Department of Physics,
G.T.N. Arts college, Dindigul.

Dr.(Mrs).K.Prabha,
Assistant Professor, Department of Physics,
Mother Teresa Women's University, Kodaikanal.

Dr.M.Kavitha – Alumni
Assistant Professor,
PG & Research Center, Department of Physics,
The Madura College, Madurai

Internal Board Members **: Mrs. P.Umarani**
Associate Professor and Head, Department of Physics,
Arulmigu Palaniandavar Arts College for women,
Palani.

: Dr.R.Valliammal
Associate Professor, Department of Physics,
Arulmigu Palaniandavar Arts College for women,
Palani.

Mrs.A.Santhi
Associate Professor, Department of Physics,
Arulmigu Palaniandavar Arts College for women,
Palani.

Mrs.R.Arulmozhi
Assistant Professor, Department of Physics,
Arulmigu Palaniandavar Arts College for women, Palani.

Dr.T.M.Selvakumari
Assistant Professor, Department of Physics,
Arulmigu Palaniandavar Arts College for women, Palani.

.

Department of Physics
M.Sc degree course
SEMESTERWISE DISTRIBUTION WITH SCHEME OF EXAMINATION – (CBCS)
(For candidates admitted during the Academic year 2022 - 2024)

Class	Sem	Title of the paper	Hours		Marks			Credit
			Theory	Practical	Int	Ext	Total	
I M.Sc	I Sem	Core Paper I :- Electromagnetic Theory	6	-	25	75	100	5
		Core Paper II :- Applied Electronics	6	-	25	75	100	5
		Core Paper III :- Classical Mechanics	6	-	25	75	100	5
		Core Elective Paper I :- Computer Programming in C++ / Numerical methods	6	-	25	75	100	4
		Core Practical Paper I :- Electronics	-	6	40	60	100	4
		Total	24	6			500	23

Class	Sem	Title of the paper	Hours		Marks			Credit
			Theory	Practical	Int	Ext	Total	
I M.Sc	II Sem	Core Paper IV :- Mathematical Physics	6	-	25	75	100	5
		Core Paper V :- Material Science	6	-	25	75	100	5
		Core Paper VI :- Quantum Mechanics	6	-	25	75	100	5
		Core Elective Paper II :- Non-Conventional Energy sources / Thin Film Technology	6	-	25	75	100	4
		Core Practical Paper II :- Digital Electronics	-	6	40	60	100	4
		Total	24	6			500	23

Class	Sem	Title of the paper	Hours		Marks			Credit
			Theory	Practical	Int	Ext	Total	
II M.Sc	III Sem	Core Paper VII :- Communication Electronics	6	-	25	75	100	5
		Core Paper VIII :- Solid State Physics	6	-	25	75	100	5
		Core Paper IX :- Nuclear and Particle Physics	6	-	25	75	100	5
		Core Elective Paper III :- Microprocessor - 8085 / Crystal Growth and Characterization	6	-	25	75	100	4
		Core Practical Paper III :- General Physics	-	6	40	60	100	4
		Total	24	6			500	23

Class	Sem	Title of the paper	Hours		Marks			Credit
			Theory	Practical	Int	Ext	Total	
II M.Sc	IV Sem	Core Paper X :- Fibre optics Communication	6	-	25	75	100	5
		Core Paper XI :- Molecular Spectroscopy	6	-	25	75	100	5
		Core Elective Paper IV :- Statistical Mechanics and Thermodynamics / Atmospheric Physics	6	-	25	75	100	4
		Core Practical Paper II :- Computer Programming in C++	-	6	40	60	100	3
		Core Paper :- Project		6	25	75	100	4
		Total	24	6			500	21

Total Marks :- 2000 **Total Credits :- 90**

SEMESTER – I
CORE PAPER-I - ELECTROMAGNETIC THEORY
6-hours - 5-credits

COURSE OBJECTIVES:

- To understand basic concepts of electromagnetic theory.
- To apply the theory and concepts to solve the Physics problems.
- To be familiar with electromagnetic theory.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understand the concepts of Electric charge, Coulombs law, Electric field, Electrostatic potential and Gauss's law	K2
CO2	Understand the concepts of magneto statistics	K2
CO3	Become familiar with the concepts of Electromagnetic induction, Faraday's law and Maxwell's equation.	K2
CO4	Know the reflection, transmission, absorption and dispersion of electromagnetic waves in vacuum and matter.	K2
CO5	Apply the knowledge of electric potentials and fields	K3

K2-Understanding K3-Applying

COURSE CONTENT

Unit-I : ELECTROSTATISTICS

Electric charge –Coulombs law- Electric field-Electrostatic potential-Gauss's law-Applications of Gauss's law –electric dipole-multiple 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– Applications of Biot –Savart law –Ampere's circuital law –Magnetic vector potential –magnetic field of a distant circuit –Magnetic scalar potential –magnetic flux –magnetisation-magnetic field produced by magnetized material –Magnetic scalar potential and magnetic pole density.

Unit-III: ELECTRODYANAMICS

Electromagnetic induction –Faraday's law –The induced electric field –Energy in magnetic fields – Maxwell's equation-electrodynamics before Maxwell –How Maxwell field - Ampere's law-Maxwell's equation –Magnetic charge Maxwell's equations in matter –Boundary conditions.

Unit-IV: ELECTROMAGNETIC WAVES

Waves in one dimension-The wave 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 linear media-reflection and transmission at normal incidence –absorption and dispersion-electromagnetic waves in conductors.

Unit-V: POTENTIAL AND FIELDS

The potential formulation –scalar and vector potentials –Gauge transformations –Coulomb gauge and Lorentz Gauge –Lorentz force law in potential form –continuous distributions –retarded potentials-Jefimenko's equation-point charge –Lienard –Wiechert potentials.

BOOK FOR STUDY:

1.JohnRarebits, Fredrick J.Milford, Robert W.Christy,
Foundations Of Electromagnetic theory, 3rd Ed.,Norosa publishing House,New Delhi,1989

UNIT-I Ch.2(2.1- 2.4,2.6- 2.9,3.1-3.4,4.1-4.5)

UNIT-II Ch.8(8.1-8.9,9.1-9.3)

2. David J.Griffths, Introduction to Electrodynamics, 3rd Ed., PHI Learning private Ltd.,2012.

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

UNIT-IV Ch.9 (9.1.1,9.1.2,9.1.2-9.2.3,9.3.1,9.3.2&9.4.1)

UNIT-V Ch.10 (10.1.1-10.1.4, 10.2.1, 10.2.1,10.2.2, 10.3.1).

BOOK FOR REFERENCE:

1.Paul Lorrian and Dale Corson ,Electromagnetic fields and waves,2nd 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.

SEMESTER – I
CORE PAPER-II APPLIED ELECTRONICS
6-hours - 5-credits

COURSE OBJECTIVES:

- To know with various semiconductor devices and amplifier systems.
- To understand various wave generators, wave shaping systems
- To develop skills in handling integrated circuits.

COURSE OUTCOME:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understand the concepts of various semiconductor devices and amplifier systems	K2
CO2	Understand the concepts of various semiconductor amplifier systems.	K3
CO3	Apply the concepts various counters and converters	K3
CO4	Apply the concepts many wave generators and wave shaping circuits	K3
CO5	Become familiar with the knowledge of integrated circuits	K2

K2-Understanding K3-Applying

COURSE CONTENT

UNIT I FIELD EFFECT TRANSISTOR

Field effect transistor: The ideal voltage controlled current source — the Junction Field Effect transistor — the JFET volt — ampere characteristics — JFET transfer characteristics — The MOSFET — The enhancement MOSFET — volt — ampere characteristics — The depletion MOSFET — MOSFET circuit symbols — The DC analysis of FETS — The MOSFET as a resistance — FET as a switch— as an amplifier — Small — signal FET models — CMOS devices.

UNIT II OPERATIONAL AMPLIFIER

Operational amplifier — architectures — The gain stage with active load — The differential stage — DC level shifting — output stages — offset voltages and currents — Measurements of op— amp parameters — Frequency response and compensation — slew rate.

OP-AMP characteristics resistance feedback – expression for gain (inverting mode only) – virtual earth – application as adder, subtractor, integrator and differentiator – analog computer – Op-amp as Schmitt trigger

UNIT III WAVE FORM GENERATORS AND WAVESIIAPING

Wave form Generators and wave shaping: Sinusoidal oscillators — Phase shift: oscillator —Wien bridge oscillator — General form of oscillator configuration — crystal oscillators — multivibrators — comparator — square - wave generation from a sinusoid — Regenerative comparator — Square and triangle - wave generators — pulse generators — The 555 IC timer —voltage time - base generators — step generators — modulation of a square wave-The Schmitt trigger (using 555Timer)

UNIT IV REGISTERS,COUNTERS AND CONVERTERS

Types of Registers – Serial In – Serial Out – Serial In – Parallel Out– Parallel In– Serial Out— Parallel In –Parallel Out –Universal Shift Register-Applications of Shift Register .

Asynchronous Counters – Decoding Gates – Synchronous Counters – Changing the Counter Modulus – Decade Counters – Presettable Counters – Counter Design as a Synthesis Problem

Variable, Resistor Networks- Binary Ladders- D/A Converters- D/A Accuracy and Resolution- A/D Converter – Simultaneous Conversion – A/D Converter –Counter Method – Continuous A/D Conversion – A/D Techniques- Dual-slope A/D Conversion.

