M.Sc. Physics

(Distance Learning Mode)

Curriculum (*2018-2019 onwards*)

for

Credit Based System

Programme Project Report

(Based on UGC-DEB 2017 guidelines)

Alagappa University

(A State University Accredited with A+ Grade by NAAC)

Karaikudi - 630 003

CONTENTS

Master of Science (M.Sc.) in Physics Programme
(Distance Learning Mode)

Credit Based System (CBS)
(*With effective from the academic year 2018 - 2019 onwards*)

a. Programme's Mission & Objectives:

The programme is named as Master of Science (M.Sc.) in Physics. The syllabus for this programme is framed under the rules of the Credit Based System (CBS). Physics is the natural science that involves the study of matter and its motion through space and time along with the related concepts such as energy and force. It is one of the most fundamental scientific disciplines. The main goal of Physics is to understand how the universe behaves. Physics explains the natural phenomena in the universe and often considered to be the most fundamental science. It provides a basis for all other sciences - without Physics, we could not have Biology, Chemistry, or anything else. Physics also makes significant contributions through advances in new technologies. One academic programme is necessary to create awareness to students in the emerging field and also it should teach basic concepts and developments of Physics to students to make them as scientist or technologists in this filed. Hence our task is to introduce the M.Sc. programme in Physics to educate the undergraduate students in the fascinating fields. Rigorous and comprehensive in approach, this syllabus presents essential contents in a detailed, clear and direct way. The programme is structured in such a way to impart more knowledge in science, in particular in Physics.

The major objectives of M.Sc. Physics programme are:

- To provide, thorough well designed studies of theoretical and experimental Physics, a worthwhile educational experience for all students.
- To acquire deep knowledge in the fundamental aspects of all branches of Physics.
- To acquire basic knowledge in the specialized thrust areas like Classical Mechanics, Quantum Mechanics, Mathematical Physics, Electromagnetic Theory, Electronics, Microprocessor & Electronic Instrumentation, Condensed Matter Physics, Nuclear and Particle Physics, Materials Science etc.,
- To develop abilities and skills that:
    - are relevant to the study and practice of science,

- are useful in everyday life,
- are encouraging efficient & safe practice and effective communication,
- are encouraging research and development activities.

- To develop attitudes relevant to science such as:
  - Concern for accuracy and precision,
  - Objectivity,
  - Integrity,
  - Enquiry,
  - Initiative and
  - Inventiveness.

b. Relevance of the Programme with Algappa University's Mission and Goals:

In order to align with the mission and goals of Alagappa University, the M.Sc. Physics Programme is planned to deliver in Distance Learning mode which may reach the maximum number of student aspirants who are unable to thrive to spend non-elastic timings of formal conventional class room education. Such a higher education in science subject with appropriate laboratory experiences will enrich the human resources for the uplift of the nation to Educational, Social, Technological, Environmental and Economic Magnificence (ESTEEM).

c. Nature of Prospective Target Group of Learners:

This M.Sc. Physics Programme through Distance Learning mode is developed by keeping in mind to give opportunity to economically and socially excluded people including graduates of various socio-economic status viz., unemployed youths, employed with marginalized salary due to lack of sufficient knowledge in the subject Physics. Also, the target group of learners includes various level employees of Physics-based companies, secondary-level school teachers, research aspirants, women taking care of family - the important unit of the community, etc.

d. Appropriateness of programme to be conducted in Distance Learning mode to acquire specific skills and competence:

M.Sc. Physics Programme through Distance Learning mode is developed in order to give subject-specific skills including i) understanding of intermediate classical mechanics topics such as coordinate transformations, oscillatory motion, gravitation and other central forces, and

Lagrangian mechanics, ii) master the basic elements of mathematical physics, iii) analyze and design basic op-amp circuits, particularly various linear and non-linear circuits, iv) create and solve mathematical models of physical phenomena using analytic and numerical methods, v) develop the programming skills of microprocessor, vi) identify the fundamental models of nuclear structure that are used to describe various modes of nuclear excitation, v) provide insight into some of the steps in the production of semiconductor devices. In addition, the programme is developed to give a detailed theoretical exposure and free-hands experience on practical parts of the study in order to impart skills of Physics to the learners.

e. Instructional Design:

e. 1. Curriculum Design:

Sl. No.	Course Code No.	Title of the Course	Marks			Credit
			CIA	ESE	TOT	
FIRST YEAR						
I SEMESTER						
1	34511	Classical Mechanics	25	75	100	4
2	34512	Mathematical Physics - I	25	75	100	4
3	34513	Linear and Integrated Electronics	25	75	100	4
4	34514	Advanced Electronics and Physics Laboratory - I	25	75	100	4
Total			**100**	**300**	**400**	**16**
II SEMESTER						
5	34521	Quantum Mechanics - I	25	75	100	4
6	34522	Mathematical Physics - II	25	75	100	4
7	34523	Electromagnetic Theory	25	75	100	4
8	34524	Advanced Electronics and Physics Laboratory - II	25	75	100	4
Total			**100**	**300**	**400**	**16**
SECOND YEAR						
III SEMESTER						
9	34531	Molecular Spectroscopy	25	75	100	4
10	34532	Quantum Mechanics - II	25	75	100	4
11	34533	Microprocessor and Electronic Instrumentation	25	75	100	4
12	34534	Advanced Electronics and Physics Laboratory - III	25	75	100	4
Total			**100**	**300**	**400**	**16**
IV SEMESTER						
13	34541	Condensed Matter Physics	25	75	100	4
14	34542	Nuclear and Particle Physics	25	75	100	4
15	34543	Materials Science	25	75	100	4
16	34544	Advanced Electronics and Physics Laboratory - IV	25	75	100	4
Total			**100**	**300**	**400**	**16**

Course Code Legend:

3	4	5	X	Y

345 - M.Sc. Physics Programme

X - Semester No.

Y - Course number in the semester

CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

No. of Credits per Course (Theory):	4
No. of Credits per Course (Practical):	4
Total No. of Credits per Semester:	16
Total No. of Credits for the Programme:	64 (16 credits × 4 semesters)

e. 2. Detailed Syllabi:

I SEMESTER

34511	**CLASSICAL MECHANICS**
Objectives	*The objective of the syllabus is to impart knowledge to the students on the basic ideas of classical mechanics and its applications.*
Outcome	On successful completion of the course, a student will be able to • Explain clearly the notion of degrees of freedom and identify them for a given mechanical system • Explain clearly the notion of degrees of phase space • Demonstrate an understanding of intermediate classical mechanics topics such as coordinate transformations, oscillatory motion, gravitation and other central forces, and Lagrangian mechanics
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on Newton's laws, simple and compound pendulum, moment of inertia, relativity theory, energy and oscillator are prerequisite.
	BLOCK I : LAGRANGE AND HAMILTON EQUATIONS
UNIT I	**NEWTON'S LAWS OF MOTION**
	Introduction – Newton's laws of motion- Kepler's laws of planetary motion- stability of orbit- Classification of a Dynamical System.
UNIT II	**LAGRANGE EQUATION**
	Lagrange's Equations for Simple Systems – Principle of Virtual Work – D'Alembert's principle – Lagrange's Equations for General Systems.
UNIT III	**HAMILTON EQUATION**
	Hamilton's Equations – Ignorable Coordinates – The Routhian Function.
UNIT IV	**HAMILTONIAN METHODS**
	Introduction – Hamilton's principle – Hamilton's Principle for a Conservative System – Principle of Least Action.
	BLOCK II: HAMILTONIAN METHODS
UNIT V	**HAMILTON-JACOBI THEORY**

	Characteristic Function and Hamilton-Jacobi Equation.
UNIT VI	**CANONICAL TRANSFORMATIONS**
	Phase Space and Liouville's Theorem – Special Transformations – Lagrange Brackets – Poisson Bracket – Calculus of Variations.
	BLOCK III: **KINEMATICS OF RIGID BODY MOTION AND SPECIAL THEORY OF RELATIVITY**
UNIT VII	**KINEMATICS OF RIGID BODY MOTION**
	Moments and Products of Inertia – Moment of Inertia of a Body about any Line – Through the origin of coordinate frame – The momental Ellipsoid – rotation Coordinate Axes.
UNIT VIII	**RIGID BODY EQUATIONS OF MOTION**
	Principal Axes and Principal Moments – Kinetic Energy of a Rigid Body Rotating about a Fixed Point – Angular Momentum of a Rigid Body – Eulerian Angles – The Compound Pendulum.
UNIT IX	**SPECIAL THEORY OF RELATIVITY**
	Some Fundamental Concepts: Theory of relativity, Equivalence of space and time.
UNIT X	**LORENTZ TRANSFORMATION**
	The Lorentz Transformation – Immediate Consequences of Lorentz transformations : contraction of length, time dilation, composition of velocities – The Mass of a Moving Particle – Equivalence of Mass and Energy.
	BLOCK IV: SMALL OSCILLATIONS AND NORMAL MODES
UNIT XI	**ONE DIMENSIONAL OSCILLATOR**
	Potential Energy and equilibrium - one dimensional oscillator: stable, unstable and neutral equilibrium.
UNIT XII	**NORMAL MODES**
	Two coupled oscillators - normal coordinates and normal modes.
UNIT XIII	**GENERAL THEORY OF SMALL OSCILLATIONS**
	General theory of small oscillations: secular equation and eigenvalue equation.