UNIT V INTEGRATED CIRCUITS

Monolithic Integrated – Circuit (Microelectronic) Technology- The Planar Processes-Bipolar Transistor Fabrication – Fabrication of FETs- CMOS Technology – Monolithic Diodes – The Metal-Semiconductor Contact- Integrated – Circuit Resistors – Integrated – Circuit Capacitors – Integrated – Circuit Capacitors – Integrated – Circuit Packaging – Characteristics of Integrated – Circuit Components – Microelectronic Circuit Layout-Charge – Couple Device (CCD)- CCD Structures-Integrated – Injection Logic (I^2L)- Microprocessors and Microcomputers

TEXT BOOK:

1. Millman ,J & Grabel, *Micro Electronics*, 2nd Ed., , A. Tata McGraw Hill, 2002, ISBN 0-07-463736
   Unit – I Ch.4 (Pg.133- 167),
   Unit – II Ch.14(Pg. 609- 643),
   Unit –III Ch. 15(Pg. 659- 699) ,
   Unit –IV Ch. 9(Pg. 321- 340), Ch.10 (Pg. 357- 392), Ch.12(Pg. 455- 483),
   Unit- V Ch. 5(Pg. 172- 201), Ch.9 (Pg. 366- 378)

2. S. M. Sze, *Semiconductor Devices Physics and Technology* ,Wiley Publication,2nd Ed.,1985

3. S.M. Sze and Kwok K. Ng, *Physics of semiconductor devices*, Wiley, Third Edition, 2007

4. D.A. Neamen, *Semiconductor Physics and Devices: Basic Principles*, McGraw-Hill, 3rd Ed., 2003

REFERENCE BOOK:

1. Malvino, A.P. & Leech .D goutamsaha,*Digital Principles and applications*, 4th Ed.,– TataMcGraw Hill.

2. B G Streetman, S Banerjee, *Solid State Electronic Devices*, Prentice Hall, 6th Ed., 2009

3. Malvino, A.P.&Leech .D goutamsaha, *Digital Principles and Applications*,4th Ed., - Tata McGraw Hill

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://nptel.ac.in/courses/108/108/108108112/

SEMESTER – I
CORE PAPER-III CLASSICAL MECHANICS
6-hours - 5-credits

COURSE OBJECTIVES:

To enable the learners to know about the

- Mechanics of single and system of particle,
- Generalized coordinates, Lagrangian formulation and mechanics of rigid body motion,
- Hamiltonian formulation of mechanics, Hamilton-Jacobi theory, harmonic oscillator problem, theory and applications of small oscillations.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Apply the concepts of – Mechanics of a particle and Mechanics of systems of particles	K3
CO2	Understand the concepts Generalized coordinates and constraints –D'Alembert's principle and Lagrange's equation for a conservative system.	K2
CO3	Apply the concepts Hamilton's Equation and Canonical Transformations.	K3
CO4	Apply the knowledge of Hamilton-Jacobi equations	K3
CO5	Become familiar with the theory of small oscillations	K2

K2-Understanding K3-Applying

COURSE CONTENT

UNIT – I MECHANICS OF SINGLE AND SYSTEM OF PARTICLES

Newton's laws of motion – Mechanics of a particle- Equation of motion of a particle – Motion of a particle under constant force and alternating force – Mechanics of systems of particles – Angular momentum of the system – kinetic energy of the system – Motion of two particles equivalent to single particle – Equation of motion of centre of mass with respect centre of force – Motion in an inverse square law force field – Classification of orbits

UNIT – II LAGRANGIAN FORMULATION

Generalized coordinates and constraints – principle of virtual work and D'Alembert's principle – Lagrange's equation for a conservative system – velocity dependent potentials and dissipation function – Lagrange's equations of motion from this principle – extension of the principle to non-conservative and non-holonomic systems – conservation theorems and symmetry properties. Applications for Lagrangian and Variational Principle: simple pendulum, compound pendulum, Atwoods machine, simple harmonic oscillators

UNIT-III HAMILTON'S EQUATION AND CANONICAL TRANSFORMATIONS

Hamilton's variational principle- Lagrange's equation from Hamilton's principle- Hamilton's principle from D'Almbert's principle- Hamiltonian- Hamilton's canonical equation of motion- Physical significance of Hamiltonian- Hamilton's equations from variational principle – the equations of canonical transformations- Advantages and examples of canonical transformations.

UNIT –IV HAMILTON-JACOBI THEORY

Hamilton-Jacobi equations for Hamilton's principle and characteristic functions – harmonic oscillator problem – separation of variable method – action angle variables – applications – linear harmonic oscillator and Kepler problem- Poisson brackets: Definitions and its properties.

UNIT-V SMALL OSCILLATIONS

Theory of small oscillations – Eigen value equations and the principle axes-Transformations-Frequencies of free vibrations and normal coordinates– Free vibrations of a linear triatomic molecule – Forced vibrations and the effect of dissipative forces.

BOOKS FOR STUDY:

1. Gupta, S.L. Kumar and Sharma, *Classical Mechanics*, , Pragathi Ed., 2014**.**
   Unit- I Ch.1 (1.3-1.4), Ch. 4(4.1-4.5)
   Unit- II Ch.1 (1.5,1.6), Ch. 2(2.5(a), 2.5(b), 2.6.1, 2.8, 2.9, 2.9.1, 2.9.2, 2.9.9, 2.9.10, 2.11, 2.15)
   Unit- III Ch.2 (2.3- 2.4, 2.7.1)
   Unit- IV Ch.3 (3.14, 3.15.1, 3.16, 3.17.1, 3.18, 3.19, 3.20, 3.21)
2. Pearson, *Classical Mechanics Goldstein*, New International 2nd Ed., 1980.
   Unit- V Ch.6 (6.1-6.5)

BOOKS FOR REFERENCE:

1. Gupta and SathyaPrakash, *Classical Mechanics*, KedarNath Ram Nath& Co, 2000.
2. Rana and Joag, *Classical Mechanics*, Tata McGraw-Hill Education, 2001.

SEMESTER – I
CORE ELECTIVE PAPER I -COMPUTER PROGRAMMING IN C++
6-hours - 4-credits

COURSE OBJECTIVE:

- To acquire the knowledge of the basic concepts of 'C' programming.
- To understand the concepts of functions, control statements and arrays.
- To get a clear knowledge of pointers, structure and union.
- To understand the concepts of classes, objects and Inheritance.
- To make the students write algorithm, draw flow charts and write simple programs. .

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Know the basic knowledge of fundamental concepts of C++ programming language.	K2
CO2	Students become able to write algorithm and draw flow charts.	K3
CO3	Understand the concepts of classes, objects and Inheritance	K2
CO4	Apply the knowledge to write simple programmes in C+ +	K3
CO5	Gain knowledge to write programs with arrays, structure, union and pointers.	K3

K2-Understanding K3-Applying

COURSE CONTENT

UNIT I: INTRODUCTION

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

UNIT II: FUNCTIONS, PROGRAM STRUCTTURE & ARRAYS

Defining a function – Return statement – Types of functions – Actual and Formal Arguments – Local and Global variables – Default Arguments — Header files – Array Notations – Array Declaration – Array Initialization - Processing with Array – Array & Functions – Multidimensional Arrays – Character Array.

UNIT III: POINTERS, STRUCTURE & UNION:

Pointer Declaration – Pointer Arithmetic – pointers and functions – Pointers and Arrays - – Pointers and Strings – Array of Pointers – Pointers to pointers – Declaration of Structure– Initialization of Structure – Arrays of structure – Arrays within a Structure – Structure - 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 – Union and classes – Classes within classes (nested class)

UNIT V: INHERITANCE AND POLYMORPHISM

Introduction – Single Inheritance – Types of Base Classes – Type of Derivation - Ambiguity in single Inheritances- Multiple Inheritance – **Polymorphism – Early Biding - Polymorphism with pointers – Virtual Functions – Late binding*.**

***Self study**

BOOK FOR STUDY:

1. D. Ravichandran, *Programming with C++*, Tata McGraw Hill Publishing Company Ltd., 2000.
   Unit I- Ch. 1 (Pg. 1- 25), Ch. 2 (Pg. 26- 42), Ch. 3 (Pg. 57- 87)
   Unit II- Ch. 4.1- 4.7 (Pg. 92- 112), Ch. 4.12 (Pg. 133), Ch. 5.1- 5.7 (Pg. 137- 165)

Unit III- Ch. 6.1- 6.7 (Pg. 169- 208), Ch. 7.1- 7.8 (Pg. 210- 252)

Unit IV- Ch. 8.1- 8.10 (Pg. 267- 315)

Unit V- Ch. 10.1- 10.7 (Pg.385- 420), Ch. 12.1 (Pg.492- 503)

BOOKS FOR REFERENCE:

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

Web Resources:

1. https://www.programiz.com/cpp-programming
2. https://www.youtube.com/watch?v=5uXYIOPvTzw
3. https://cs.uno.edu/~jaime/Courses/2025/devCpp2025Instructions.html

SEMESTER – I
CORE ELECTIVE PAPER I – NUMERICAL METHODS
6-hours - 4-credits

COURSE OBJECTIVES:

- To learn numerical solutions of differential equations.
- To learn numerical differentiation and integration.
- To learn how to interpolate the given set of values.
- To learn about interpolation polynomials.
- To know the boundary value problems for the second order ordinary differential equations.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Derive numerical methods for various mathematical operations.	K2
CO2	Solve a system of linear equations	K3
CO3	Understand Trapezoidal and Simpson's 1/3 and 3/8 rules for numerical integrations.	K2
CO4	Apply Euler and Runge - Kutta methods for solving first and second order equations	K3
CO5	Apply numerical methods to real life applications	K3

K2-Understanding K3-Applying

COURSE CONTENT

UNIT -I

Solution of algebraic and transcendental equations- Iteration method- Newton Raphson method- method of false positions- Solutions of simultaneous linear equations- Direct method- Gauss elimination method, Gauss Jordan method- Iteration method- Jacobi method, Gauss- Seidel method.

UNIT -II

Newton's forward and backward interpolation formula- Central Difference- Interpolation formulae (For equal intervals)- Gauss's forward and backward formula- Stirling's formula.

UNIT -III

Interpolation with unequal intervals- Divided differences- Lagrange's formula- Numerical differentiation upto second order- Maxima and minima.

UNIT -IV

Numerical integration- Quadrature (Cote's) formula- Trapezoidal rule- Simpson's one- third rule- Three- eight rule- Weddle's rule.

UNIT -V

Numerical solution of differential equation- Taylor series method- Euler's method- Modified Euler's method- Runge- Kutta method- second and fourth order Runge- Kutta- method.

BOOKS FOR STUDY:

1. Dr.P.Kandasamy, Dr.K.Thilagavathy and Dr.K.Gunavathi, *Numerical methods*, S.Chand and Company LTD, 2012.

   Unit I- Ch.3 and Ch.4 (4.2, 4.7- 4.9)
   Unit II- Ch. 6 (6.2- 6.6), Ch.7 (7.3- 7.5)
   Unit III- Ch. 8 and Ch.9 (9.2- 9.6)
   Unit IV- Ch. 9 (9.7- 9.15)
   Unit V- Ch. 11 (11.5,11.9- 11.15)

BOOKS FOR REFERENCE:

1. Arumuga, Issac, Somasundaram, *Numerical Analysis*, New Gamma Publishing House, Palayamkottai 2003
2. G. Balaji, *Numerical Methods*, G.Balaji Publishers, Chennai *2007*.
3. Venkataraman M.K, *Numerical methods in Science and Engineering*, The National Publishing Company, Madras, 2009.

Web Resources:

1. https://www.teacheron.com/online-numerical_methods-tutors
2. http://www.numerical-methods.com/

PG – I M.Sc. PHYSICS – Core Practical – I

SEMESTER – I
CORE PRACTICAL PAPER I – ELECTRONICS PRATICALS
6-hours - 4-credits

COURSE OBJECTIVE

- To provide a comprehensive understanding of electronic devices and circuits.
- To study basic circuits using diodes and transistors.
- To acquire the skills about oscillators and power amplifiers circuits using transistor.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understand the characteristics of diodes and transistors	K2
CO2	Apply the knowledge to measure frequency of oscillators	K3
CO3	Design and implement feedback amplifier circuits	K3
CO4	Design dual power supply using ICs	K3
CO5	Apply the skills to design simple electronic circuits and mini projects	K3

K2-Understanding K3-Applying

ELECTRONICS (Suggestive - any Eight)

List of Experiments:

1. FET characteristics
2. FET amplifier
3. Zener diode as voltage regulator
4. Determination of Planck's constants
5. Wave shaping circuits
6. Emitter follower
7. UJT – Relaxation oscillator
8. Phase shift oscillator
9. Wein bridge oscillator
10. Saw tooth wave generator
11. Operational amplifier characteristics
12. Two stage RC coupled amplifier – with and without feedback
13. Passive filter circuits – Low , High and Band pass filter
14. Dual power supply using regulated ICs

SEMESTER – II
CORE PAPER-IV- MATHEMATICAL PHYSICS
6-hours - 5-credits

COURSE OBJECTIVES:

- To impart knowledge about various mathematical tools employed to solve physics problems..
- To work with vectors and matrices.
- To develop mathematical skills to solve problems in quantum mechanics and electrodynamics in theoretical physics.
- To acquire essential knowledge about Fourier Series and Fourier transforms
- To know the methods of partial differential equations and special functions

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Apply basics of vector calculus and matrices to solve higher level problems in quantum mechanics.	K3
CO2	Solve ordinary and partial differential equations in physical sciences.	K3
CO3	Evaluate problems using Green Functions	K4
CO4	Apply Fourier series and Fourier transforms	K3
CO5	Gain knowledge about special functions for solving problems in theoretical physics.	K2

K2-Understanding K3-Applying K4 -Analysing

COURSE CONTENT

UNIT I: VECTORS

Gradient of a scalar field- Line, surface and volume integrals- Gauss divergence theorem- Stoke's theorem- Green's theorem in a plane-Orthogonal coordinates- Gradient, divergence and curl in spherical and cylindrical coordinates- Linear vector space- Linear dependent and independent vectors- Orthogonality vectors.

UNIT II: MATRICES

Review of Algebraic operators of matrices- Sub matrices- Partitioning of matrices- Special types of a matrices- Transpose and the conjugate of a matrix- Hermitian and Skew Hermitian matrices-Orthogonal and Unitary matrices- Trace of a matrix - linear transformation-Eigen values and Eigen functions- Caley-Hamiltonian's theorem-Diagonalisation -Dirac and Pauli's matrix.

UNIT III: FOURIER SERIES AND FOURIER TRANSFORM

Dirichlets condition-Determination of coefficients-Properties of fourier series-Parseval's identity-Application of fourier series, fourier integral-Fourier transform-Properties of fourier transform (Linearity, similarity, modulation, convolution and Parseval's identity)-Fourier transform of derivatives- Fourier sine and cosine transform of derivatives-Finite Fourier transform.

UNIT IV: SPECIAL FUNCTION

Gamma and beta functions-Properties and some basic relations- Differential equation and series solution of Legendre and Bessel's and their polynomials-Laguerre polynomial-Rodrigues's formula for Laguerre polynomials-Generating function for $P_n(x)$ and $j_n(x)$- recurrent relation- orthogonality relation. Hermite differential equation and Hermite polynomials-generating function of Hermite polynomials-Recurrence formula for Hermite polynomials- Rodriguez formula for Hermite polynomial-orthogonality of Hermite polynomial.

UNIT V: PARTIAL DIFFERENTIAL EQUATION

Characteristics and boundary condition for PDEs- nonlinear particle differential equations-separation of variables in Cartesian, cylindrical and spherical polar coordinates- heat equations - Laplace equation and Poisson equations- non homogenous equation-Green's function-symmetry of Green function for Poison equation- Laplace equation and Helmholtz equation.

BOOK FOR STUDY:

1. Mathematical Physics and Classical Mechanics, Sathyaprakash, Sultan Chand & Sons, 2012.

BOOKS FOR REFERENCE:

1. Mathematical Physics, Eugene Butkov, Addition Wesley
2. Applied Mathematics for Engineering and Physicist, Pipes and Harvil
3. Matrices and Tensors, A.W. Joshi II Edition, Wiley Eastern Ltd,1984
4. Chemical Application of Group theory, F. Albert Cotton II Edition
5. Mathematical Physics, B.D. Gupta III Edition, 2005, Vikas publishing House Pvt. Ltd, New Delhi.
6. Mathematical Method for Physicist, G. Arfken and J.Weber IV Ed Academic press and prism book(1995)

Web Resources:

1. https://oer.uoch.edu.pk/home/watch_lecture/1373/70674
2. https://www.physics.uoguelph.ca/chapter-3-legendre-polynomials

SEMESTER – II
CORE PAPER-V- MATERIALS SCIENCE
6-hours - 5-credits

COURSE OBJECTIVE

1. To understand the properties of conducting materials and classification of solids on the basis of band theory.
2. To know the properties of dielectric materials
3. To study the behaviour of optical materials and their to applications in recent development.
4. know the properties of modern engineering materials like nanophase materials, ceramic materials, shape memory alloys etc,
5. To study the properties of polymers, Biomaterials and non-liner materials.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understand the behaviour of semiconductors.	K2
CO2	Acquire knowledge about the behaviour of different types of Magnetic and dielectric materials	K2
CO3	Apply the knowledge about the optical devices like LED, LCD and Photoconductor in practical applications.	K3
CO4	Apply the skills about the characteristics and synthesis of nanomaterials in research field.	K3
CO5	Analyze the behaviour of various modern engineering materials like Polymers, ceramic materials, Biomaterials, and Non-liner materials in recent development.	K4

K2-Understanding K3-Applying K4 -Analysing

COURSE CONTENT

UNIT I: CONDUCTING AND SEMICONDUCTING MATERIALS

Conductors – classical free electron theory of metals- Electrical and thermal conductivity- Wiedemann- Franz Law- Lorentz number- Drawbacks of classical theory- Quantum theory- Fermi distribution function- Effect of temperature on Fermi Function- Density of energy states- Carrier concentration in metals

Intrinsic semiconductor- carrier concentration derivation- Fermi level- Variation of Fermi level with temperature- electrical conductivity – Band gap determination- extrinsic semi conductors- carrier concentration derivation in n- type and p- type semiconductor- variation of Fermi level with temperature and impurity concentration- compound semiconductors- Hall effect- Determination of Hall coefficient- applications

UNIT II: MAGNETIC AND DIELECTRIC MATERIALS

Origin of magnetic moment – Bohr magneton – Dia and Para magnetism – Ferro magnetism – Domain theory – Hysteresis – Soft and hard magnetic materials – anti- ferromagnetic materials – Ferrites – applications- Magnetic recording and readout – Storage of magnetic data – tapes, floppy and magnetic disc drives.

Electrical susceptibility- dielectric constants- electronic, ionic, orientational and space charge polarization- frequency and temperature dependence of polarization- internal field – Claussius- Mosotti relation (derivation)- dielectric loss- dielectric breakdown- uses of dielectric materials (capacitor and transformer)- Ferro electricity and applications.

UNIT III: OPTICAL MATERIALS

Optical properties of metals, insulators and semiconductors- excitons, traps, colour centres and their importance- phosphorescence and fluorescence- different phosphorus used in CRO screens- liquid crystal as display material- twisted nematic display- construction and working of LED- LED materials- thermography and its applications- photo conductivity and photo conducting materials.

UNIT IV: NANO MATERIALS

Nanomaterials - synthesis –plasma arcing –chemical vapour deposition – solgels –electro deposition-ball milling-properties of nanoparticles and applications- metallic nanoclusters - Carbon nano tubes- structure and fabrication – carbon - arc method –pulsed laser deposition- chemical vapour deposition- structure- properties and applications

UNIT V: MODERN ENGINEERING MATERIALS

Metallic glasses- concept behind the formation - preparation , properties and applications - Shape Memory alloys (SMA)- phases, processing , characteristics ,types, properties of NiTi alloy, applications, advantages and disadvantages of SMA –advanced ceramic materials-**polymers-biomaterials-non-linear materials and their applications*.**

***Self study**

BOOKS FOR STUDY:

1. Dr.P.Mani ,*Engineering Physics –II*, Dhanam Publications, 2011
   Unit I- Ch. 1 (Pg. 1.1- 1.42), Ch. 2 (Pg. 2.1- 2.67)
   Unit II- Ch. 3 (Pg. 3.1- 3.59), Ch. 5 (Pg. 5.1- 5.51)
   Unit IV- Ch. 7 (Pg. 7.1- 7.45)

2. Dr.S.Asath Bahadur, A.Chitra Devi and Dr.S.Sankaranarayanan, *Materials Science*, AM Publications, 2003
   Unit III- Ch. 5 (Pg. 5.1- 5.61).
   Unit V- Ch. 6 (Pg. 6.1- 6.55).