UNIT XIV	LINEAR TRIATOMIC MOLECULE
	Small oscillations in normal coordinates - vibrations of a linear triatomic molecule.
Book For Study	
1. Classical Mechanics, K. Sankara Rao, PHI Learning Private Limited – 2009, New Delhi.	
2. Classical Mechanics- J.C.Upadhyaya, Himalaya Publishing House-2nd Edition, 2010.	
References	
1. Classical Mechanics- Herbert Goldstein –Pearson publishers-3rd Edition, 2011. 2. Classical mechanics – S.L. Gupta, Meenakshi Prakashan, New Delhi, 1970. 3. Introduction to Classical Mechanics - R.G. Takwala and P.S. Puranik, Tata - McGraw Hill, New Delhi, 1980.	
Mode of Evaluation	Assignment/Seminar/Written Examination

34512	**MATHEMATICAL PHYSICS – I**
Objectives	*The main objective of this paper is to impart understanding on the fundamental thoughts of mathematical physics to the students.*
Outcome	On successful completion of the course, a student will be able to • Master the basic elements of mathematical physics and demonstrate an ability to use vector analysis, matrices and special functions in the solution of physical problems
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on vectors, matrix, integration, differentiation and Laplace transforms are prerequisite.
	BLOCK I: VECTOR ANALYSIS
UNIT I	**VECTOR ANALYSIS**
	Introduction to vectors and product of vectors – Gradient, Divergence, curl.
UNIT II	**INTEGRATION OF VECTORS**
	Gauss's Theorem – Stoke's Theorem – Potential Theory – Gauss's law and Poisson's Equation – Dirac Delta function.
UNIT III	**ORTHOGONAL CURVILINEAR COORDINATES**
	Special Coordinate systems – Circular, Cylindrical Coordinates – Orthogonal coordinates – Differential Vector Operators – Spherical Polar Coordinates.
	BLOCK II: MATRICES
UNIT IV	**ALGEBRA OF MATRICES**
	Introduction to Matrix - Properties of matrix.
UNIT V	**RANK OF MATRIX**
	Rank of matrix and some of its theorems - Cramers rule - Characteristic equation.
UNIT VI	**EIGEN VALUES, EIGEN VECTOR, DIAGONALIZATION**

	Eigen values, eigenvectors, Orthogonal Matrices – Hermitian Matrices and Unitary Matrices – Diagonalization of Matrices - Solving differential equations.
	BLOCK III: SPECIAL FUNCTIONS
UNIT VII	**GAMMA AND BETA FUNCTIONS**
	Gamma function - Beta function – Relation between Gamma and Beta function.
UNIT VIII	**LEGENDRE FUNCTION**
	Legendre's differential equation: Legendre polynomials - Generating functions - Recurrence relation - Rodrigue's formula – Orthogonality.
UNIT IX	**BESSEL'S FUNCTION**
	Bessel's differential equation: Bessel polynomials - Generating functions - Recurrence relation -Rodrigue's formula – Orthogonality.
UNIT X	**HERMITE FUNCTION**
	Hermite differential equation – Generating functions – Hermite polynomials - Recurrence relations – Rodrigue's formula – Orthogonality.
UNIT XI	**LAGUERRE FUNCTION**
	Laguerre differential equations – Generating functions - Laguerre polynomials - Recurrence relation - Rodrigue's formula – Orthogonality.
	BLOCK IV: INTEGRAL TRANSFORMS
UNIT XII	**FOURIER TRANSFORM**
	Introduction and Definitions – Fourier Transforms – Development of the Inverse Fourier Transform – Fourier Transforms Inversion Theorem.
UNIT XIII	**FOURIER TRANSFORM OF DERIVATIVES**
	Fourier Transform of Derivatives – Convolution Theorem – Momentum Representation.
UNIT XIV	**LAPLACE TRANSFORM**

	Laplace Transforms – Laplace Transform of Derivatives – Other Properties – Convolution or Faltungs Theorem – Inverse Laplace Transform-applications.
Book For Study	
1. Essential Mathematical Methods for Physicists, George B. Arfken, Hanes J.Weber, Frank E. Harris, 7th Edition, Elsevier, 2012. 2. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, Wiley, 2014.	
References	
1. Mathematical Physics, B.D. Gupta, Vikas Publishing House Pvt. Ltd, 2010. 2. Mathematical Physics, Sathyaprakash, Sultan Chand, 2013. 3. Topics in Mathematical Physics-Parthasarathy H, Ane Books Pvt. Ltd. 2007.	
Mode of Evaluation	Assignment/Seminar/Written Examination

34513	**LINEAR AND INTEGRATED ELECTRONICS**
Objectives	*The objective of the course is to impart in depth knowledge about Semiconductors, Diodes, Transistors, Operational amplifiers, etc to the students. The theoretical knowledge gained in the class room can be experimented in the practical classes.*
Outcome	On successful completion of the course, a student will be able to • Discuss the op-amp's basic construction, characteristics, parameter limitations, various configurations and countless applications of op-amp • Analyze and design basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators, and data converters
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on transistor, diode, amplifier, oscillators and semiconductor are prerequisite.
	BLOCK I: SEMICONDUCTOR AND DIODE
UNIT I	**SEMICONDUCTOR PHYSICS**
	Introduction to semiconductor – Intrinsic and extrinsic semiconductors – PN junction.
UNIT II	**SEMICONDUCTOR DIODE**
	Forward and Reverse bias of diode – Characteristics of forward and reverse bias of diode – Zener diode, its construction and characteristics – Zener diode as voltage regulator.
UNIT III	**SPECIAL-PURPOSE DIODES**
	Schottky diode – Tunnel diode - LED's.
	BLOCK II: TRANSISTOR BIASING AND AMPLIFIER
UNIT IV	**TRANSISTORS**
	Transistor action – Transistor connections: CB, CE and CC configurations.
UNIT V	**TRANSISTOR AMPLIFIER**
	Transistor as an amplifier: Class A, Class B and Class C operations and their field of application.
UNIT VI	**TRANSISTOR BIASING**

	Transistor biasing and stabilization – Need for biasing – DC load line – operating point – Bias stability – Transistor biasing circuits –Fixed bias circuit – Base bias with emitter feedback – Base bias with collector feedback – Voltage
	divider bias circuit.
UNIT VII	**TRANSISTOR AUDIO POWER AMPLIFIER**
	Class B push pull amplifier-Transformer coupled audio power amplifier.
	BLOCK III: OPTO ELECTRONIC DEVICES AND OSCILLATORS
UNIT VIII	**FIELD EFFECT TRANSISTORS AND SILICON CONTROLLED RECTIFIER**
	Construction, working and I/O characteristics of FET, JFET, MOSFET and SCR.
UNIT IX	**POWER ELECTRONICS AND OPTO ELECTRONIC DEVICES**
	Construction, working and I/O characteristics of DIAC and TRIAC, Solar cells, Photo detectors.
UNIT X	**SINUSOIDAL OSCILLATORS**
	Oscillator: Wien bridge – RC phase shift, Hartley, Colpitt's oscillators.
	BLOCK IV: OPERATIONAL AMPLIFIER
UNIT XI	**OPERATIONAL AMPLIFIER**
	Operational amplifier – Block diagram of OP-AMP – Equivalent circuit of IC 741.
UNIT XII	**ELECTRICAL PARAMETERS OF OP-AMP**
	Electrical parameters – Input offset voltage and current input bias current – Differential input resistance – Input capacitance – Output offset voltage and nullification – CMRR – Slew rate.
UNIT XIII	**APPLICATIONS OF OP-AMP**
	Applications of OP-AMP 741: Inverting, Non-inverting Amplifiers – Adder – Subtractor – Comparator – Differentiator – Integrator – Analog computation.
UNIT XIV	**ACTIVE FILTERS**
	Active filters: First order high pass and low pass filters, Band pass filter.