BOOKS FOR REFERENCE:

1. J.C.Anderson, K.D.Leaver, R.D.Rawlings and J.M.Alexander, *Materials Science*, 4th Ed., Chapman – Hall London, 1990.
2. V.Ragavan, *Materials Science and Engineering*, 3rd Ed., Prentice-Hall India, New Delhi , 2011.

Web Resources:

1. http://www.istl.org/02-spring/internet.html

SEMESTER – II
CORE PAPER – VI - QUANTUM MECHANICS
6-hours - 5-credits

COURSE OBJECTIVES:

- To impart knowledge on topics of advanced quantum mechanics
- To understand and to develop problem solving ability on formalism of quantum mechanics, energy Eigen value problems and approximation methods.
- To understand time dependent and independent theories and perturbation theories.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Spot, identify and relate the eigenvalue problems for energy, momentum and angular momentum.	K2
CO2	Understand the one and three dimensional energy Eigen value problems.	K2
CO3	Apply the concepts of Angular momenta, their properties commutation relations of total angular momentum with components.	K3
CO4	Apply the Stationary perturbation theory, time independent quantum approximation methods and application of WKB method.	K3
CO5	Become familiar with the time dependent perturbation theory and the semi-classical treatment of radiation.	K2

K2-Understanding K3-Applying

COURSE CONTENT

UNIT I - GENERAL FORMALISM OF QUANTUM MECHANICS

Linear vector space – linear operator – Eigen values and Eigen functions – the Hermitian operator – Postulates of Quantum Mechanics – simultaneous measurability of observables – General Uncertainty relation - Dirac's notation – Equations of motion – Momentum representation – related solved problems.

UNIT II - ONE AND THREE DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS

Square-well potential with rigid walls – square-well potential with finite walls – square potential barrier – alpha emission – Bloch waves in a periodic potential – Kronig-Penney square-well periodic potential – Linear harmonic oscillator: Schrödinger method Particle moving in a spherically symmetric potential – spherical harmonics – radial equation – system of two interacting particles – rigid rotator – hydrogen atom – radial equation and its solution – energy Eigen values – radial wave functions – wave function of hydrogen like atoms – radial probability density.

UNIT III - ANGULAR MOMENTA AND THEIR PROPERTIES

Angular momentum operator in position representation – spin angular momentum – the total angular momentum operators – commutation relations of total angular momentum with components – Eigen values of J2 and JZ – Eigen values of J+ and J- - Eigen values of JX and JY - explicit form of the angular momentum matrices – addition of angular momenta: Clebsch- Gordan coefficients – properties of Clebsch- Gordan coefficients.

UNIT IV - TIME INDEPENDENT QUANTUM APPROXIMATION METHODS

Stationary perturbation theory (non degenerate case) – evaluation of first order energy and evaluation of first order correction to wave function – normal helium atom – stationary perturbation theory : degenerate case – first order Stark effect in hydrogen atom – The variation method – The WKB method – application of WKB method: probability of penetration of a barrier.

UNIT V - TIME DEPENDENT PERTURBATION THEORY

Time development of states – transition probability: Fermi – Golden rule – adiabatic approximation.

The semi-classical theory of radiation

Application of time dependent perturbation theory to semi classical theory of radiation- Interpretation in terms of absorption and emission- Einstein transition probabilities- Selection rules- Forbidden transitions.

BOOKS FOR STUDY:

1. G. Aruldhas, *Quantum Mechanics*, PHI learning Pvt. Ltd. 2009.
   Unit I- Ch.3 (3.1- 3.10)
   Unit II- Ch.4 (4.1- 4.7), Ch.5 (5.1- 5.8)
2. Satya prakash, Swati Saluja, *Quantum Mechanics*, Kedar Nath Ram Nath, Meerut, Delhi, 2015.
   Unit III- Ch.10 (10.1- 10.11)
   Unit IV- Ch.11 (11.2- 11.10)
   Unit V- Ch.12 (12.0, !2.1, 12.2, 12.5)

BOOKS FOR REFERENCE:

1. A text book of Quantum Mechanics P.M. Mathews and K.Venkatesan,TataMcGrawHill education Pvt. Ltd (2004).
2. Quantum mechanics Leonard. I. Schiff, McGraw Hill Co (2002).
3. Modern quantum mechanics J. J Sakurai, Jim J Napolitino, Pearson new international (2014).
4. Quantum Mechanics: AjoyGhatak and Lokanathan, Theory and applications Macmillan India Ltd (2002).

Web Resources:

1. https://www.britannica.com/science/quantum-mechanics-physics
2. https://en.wikiversity.org/wiki/Quantum_mechanics/Course

SEMESTER – II
CORE ELECTIVE PAPER II :-NON-CONVENTIONAL ENERGY SOURCES
6-hours - 4-credits

COURSE OBJECTIVES:

- To make the students to know about the importance of non-conventional energy sources.
- To know the various technologies of solar radiation collection and storage .
- To understand wind energy& its applications
- To discuss on energy from biomass and biogas production from waste biomass
- To impart knowledge on geothermal energy, tidal energy and ocean thermal energy

COURSE OUTCOMES:

On completion of the paper the student will be able to,

CO	Statement	Blooms Taxonomy level
CO1	Acquire knowledge on energy sources available in the world	K2
CO2	Understand solar energy collection and storage process	K2
CO3	learn wind energy programme in India	K3
CO4	Know the recent development in biomass conversion technologies	K4
CO5	Aware of applications of geothermal energy, tidal energy and ocean thermal energy	K5

K2 - Understanding K3 – Applying K4 – Analyzing K5 - Evaluating

COURSE CONTENT

UNIT I

Classification of energy resources — Conventional energy sources— disadvantages of conventional energy sources- importance of non-conventional energy sources — Solar Energy Basics- solar collectors-physical principles of the conversion of solar radiation into heat- Flat plate collector-concentrating collector: Focussing type- advantages and disadvantages of concentrating collector over Flat-plate collector

UNIT II

Solar Energy Storage- Introduction- Solar Energy Storage systems-Thermal storage-Mechanical storage-Applications of solar energy-solar water heater- solar pumping- solar furnace-solar cooker-methods of producing hydrogen from solar energy

UNIT III

Wind energy - Introduction –Nature of the wind -Wind energy conversion- Basic components of Wind Energy Conversion System(WECS)-advantages and disadvantages of WECS - Horizontal axis wind turbine - Environmental aspects - Wind energy programme in India

UNIT IV

Energy from Biomass - Introduction –biogas generation-methods for obtaining energy from biomass- Biomass resources - Biomass gasification -Down draft type, Up draft type -Biogas production from waste biomass –Availability of raw materials and gas yield - Bio mass energy programme in India.

UNIT V

Geothermal energy - Introduction - Applications - geothermal energy in India - Tidal energy – basic principle of tidal power – Advantage and limitations of tidal power generation - - Ocean Thermal Electric Conversion(OTEC) – Open cycle OTEC System- Closed or Anderson OTEC cycle-Prospects of OTEC in India

BOOK FOR STUDY:

1. Non-Conventional energy sources - G.D. Roy, Khanna Publications

BOOKS FOR REFERENCE:

1. Non-Conventional Energy sources, B H.Khan, McGraw Hill, rd edition, 2009.

2. Solar energy utilization - G.D. Roy, Khanna Publications.

SEMESTER – II
CORE ELECTIVE PAPER II :- THIN FILM TECHNOLOGY
6-hours - 4-credits

COURSE OBJECTIVES:

- To provide the basic concepts of thin films technology
- To make the students acquire the knowledge about thin film coating
- To know the significance characterization techniques to analyze sample
- To explain the electric, electronic, magnetic, and structural behaviour of functional materials
- To help them understand the applications of thin films.

COURSE OUTCOMES:

On the successful completion of the course, student will be able to

CO	Statement	Blooms Taxonomy level
CO1	gain knowledge on the mechanism, process for the synthesis and evolution of thin films	K2
CO2	understand principles, advantages and drawbacks of different thin film deposition methods	K2
CO3	familiarize basics of defects and dislocations, and learn how it can be identified and removed	K3
CO4	learn characterization techniques to analyze sample	K4
CO5	apply the knowledge of thin film in research level applications	K3

K2 - Understanding; K3 - Applying; K4 - Analyzing

COURSE CONTENT

UNIT I : PREPARATION OF THIN FILM

Nature of Thin Film - Deposition Technology - Distribution of Deposit - Resistance Heating - Thermal Evaporation - Flash Evaporation.

UNIT II: DEPOSITION TECHNIQUES

Electron Beam Method - Cathodic Sputtering - Glow Discharge Sputtering - Low Pressure Sputtering - Reactive Sputtering - RF Sputtering - Chemical Vapour Deposition (CVD) - Chemical Deposition.

UNIT III: FILM THICKNESS & ITS CONTROL

Mass Methods - Optical Method – Photometry – Ellipsometry - Interferometry - Other Methods - Substrate Cleaning - Microscopic Defect and Dislocation - Edge Dislocation - Screw Dislocation -Boundary Defect - Stress Effect - Removal of Defect - Defect and Energy State.