Books For Study	
1. Electronic Principles – Albert Malvino, David J Bates, 7th Edition, McGraw Hill. (2007). 2. Op-Amps and linear integrated circuits – Ramakant A.Gayakwad, 4th Edition, Prentice Hall. (2009).	
References	
1. Principles of Electronics – V.K.Mehta, 6th Revised Edition, S.Chand and Company. (2001). 2. Electronic Devices and circuits – David A.Bell, 4th Edition, Prentice Hall. (2007).	
Mode of Evaluation	Assignment/Seminar/Written Examination

34514	**ADVANCED ELECTRONICS AND PHYSICS LABORATORY - I**
Objectives	*The main objective of this practical paper is to exercise the practical in various advanced electronics and advanced analytical experiments to the students.*
Outcome	On successful completion of the course, a student will be able to • Understand the basic operations in electronic circuits • Develop the programming skills of Microprocessor • Understand the concept of ICs manufacturing • Appreciate the applications of Microprocessor programming • Understand the basic principles of the experiments • Understand simple concepts to demonstrate an experiment
Schedule	Contact Hours: 120 hours
Prerequisite	Basic knowledge on transistor, diode, amplifier, oscillators, semiconductor, spectrometer and microscope are prerequisite.
	(Any Fifteen of the following) 1. Study the characteristics of FET. 2. Study the characteristics of transistor (CE mode). 3. Study the characteristics of Zener diode and construct regulated DC power supply. 4. Construct the logic gates using discrete components. 5. Design of FET amplifier - CS Configuration. 6. Characteristics of UJT. 7. Relaxation oscillator (UJT). 8. Transistor Astable multivibrator. 9. Monostable multivibrator (Transistor).

	10. Transistorized Hartely and Colpitt's audio oscillator. 11. Calibration of Spectrograph – Iron or Copper spectrum. 12. Michelson's Interferometer. 13. q, n, σ - Elliptical fringes. 14. q, n, σ - Hyperbolic fringes. 15. Ultrasonic Interferometer – Construction of oscillator and measurements. 16. Babinet's Compensator and study of polarized light. 17. G.M Counter – Statistical probability, Absorption measurements, Half life. 18. Any of the experiments of equal standard.

II SEMESTER

34521	**QUANTUM MECHANICS-I**
Objectives	*The main objective of this paper is to impart knowledge on the fundamental aspects of quantum mechanics to the students.*
Outcome	On successful completion of the course, a student will be able to • Know the background for the main features in the historical development of quantum mechanics • Discuss and interpret experiments displaying wavelike behaviour of matter, and how this motivates the need to replace classical mechanics by a wave equation of motion for matter (the Schrödinger equation) • Understand the central concepts and principles of quantum mechanics: the Schrödinger equation, the wave function and its physical interpretation, stationary and non-stationary states, time evolution and expectation values
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on atom, particle and wave, light and time are prerequisite.
	BLOCK I: *FOUNDATIONS*
UNIT I	**POSTULATES**
	Wave particle duality – Uncertainty principle – applications – Postulates of quantum mechanics.
UNIT II	**SCHRODINGER EQUATION**
	Schrodinger equation – both time dependent and independent – Ehrenfest's theorem – eigen function and eigen vectors – probability density.
UNIT III	**ONE DIMENSIONAL PROBLEM**
	Applications to one dimensional problems: Linear harmonic oscillator and tunnel effect.
	BLOCK II: *DISCRETE EIGEN VALUE PROBLEM*
UNIT IV	**THE FREE PARTICLE**