UNIT IV: THIN FILM ANALYSIS

Electron Diffraction Technique - High Energy Electron Diffraction - Low Energy Electron Diffraction - Electron Microscopy - Scanning Electron Microscopy – X Ray Photoelectron Spectroscopy - Mass Spectroscopy - Thermodynamics of Nucleation - Nucleation Theories - Film Growth - Incorporation of Defects, Impurities in Film - Deposition Parameters and grain size.

UNIT V: THIN FILM GROWTH PROCESS

Epitaxy - Thin Film Structure – Substrate Effect - Epitaxial Deposit – Twinning and Multi twinning -Phase Transition - Dissociations - Film Thickness Effect - Crystal Growth Process.

BOOKS FOR STUDY:

1. Thin Film Fundamentals - A. Goswami, New Age International-New Delhi
2. Thin Film Phenomena - K.L.Chopra

BOOKS FOR REFERENCE

1. Handbook of Thin Film Technology-L.T. Meissel& R. Glang-McGrawHill.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.youtube.com/watch?v=o9uRmL38R6A

SEMESTER – II
CORE PRACTICAL PAPER II– DIGITAL ELECTRONICS PRATICALS
6-hours - 4-credits

COURSE OBJECTIVES

- To know the concepts of flipflops.
- To understand the basic digital circuits and to verify their operation.
- To design digital circuits using ICs.
- To expose students to the operation of typical microprocessor (8085) trainer kit

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Design half adder and full adder circuits and verify their truth tables.	K3
CO2	Analyze and verify Demorgan's theorem.	K4
CO3	Apply the skills to solve different problems by developing different programs using micro processor 8085 kit.	K3
CO4	Apply the procedures to design adder and subtractor using Op – amps.	K3
CO5	Design Flip flops and multivibrators using ICs.	K3

K3-Applying K4 -Analyzing

List of Experiments (Suggestive - any Eight)

1. Astablemultivibrator – IC 555 Timer
2. Adder – IC 741 Operational amplifier
3. Subtractor - IC 741 Operational amplifier
4. Addition , Subtraction and Multiplication – Microprocessor
5. Code conversion – Microprocessor
6. Solving simultaneous equations using Op-amp IC 741
7. Multiplexer &Demultiplexer
8. Verification of De Morgan's Theorems
9. Half adder and Full adder – Verification of truth tables
10. Half subtractor and full subtractor - Verification of truth table
11. D/A converter – IC 741 – operational amplifier
12. RS ,JK and D Flip-Flops using ICs

SEMESTER – III
CORE PAPER VII – COMMUNICATION ELECTRONICS

6-hours - 5-credits

COURSE OBJECTIVES:

- To provide the basic concepts of electronic communications
- To introduce various modulation and demodulation techniques of electronic communication
- To understand the various radio receivers with their parameters
- To know various types of antennas
- To provide the basic concepts of electronic communications

COURSE OUTCOMES:

On completion of the paper the student will be able to

CO	Statement	Blooms Taxonomy level
CO1	Acquire knowledge on recent developments in the scientific and technological fields based on electronic principles	K2
CO2	Apply different modulation and demodulation techniques in advanced electronic communications	K3
CO3	Analyze generation and detection of AM and FM signals and comparison between them	K3
CO4	Indentify different radio receiver circuits and role of AGC.	K3
CO5	Apply the recent developments in the field of information technology and internet	K3

K2-Understanding, K3-Applying

COURSE CONTENT

UNIT- I – AMPLITUDE MODULATION

Introduction –Amplitude Modulation –Amplitude Modulation Index - Modulation Index For Sinusoidal AM- Frequency Spectrum for Sinusoidal AM – Average Power for Sinusoidal AM- Effective Voltage and Current for Sinusoidal AM – Non sinusoidal Modulation – Double –sideband Suppressed Carrier(DSBSC) Modulation – Amplitude Modulator Circuits- Amplitude – Modulated Transmitters – AM Receivers- Single-Side band principles- Balanced Modulators – SSB Generation – SSB Reception – Modified SSB Systems.

UNIT- II – FREQUENCY MODULATION

Introduction – Frequency modulation – Sinusoidal FM – Frequency spectrum for Sinusoidal FM – Average Power in Sinusoidal FM – Non-sinusoidal Modulation : Deviation Ratio – Measurement of Modulation Index For Sinusoidal FM – Phase Modulation – Equivalence between PM and FM – Sinusoidal phase modulation – Digital phase modulation – Angle Modulator circuits – FM Transmitters – Angle modulation detectors – Automatic Frequency Control .

UNIT- III – DEMODULATION AND RADIO RECEIVERS

Essentials of AM detection – Diode detector for AM signals – diagonal peak clipping – negative peak clipping - Transistor detectors for AM signals –AM receiver using phase –locked loop (PLL).

FM detection – basic concepts of FM signals – Foster- Seeley discriminator – ratio detector - Quadrature detector – Phase locked loop detector (demodulator)

Tuned radio frequency receiver (TRF) - Super heterodyne AM receiver – FM receiver – Comparison between AM and FM – Super heterodyne receivers – Choice of intermediate and oscillator frequencies – Image rejection – Adjacent channel selectivity – Spurious responses – Tracking – Automatic gain control – Double conversion receivers.

UNIT- IV – ANTENNAS,

Types of antennas –Electromagnetic radiation-The elementary doublet(Hertzian Dipole)-Current and voltage distribution-Resonant antennas ,Radiation patterns and length calculations-Nonresonant antennas (Directional antennas)-Antenna gain and effective radiated power –Radiation measurements and field intensity –Antenna resistance-Bandwidth and polarization - Undergrounded Antennas-Grounded Antennas-Grounding systems –Effects of antenna height-General considerations-Selection of feed point-Antenna couples –Impedance matching with stubs and other devices –Dipole arrays-Folded dipole and Applications-Non resonant antennas-The Rhombic-Antennas with Parabolic reflectors- Horn Antennas –

Lens antennas-Folded Dipole (Bandwidth Compensation)-Helical Antenna-Discone antenna-Log-Periodic Antennas-Loop Antennas-Phased Arrays

UNIT - V – TV TRANSMISSION & RECEPTION AND RADARS

TV TRANSMISSION & RECEPTION: Principles of transmission & reception of colour TV signals– Television system and standards-TV systems-Video bandwidth requirement-Fundamentals—Beam scanning-Blanking and Synchronizing pulses-Colour Transmission-Principle of reception of colour T.V.signal-The picture tube.

RADAR SYSTEMS

Fundamentals-Radar performance factors - Basic pulsed radar systems-Antennas and Scanning-Display methods-Pulsed radar systems-Moving –target indication (MTI)-Radar beacons - CW Doppler radar-Frequency –modulated CW radar-Phased array radars-Planar array radars.

BOOKS FOR STUDY:

1. Electronic communication by - DENNIS RODDY and JOHN COOLEN - Fourth edition – Pearson Prentice Hall.
   Unit I – Ch. 8 (Pg.223- 247), Ch.9 (Pg.262-273)
   Unit II – Ch. 10 (Pg.283- 318)
2. Electronic communication system by KENEDDY & DAVIS-Fourth Edition – Tata Mcgraw-Hill Edition
   Unit III - Ch. 6 (Pg.119 - 146)
   Unit IV - Ch. 9 (Pg.256 - 303)
   Unit V -Ch. 17 (Pg 648- 697), Ch.15 (Pg.601-640)

BOOKS FOR REFERENCE:

1. Principles of electronics – V.K.METHA.
2. Basic electronics and applied electronics by A.UBALD RAJ & G.JOSE ROBIN.
3. Basic Electronics (Solid state) by B.L.THERAJA (IIIrd Edition 1988).

SEMESTER – III
CORE PAPER VIII– SOLID STATE PHYSICS
6-hours - 5-credits

COURSE OBJECTIVE:

- To be familiar the basics of crystal structures
- To understand the concepts of crystal structures
- To apply the acquired knowledge and understanding to solve problems

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understand the basis of the Crystal Structure, Diffraction of waves by crystals, Bragg law, Reciprocal an Lattice Vectors	K2
CO2	Understand the concepts of Crystal Binding And Elastic Constants	K2
CO3	Get familiar with the knowledge of phonons	K2
CO4	Apply the knowledge of free electron Fermi gas	K3
CO5	Apply the concepts of semi Conductors and Fermi Surfaces of Metals	K3

K2-Understanding K3-Applying

COURSE CONTENT

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-- Anharmonic 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-crystal momentum of an electron.

UNIT V: SEMI CONDUCTORS, FERMI SURFACES AND METALS

Band gap - Equations of Motions - Effective Mass -physical interpretation 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

BOOK FOR STUDY:

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

   Unit I-Ch. l& 2 (Pg. 3-19, 29-34, 36,37,48,49)

   Unit II-Ch. 3 (Pg. 55-62, 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- (pg199-206, 209-212, 235-242, 244-252,26)) Ch.8 & 9. 2770

BOOKS FOR REFERENCE:

1. S.O.Pillai, *Solid State Physics*, V edition, Newage Int. Ltd.,

2. J.P. Srivatsva, *Elements of Solid State Physics*, Prentice –Hall of India.

Web Resources:

- https://www.britannica.com/science/crystal
- https://www.vedantu.com/physics/phonon

SEMESTER – III

CORE PAPER IX
NUCLEAR AND ELEMENTARY PARTICLE PHYSICS

6-hours - 5-credits

COURSE OBJECTIVES:

- To know about nuclear forces, models and reactions.
- To understand scientific and technological applications of nuclear Physics as well as their social, economic and environmental implications.
- To explore the various radioactive decays.
- To understand the concept of elementary particles.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understand the concepts of nuclear forces, nucleon scattering and nuclear magnetic moment	K2
CO2	Apply the concepts nuclear models	K3
CO3	Apply the concepts and laws of nuclear reactions	K3
CO4	Understand the various radioactive decays	K2
CO5	Become familiarize with the types and properties of elementary particle.	K2

K2-Understanding K3-Applying

COURSE CONTENT

UNIT-I: NUCLEAR FORCES

Introduction – Ground state of deuteron – Low energy neutron – Proton scattering – Spin dependence of n-p interaction – Effective range of theory –Scattering parameters from low energy data- Non – central force – Quadrapole moment of the deuteron – Proton proton scattering at low energies – Neutron - neutron scattering – Change independence of nuclear force - Exchange interaction and saturation – Meson theory of nuclear force – Nature of two nucleon potential

UNIT-II: NUCLEAR MODELS

Constitution of the nucleus: neutron- proton hypothesis- Nuclear models- Liquid drop model- Bethe- Weizacker formula- Applications of the semi empirical binding energy formula- Fermi gas model of the nucleus- Nuclear shell structure- Single particle shell model- Individual particle model- Collective model- Electric quadrupole moments for strongly deformed nuclei- Nilson's unified model for deformed potential.

UNIT-III: NUCLEAR REACTIONS

Kinds of reaction and conservation laws – Energy of nuclear reactions – Nuclear cross section – Continuous theory of nuclear reaction – Resonance – Breit and Wigner dispersion formula – Stages of nuclear reactions – Kinematics of stripping and pick up reaction

UNIT-IV: RADIOACTIVE DECAYS

Alpha particles

Determination of q/m of alpha particles – Determination of charge and mass – Identification of alpha particles – Determination of velocity – Disintegeration energy – Range

Beta particles

Determination of specific charge – Bucherer's experiment – Beta energy – Fermi's theory of allowed beta decay – Allowed and forbidden transitions – Selection rules

Gamma Rays

Nature of gamma rays – passage – Photo electric absorption – Compton scattering – Electron positron pair production and annihilation – Determination of gamma ray energy – Nuclear isomerisim – Internal conversion

UNIT-V: ELEMENTRY PARTICLE PHYSICS

Classification of elementary particles – Particle Interaction- Conservation laws- Invariance under: charge, parity- Cp time and C.P.T- Electrons and Positrons- Protons and Anti- protons- Neutrions and Anti-Neutrinos- Photons- Mesons- Muon- Pions- K- Mesons- Hyperons- Elementary particle symmetries- Quark theory- Electromagnetic structure of nucleons.

BOOKS FOR STUDY:

1. S.N. Ghoshal , *Nuclear Physics,* S. Chand and Co., II,Ed., 1994.
   Unit I- Ch. 17 (17.1, 17.2, 17.6, 17.8, 17.9, 17.12, 17.13, 17.16, 17.17, 17.18, 17.23, 17.24)
   Unit II- Ch. 9 (9.1, 9.4- 9.9, 9.12, 9.14, 9.19, 9.20)
2. Nuclear Physics, D.C. Tayal, Himalaya Publishing House Pvt., Ltd., V edition, 2018.
   Unit III – Ch. 10 (10.1, 10.2, 10.3, 10.6, 10.13, 10.4, 10.16-10.19)
   Unit IV - Ch. 4 (4.1, 4.2, 4.3, 4.4, 4.5, 4.6)
   Ch.5 (5.1, 5.2, 5.3, 5.7, 5.8, 5.9)
   Ch.6 (6.1, 6.2, 6.3, 6.4, 6.5, 66, 6.7, 6.10, 6.11)
   Unit V Ch.16 (16.1-16.10, 16.13, 16.14, 16.16, 16.19, 16.20)

BOOKS FOR REFERENCE:

1. R. D. Evans, "Atomic Nucleus", Mcgraw-Hill NY.1955.
2. J. M. Blatt and V. F. Weisskopf, "Theoretical Nuclear Physics". Berlin 1979.
3. H. Enge, " Introduction to Nuclear Physics Addision-Wesley" .Reading MA. 1975
4. R. R. Roy and B. P. Nigam, "Nuclear Physics", Wiley Eastern, Madras1993.
5. D.C. Tayal „Nuclear Physics"Bohr and B. R. Mottelson, "Nuclear Structure" Vol. I (1969) and Vol.II(1975), Benjamin Reading .

SEMESTER – III
COREELECTIVE PAPER III – MICROPROCESSOR - 8085
6-hours - 4-credits

COURSE OBJECTIVES:

In studying the paper the students can

- Get clear knowledge of Microcomputer arrangement and an Introduction to Intel processors.
- Meet the challenges of this growing technology one has to be conversant with programmable aspect of microprocessor.
- Understand and apply various instructions in 8085.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understand the Microcomputer arrangement and the Intel processors 8085, its Pin functions and its architecture.	K2
CO2	Know the assembly language instruction set of 8085.	K2
CO3	Apply the assembly level language instructions for writing various programs.	K3
CO4	Understand instruction timings.	K2
CO5	Apply the knowledge of 8085 in understanding the memory interfacesand to study microprocessor applications.	K3

K2-Understanding K3-Applying

COURSE CONTENT

UNIT I - MICROCOMPUTER ORGANISATION AND 8085 MICROPROCESSOR

Microcomputer arrangement – Memory, a general discussion – Read Only Memory (ROM) – Random Access Memory (RAM) – Microprocessor as CPU – Input unit – Output unit – System bus and bus structure – Execution of an instruction.

Introduction to Intel processors – Pin functions of 8085 – Architecture of 8085.

UNIT II – INSTRUCTION SET OF 8085 I AND II

Machine language and Assembly language – Programmer's model of 8085 – Data transfer instructions –I – Arithmetic instructions – Logic instructions - Special instructions – Assembly language to Hex code.

Data transfer instructions-II – Branch instructions – Stack and Stack related instructions – I/O and Machine control instructions – 8085 addressing Modes.

UNIT III – ASSEMBLY LANGUAGE PROGRAMS

Addition – Subtraction – Multiplication – Division – Square and Square root – Sorting and Searching – Code Conversion – Debugging a program.

UNIT IV – 8085 INSTRUCTION TIMINGS

Introduction – Memory Read cycle – Memory Write cycle – Wait States – Halt States – Hold State – Timing diagrams for some instructions – Delay Calculations.

UNIT V – 8085 MEMORY INTERFACE & MICROPROCESSORAPPLICATIONS

Memory Interface-basics – Demultiplexing Address / Data bus – Generating control signals.

LED Interface (Flashing LEDs, Hex counter, BCD counter and traffic light control) – Seven segment display interface – Hex keyboard interface.

BOOK FOR STUDY:

1. Fundamentals of Microprocessor-8085 – V.Vijayendran, (Printers & Publishers Pvt., Ltd) 2011
   Unit I : Chapter -2 (2.1-2.9 & Chapter -3 3.1 - 3.3 P 31-60)
   Unit II : Chapter 4 & 5 (4.1 – 4.7 & 5.1 – 5.5 P 61 to 117)
   Unit III : Chapter 6 (6.1 – 6.8 P 118 – 181)
   Unit IV : Chapter 7 (7.1 – 7.8 P 182 – 204)
   Unit V : Chapter 8 (8.1 – 8.5 P 205 – 223)

BOOKS FOR REFERENCE:

1. Microprocessor – Ramesh S. Gaonkar
2. Microprocessor Principles and Applications – Ajit Pal
3. Microprocessor and Its Applications – A.NagoorKani.

SEMESTER – III
CORE ELECTIVE PAPERIII - CRYSTAL GROWTH AND CHARACTERIZATION
6-hours - 4-credits

COURSE OBJECTIVES:

The main objectives of this course are to:

- provide an extended knowledge on advanced condensed matter topic like crystal growth methods.
- make the students understanding on the theories involve in the nucleation and growth process.
- know the fundamental concepts behind the solution, melt and vapour growth techniques.
- study the experimental methods in solution, melt and vapour growth techniques.
- provide necessary knowledge on the functioning of various characterization tools.

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

CO	Statement	Blooms Taxonomy level
CO1	Understand the process of crystal nucleation and growth	K2
CO2	Know about various crystal growing techniques	K3
CO3	Understand the methodologies of solution and gel growth techniques	K2, K3
CO4	Understand the concepts behind the melt and vapour growth techniques	K2, K3
CO5	Know about different characterization techniques	K4, K5

K2-Understanding K3-Applying K4 –Analyzing K5- Evaluating

COURSE CONTENT

UNIT I: NUCLEATION THEORY

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

UNIT II: SOLUTION GROWTH TECHNIQUES

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

UNIT III: MELT GROWTH TECHNIQUES

Basics of melt growth - Bridgman method – Growth apparatus - Crucibles, Heater, Measurement and Control of Temperature – growth process – Applications of Bridgman method - Czochralski technique – Growth apparatus – seed preparation – pulling rate – shape of crystal melt interface – Growth process.

UNIT IV: VAPOUR GROWTH TECHNIQUES

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

UNIT V: CHARACTERIZATION TECHNIQUES

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

BOOKS FOR STUDY:

1. Crystal Growth Processes- J. C. Brice, John Wiley and Sons, New York, 1986.
2. Crystal Growth Processes and Methods- P. SanthanaRagavan and P. Ramasamy, KRU Publications, Kumbakonam, 2001.
3. Introduction to Crystal Growth Principles and Practice -H.L. Bhat, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2015.

BOOKS FOR REFERENCE:

1. Hand book of Crystal Growth -GovindhanDhanaraj, KullaiahByrappa, Vishwanath Prasad, Michael Dudley (Eds.), Springer Heidelberg Dordrecht London New York, 2010.
2. Crystal Growth -B.R. Pamplin, Pergamon Press, Oxford, 1975.
3. Elementary Crystal Growth (Edited)- K. Sangwal, SAAN Publishers, Lublin, 1994.
4. Materials Characterization Techniques-Sam Zhang, Lin Ki, Ashok Kumar, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009.

SEMESTER – III
CORE PRACTICAL PAPER III – GENERAL PHYSICS
6-hours - 4-credits

(Suggestive – Any Eight experiments)

Course Objectives:

- To make students to apply the theoretical knowledge gained in core papers to do practicals.

Course Outcomes:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	The Self inductance of a coil L is determined using different AC bridges	K3
CO2	Mutual inductance of two coils are compared using B.G	K3
CO3	Using Spectrometer the Fraunhofer lines are observed and wavelengths are determined from Solar spectrum	K3
CO4	Wavelength of Monochromatic light is determined using Biprism with Spectrometer and with Optic bench.	K4
CO5	Determination of Refractive index of liquid by Newton's rings. Determination of Young's modulus by forming Hyperbolic fringes.	K5

K3-Applying K4 – Analysing K5 - Evaluating

List of Experiments

1. Self inductance of a coil L – Owen's bridge
2. Self inductance of a coil L – Anderson's Bridge
3. Self inductance of a coil L – Rayleigh's Bridge
4. Determination of mutual inductance – B.G
5. Comparison of mutual inductance – B.G
6. Solar spectrum – Fraunhofer lines – Spectrometer
7. Cauchy's constants – Spectrometer
8. Hartmann's interpolation formula – Spectrometer
9. Refractive index of liquid – Newton's rings
10. Wavelength of Monochromatic light – Biprism – Spectrometer
11. Determination of λ of monochromatic light – Michelson interferometer
12. Young's modulus – Hyperbolic fringes
13. Optic bench – Biprism experiment

SEMESTER – IV
CORE PAPER X - FIBRE OPTIC COMMUNICATION
6-hours - 5-credits

COURSE OBJECTIVES:

- To expose the students to the basics of signal propagation through *optical* fibers, components and devices.
- To recognize and classify the structures of optical fiber and types.
- To provide students with the design and operating principles of optical communication systems and networks.
- To understand the structure, the performance and the signal analysis of optical sources and optical detectors.
- To know the power coupling losses due to connectors, splices and fiber numerical aperture.

COURSE OUTCOMES:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Get the knowledge of properties and types of fibers.	K2
CO2	Understand optical fiber structure, wave guiding and fabrication	K2
CO3	Acquire the knowledge of optical fiber transmission link and advantages of optical fiber communication.	K3
CO4	Gain the knowledge of different kinds of losses, signal distortion in optical wave guides and other signal degradation factors.	K3
CO5	Analyze various coupling losses.	K4

K2-Understanding K3-Applying K4 - Analyzing

COURSE CONTENT

UNIT I: OPTICAL FIBERS AND SENSORS

Introduction- optical fiber system- optical fiber cable- total internal reflection- propagation of light- through an optical fiber- critical angle of propagation- acceptance angle- Numerical aperture- modes of propagation- types of rays- cclassification of optical fibers- single mode step index fiber- multimode step index fiber- graded index fiber- Fiber optic communication system- merits of optical fibers- fiber optic sensors- temperature sensor- displacement sensor- force sensor- liquid level sensor.

UNIT II: FIBER MATERIALS, FABRICATIONS AND SIGNAL DEGRADATIONS

Glass fibers- Halide glass fibers- Active glass fibers- Plastic- Clad glass fibers- plastic- Fiber fabrication- Outside vapour phase oxidation- Vapour phase axial deposition- Modified chemical vapour deposition- - Attenuation units- Absorption scattering losses- Bending loses- Core and cladding losses- signal distortion in fibers.

UNIT III: OPTICAL SOURCE AND DETECTORS

Energy bands- Intrinsic and extrinsic material- pn junction- Direct and indirect bandgap – Semiconductor device fabrication – LED – LED structure – Light source materials – Modulation capacity – Laser diode modes and threshold condition – Laser diode structure and radiation pattern – single mode laser – Physical principle of Photodiodes – the pin photodetectors – Avalanche Photodiode.

UNIT IV: POWER LAUNCHING AND COUPLING

Source to fibre power launching – source output pattern power – power launching verses wavelength – Equilibrium numerical aperture – Non imaging microsphere laser diode to fibre coupling to fibre joints – Mechanical misalignment- Fibre splicing – Splicing techniques – Optical connectors.

UNIT V: OPTICAL RECEIVER OPERATION

Fundamental receiver operation- Digital signal transmission- error sources- front- end amplifier- Digital receiver performance- probability of error- receiver sensitivity- coherent detection- fundamental concepts- Homodyne detection- Heterodyne detection- PSK Homodyne system- Heterodyne detection schemes- **Burst mode receivers- Analog receivers***.

***Self study**

BOOK FOR STUDY:

1. Dr. N. Subrahmanyam, Brijlal and Dr. M. N. Avadhanulu, *A Textbook of Optics*, 25th revised Ed., S. Chand& Company pvt.ltd., New Delhi.
   Unit I- Ch. 24 (Pg.655- 671), (Pg. 689- 694)

2. Gerd Keiser, *Optical fiber communications*, 4th Ed., Tata McGraw Hill Education, pvt. Ltd., New Delhi.
   Unit II- Ch. 2.7 (Pg.67- 73), (Pg.90-102)
   Unit III- Ch. 4 (Pg.135- 158), (Pg.162- 168), (Pg.222- 231)
   Unit IV- Ch. 5 (Pg.190- 216)
   Unit V- Ch. 7 (Pg.250- 261), (Pg.265- 278)

BOOK FOR REFERENCE:

2. Introduction to Fiber Optics, Ajoy Ghatak and K.Thyagarajan, Cambridge University Press.

Web Resources:

- https://www.techtarget.com/searchnetworking/definition/fiber-optics-optical-fiber
- https://www.tutorialspoint.com/principles_of_communication/principles_of_optical_fiber_communications.htm

SEMESTER – IV

CORE PAPER XI - ATOMIC AND MOLECULAR SPECTROSCOPY

6-hours - 5-credits

Course Objectives:

To study about the

- Atomic Spectroscopy, Microwave Spectroscopy, IR Spectroscopy and Raman Spectroscopy

- Electronic Spectra of diatomic molecules
- NMR and AQR Spectroscopy.

Course Outcomes:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understood the concepts of atomic spectroscopy	**K2**
CO2	Understood the concepts of molecular spectroscopy	**K2**
CO3	Knew about the Raman spectroscopy and Electronic spectra of diatomic molecules	**K2**
CO4	Applied the knowledge of NMR and NQR spectroscopy	**K3**
CO5	Applied the knowledge of the principles of ESR Spectroscopy: and Mossbauer Spectroscopy:	**K3**

K2-Understanding, **K3**-Applying

Course Content

UNIT I : ATOMIC SPECTROSCOPY

Spectra of the alkali metal vapours– Elements with more than one outer valence electron – magnetic moment and space quantization of angular momentum– The magnetic moment of the atom – Normal Zeeman effect – Anamalous Zeeman effect– Emitted transitions in anomalous Zeeman transitions – The Lande's 'g' formula – The Paschen Back effect – hyperfine structure of spectral line – Zeeman effect of hyperfine structure – the Back-Goudsmit effect.

UNIT II : MICROWAVE SPECTROSCOPY

The rotation of molecules – rotational spectra of rigid diatomic molecules – the intensities of spectral lines – the non rigid rotator – the spectrum of a non-rigid rotator – symmetric top molecules

IR Spectroscopy

The vibrating diatomic molecules – The simple harmonic oscillator – The anharmonic oscillator – The diatomic vibrating rotator – fundamental vibrations and their symmetry – The influence of rotation on the vibrational spectra of polyatomic molecules – linear molecules – symmetric top molecules.

UNIT III :

Raman spectroscopy

Quantum theory – Classical theory – pure rotational Raman spectra – linear molecules – symmetric top molecules – Raman activity of vibrations – Rule of mutual exclusion – Vibrational Raman spectra – Rotational fine structure .

Electronic spectra of diatomic molecules

Vibrational coarse structure – Deslandres tables – Frank-Condon principle – rotational fine structure of electronic – vibrational transition.

UNIT IV :

NMR spectroscopy:

Quantum mechanical and classical description – The Bloch equations - Relaxation processesspin lattice and spin relaxation – Fourier transformation - Experimental technique- principles and working of Fourier transform NMR spectrometer- chemical shift.

NQR spectroscopy:

Fundamental requirements - general principles – Half integral spins – Integral spins experimental detection of NQR frequencies.

UNIT V :

ESR Spectroscopy:

Basic principles of ESR – experiments - ESR Spectrometer - Reflection cavity and microwave bridge – ESR spectrum- **Hyperfine structure –** Study of free radicals.

Mossbauer Spectroscopy:

The Mossbauer effect – The recoilless emission and adsorption – The Mossbauer spectrum experimental methods.

Books for study:

1. Fundamentals of Molecular Spectroscopy C.N. Banwell and E.M. Mc Cash, Tata McGraw Hill Pub.Co, 4th Edition (1994).
2. Spectroscopy B.P.Straughan and S.Walker, John Wiley Wiley& Sons Inc., Newyork (1976).

Books for Reference:

1. Elements of spectroscopy Gupta Kumar, PragathiPrakasan pub. Co., Meerut (2007).
2. Molecular structure and spectroscopy G. Aruldhas, Prentice Hall of India (2002).

SEMESTER – IV

CORE ELECTIVEPAPER IX – STATISTICAL MECHANIS AND THERMODYNAMICS

6-hours - 4-credits

Course Objective : To enable the learner to know about

- Basic laws in Thermodynamics,
- Classical law and distributions,
- Basic concepts in quantum statistics.

Course Outcomes:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Know about statistical nature of concepts and laws in thermodynamics	**K2**
CO2	Get knowledge about basic concepts and relations including phase space, ensemble, statistical, thermal and mechanical equilibrium.	**K2**
CO3	Get knowledge about using the statistical Physics method such as Boltzmann and Gibb's distributions.	**K2**
CO4	Get knowledge about quantum statistics.	**K2**
CO5	Applying quantum statistics to Ideal Bose Einstein gas and Fermi- Dirac gas.	**K3**

K2-Understanding, K3-Applying

Course Content

UNIT I: THERMODYNAMICS AND RADIATION

Second law of thermodynamics- Entropy and Second law of thermodynamics- Entropy and Disorder- Thermodynamic Potential and Reciprocity relation- Thermodynamic Equilibria -Chemical Potential. Black body radiation – Planck's Radiation law.

UNIT II: BASIC CONCEPTS

Phase space- Volume in phase space-Number of phase cells in given energy range of harmonic oscillator- Number of phase cell in the given energy range of 3-dimensional free particle-Concept of

ensemble- Micro canonical ensemble-Canonical ensemble- Grand Canonical ensemble- Density distribution in phase space- Liouvilles theorem- Postulate of equal a priori probability- Statistical equilibrium- Thermal equilibrium- Mechanical equilibrium-Particle equilibrium-Connection between Statistical and thermodynamic quantities.

UNIT III: CLASSICAL DISTRIBUTION LAW

Microstates and Macro states-Classical Maxwell-Boltzmann distribution law- Evaluation of constants, α and β- Maxwell's law of Distribution of velocities- Principle of equi-partition of energy - Connection between the partition function and thermodynamic quantities –Boltzman' entropy relation – Perfect gas in micro canonical Ensembles - Gibbs paradox- Partitionfunction and its correlation with thermodynamics quantities- Partition functions and its properties- Comparison of ensembles.

UNIT IV: QUANTUM STATISTICS

In-distinguish ability and quantum statistics- Statistical weight and a priori probability- Identical particle's and symmetry requirements - Bose Einstein' Statistics- Fermi Dirac Statistics –Maxwell – Boltzmann statistics **- Comparison of M-B, B-E, and F-D statistics*-**

Thermodynamic interpretation of parameter's α and β - Eigen states and the Maxwell Boltzmann equation - Blackbody radiation and Planck radiation- Thermodynamic properties of diatomic molecules Specific heat of solids: Dulong and Pettit's law- Einstein's Theory – Debye theory.

UNIT V: APPLICATION OF QUANTUM STATISTICS

Ideal Bose Einstein gas:

Energy and pressure of ideal Bose Einstein gas- Gas Degeneracy - Bose Einstein condensation-Thermal properties of Bose Einstein gas - Liquid helium - Ideal

Fermi- Dirac gas:

Energy and pressure of ideal Fermi-Dirac gas – Weak degeneracy – Strong degeneracy at T=0- Fermi energy –Fermi temperature – Thermodynamic functions of degenerate Fermi – Dirac gas Electron gas - Free electron model and electronic emission.

Books for Study:

1. *Statistical Mechanics*, Gupta & Kumar, PragatiPrakashan Meerut (2003).

Unit I- Ch. A (Pg. 3 – 21) , (A – 1 – A-6) ,Ch. B (Pg. 28 – 37) , (B-5 – B-8)

Unit II- Ch. 1 (Pg. 78 – 87) , (1.1 – 1.5) , (Pg. 89 – 94) , (1.7) , (Pg. 95 – 102), (1.9 – 1.14)

Unit III- Ch. 2 (Pg. 103 - 104) ,(2.1) , (Pg.109-114) , (2.7-2.9) , (Pg.116-118), (2.10), (Pg. 119-122) (1.1 – 1.5) (2.12), (Pg. 123-124) , (2.14), (Pg. 126-129) , (2.16)

Ch. 3 (Pg. 141 - 150) ,(3.0-2 – 3.0-4) , (Pg.160-163) , (3.1-4) , (Pg.117), (3.2-3)

Unit IV-Ch. 5 (Pg.214-215) ,(5.3) , (Pg.218-219) , (5.8)

Ch. 6 (Pg.238-246) ,(6.1-6.4) , (Pg.248-250) , (6.6-6.7) , (Pg.252-255), (6.9-6.10)

Ch. 7 (Pg.258-261) ,(7.10) , (Pg.266-272) , (7.2-7.2-3)

Unit V-Ch. 8 (Pg.274-287) ,(8.0 – 8.4)

Ch. 9 (Pg.295-305) ,(9.0 – 9.1) , (Pg.305-307) , (9.3) , (Pg.309-311), (9.4).

2. *Elements of Statistical Mechanics* , Kamal Singh, S.P.Singh, S.Chand & Co Pvt Ltd (1999).

Books for Reference:

1. *Fundamentals of Statistical Mechanics* - Keiser Huang, (2009).
2. *Fundamentals of Statistical Mechanics And Thermal Physics* - F Reif, McGraw, Hill (2010).

SEMESTER – IV
CORE ELECTIVE PAPER IX – ATMOSPHERIC PHYSICS
6-hours - 4-credits

Course Objectives:

- Students can demonstrate familiarity with microphysical principles and how they determine the structures of the atmosphere and clouds.
- Students can demonstrate the ability to apply principles of cloud microphysics and atmospheric chemistry to the solution of atmospheric problems.

Course Outcomes:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	Understand the Physical Meteorology: Structure of Earth's Atmosphere and Composition- Law of Thermodynamics of the Atmosphere	**K2**
CO2	Understand the Fundamental Forces and Structure of Static Atmosphere. Momentum, Continuity & Energy Equations and Thermodynamics	**K2**
CO3	Understand the various Climatic Classifications and Monsoon Seasons	**K2**
CO4	Get the knowledge ofRole of Meteorology in Atmospheric Pollution	**K2**
CO5	Apply the concepts of Radar Principles and Technology & Radar Signal Processing &Display of Weather in Radar	**K3**

K2-Understanding, K3-Applying

Course Content

UNIT-I: PHYSICAL & DYNAMIC METEOROLOGY

Physical Meteorology: Structure of Earth‟s Atmosphere and Composition- Law of Thermodynamics of the Atmosphere- Adiabatic Process-Potential Temperature-ClausiusClapyeron Equation-Laws of Black Body Radiation-Solar and Terrestrial Radiation-AlbedoGreen House Effect-Heat Balance of Earth Atmosphere System.

UNIT-II: DYNAMIC METEOROLOGY

Fundamental Forces-Structure of Static Atmosphere-Momentum, Continuity and Energy Equations-Thermodynamics of the Dry Atmosphere-Elementary Applications of the Basic Equations-Circulation Theorem-Vorticity-Potential Vorticity and Potential Vorticity Equations.

UNIT-III: CLIMATE & MONSOON DYNAMICS

Climate Classification-Polar, Artic, Antarctic, Temperate & Tropical Climates Wind, Temperature & Pressure Distribution over India in the Lower, Middle and Upper Atmosphere during Pre- Post- and Mid-Monsoon Season-Dynamics of Monsoon Depression and Easterly Waves-Intra Seasonal and Interannual Variability of Monsoon-QuasiBi Weekly and 30-60 Day Oscillations-Walker Circulation, Southern Oscillations & El Nino

UNIT-IV: ATMOSPHERIC POLLUTION

Role of Meteorology in Atmospheric Pollution-Atmospheric Boundary Layer-Air StabilityLocal Wind Structure-Ekman Spiral-Turbulence & Boundary Layer Scaling-Residence Time and Reaction Rates of Pollutants-Sulphur Compounds-Carbon CompoundsOrganic compounds-Aerosols- Toxic Gases and Radio Active Particles-Trace Gases

UNIT-V: RADAR METEOROLOGY

Basic Meteorology-Radar Principles and Technology-Radar Signal Processing &DisplayWeather Radar- Observation of Precipitating Systems-Estimation of Precipitation-Radar observation of Tropical Storms & Cyclones-Use of Weather Radar in Aviation-Clear Air Radars-Observation of a Clear Air Phenomena State Integrated Board of Studies – Physics

BOOKS FOR STUDY:

1. The Atmosphere-Frederick K. Lutgens and Edward J. Tarbuk.

BOOKS FOR REFERENCE:

1. Dynamic Meteorology-J.R. Holton-Academic Press- NY
2. The Physics of Monsoons-R.N. Keshvamurthy& M. Shankar Rao-Allied Publishers
3. Principles of Air Pollution Meteorology-Tom Lyons &Prillscott-CBS Publishers & Distributors
4. Radar Meteorology-Henry Saugageot.

SEMESTER – IV
CORE PRACTICAL PAPER IV – COMPUTER PROGRAMMING IN C++

6-hours - 3-credits

Course Objective

- To understand the programming techniques in C++
- To write and run many programs

Course Outcomes:

On completion of the paper Students will be able to

CO	Statement	Blooms Taxonomy level
CO1	**W**rite simple programme in 'C++'	K3
CO2	**U**se control statements and simple if else statements in writing programmes	K3
CO3	**W**rite programs using switch case	K3
CO4	**W**rite programe using for loop	K4
CO5	**W**rite programe using functions	K5

K3-Applying K4 – Analysing K5 - Evaluating

List of Experiment (Suggestive - any Eight)

1. Sum of two numbers
2. Multiplication of two numbers
3. Fahrenheit to Celsius conversion
4. Solving quadratic equation
5. Find the largest among three numbers
6. Arranging data in ascending / descending order
7. Fibonacci series
8. Finding prime number
9. Factorial of a number
10. Finding Armstrong number
11. Reversing the numbers
12. Multiplication of two matrices

ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN, PALANI

P.G DEPARTMENT OF PHYSICS

OUTCOME BASED EDUCATION

ACADEMIC STRUCTURE IN AUTONOMY

CHOICE BASED CREDIT SYSTEM (CBCS)

Effect from the Academic year 2022-23 onwards

INTERNAL QUESTION PATTERN

Section	Pattern	Marks	Total
A	1& 2 Either or Pattern	2x 5	10
B	3& 4 Either or Pattern	2x 10	20
		TOTAL	30

COMPONENTS OF INTERNAL ASSESSMENT

Components	Calculation		Marks
Test I	30/2	(15+ 15)/2	15
Test II	30/2		
Assignment			5
Seminar			5
TOTAL INTERNAL MARKS			25

EXTERNAL QUESTION PATTERN

Section	Pattern	Marks	Total
A	1- 5 Either or Pattern	5x 5	25
B	6- 10 Either or Pattern	5x 10	50
		TOTAL	75

EQUAL WEIGHTAGE TO BE GIVEN TO ALL THE FIVE UNITS