	The free particle – Particle in a box.
UNIT V	**THREE DIMENSIONAL PROBLEM**
	Three dimensional harmonic oscillator – Rigid rotator.
UNIT VI	**APPLICATION TO DIATOMIC MOLECULES**
	Application to diatomic molecules – Hydrogen atom – Separation of variables and solution of R,θ,Φ equation – Discussion of bound states and parity.
	BLOCK III: REPRESENTATION THEORIES
UNIT VII	**HORMONIC OSILLATOR**
	Dirac's ket and bra vectors – Harmonic oscillator – Solution using ladder operator and matrix representation.
UNIT VIII	**QUANTUM DYNAMICS**
	Schrődinger, Heisenberg and interaction pictures.
UNIT IX	**TIME INDEPENDENT PERTURBATION THEORY**
	Perturbation theory (first order) – Time independent – Stark effect in hydrogen atom.
UNIT X	**VARIATIONAL PRINCIPLE**
	Variation method – Ground state of helium atom – Ground state of Deuteron.
UNIT XI	**W.K.B APPROXIMATION**
	W.K.B approximation – Application to bound states.
	BLOCK IV: TIME EVOLUTION
UNIT XII	**TIME DEPENDENT PERTURBATION THEORY**
	Time dependent perturbation theory – The golden rule and application – Spontaneous emission – Stimulated emission.
UNIT XIII	**QUANTUM THEORY OF RADIATION**
	Einstein's A & B coefficients – Semi – classical and quantum theory of radiation – Eigen value and Eigen function.

UNIT XIV	THEORY OF SCATTERING
	Rayleigh and Raman scattering – Selection rules.

Books For Study

1. Quantum Mechanics I: The Fundamentals, S. Rajasekar, R. Velusamy, CRC Press, 2015
2. A text book of Quantum Mechanics – P.M Mathews and K.Venkatesan, McGraw Hill, New Delhi 1975.
3. Quantum Mechanics – G.Aruldhas – PHI Learning Private Limited, New Delhi 2009.
4. Quantum Mechanics - V.Devanathan, Alpha Science International, Limited, 2005.

References

1. Quantum Mechanics – L.Schiff, Mc Graw Hill, 1968.
2. Quantum Mechanics – J.P.Dicke and R.H.Wittke, Addison Wiley, 1978.
3. Quantum Mechanics - A.K. Ghatak and Lokanathan, McMillan, 1977.
4. Quantum Mechanics – R.Shankar,Springer, 1994.

Mode of Evaluation	Assignment/Seminar/Written Examination

34522	MATHEMATICAL PHYSICS – II
Objectives	*The main objective of this paper is to impart understanding on the fundamental thoughts of mathematical physics to the students.*
Outcome	On successful completion of the course, a student will be able to • Create and solve mathematical models of physical phenomena using analytic and numerical methods • Design, execute, and interpret experiments to test hypotheses and mathematical models
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on vectors, matrix, integration, differentiation and Laplace transforms are prerequisite.
BLOCK I: COMPLEX VARIABLE	
UNIT I	
	Cauchy-Riemann Conditions – Cauchy's Integral Formula – Laurent Expansion – Mapping – Conformal Mapping.
UNIT II	**CALCULUS OF RESIDUES**
	Singularities – Calculus of Residues and contour integrals – Method of Steepest Descents.
BLOCK II: APPLICATION OF PARTIAL DIFFERENTIAL EQUATIONS AND ORTHOGONAL FUNCTIONS	
UNIT III	**SEPERATION OF VARIABLES**
	Heat equation – Laplace and Poisson equation - wave equation - separation of variables.
UNIT IV	**STURM LIOUVILLE PROBLEM**
	Green's Function – Sturm-Liouville theory - Self – Adjoint PDEs.
UNIT V	**ORTHOGONALIZATION PROCESS**
	Hermitian Operators – Gram-Schmidt Orthogonalization – Completeness of Eigen Functions.
BLOCK III: TENSOR ANALYSIS	
UNIT VI	**INTRODUCTION TO TENSOR**

	Introduction – The Algebra of Tensors – Quotient law – Cartesian Tensors.
UNIT VII	**COVARIANT FORMULATION OF TENSORS**
	Four vectors in special relativity – Covariant formulation of electrodynamics.
UNIT VIII	**DUAL AND METRIC TENSORS**
	Dual tensors, irreducible tensors - Metric Tensors - Christoffel symbols - Geodesics.
	BLOCK IV*: *GROUP THEORY AND PROBABILITY
UNIT IX	**INTRODUCTION TO GROUP THEORY**
	Definition of group – Homomorphism and Isomorphism.
UNIT X	**MATRIX REPRESENTATION OF GROUP THEORY**
	Matrix Representations: Reducible and Irreducible – Proof of the Orthogonality theorem.
UNIT XI	**ROTATION GROUPS**
	Rotation groups SO(2) and SO(3) – Special Unitary group SU(2) – The Character of a Representation – Construction of Character Tables.
UNIT XII	**PHYSICAL APPLICATIONS OF GROUP THEORY**
	Physical applications of group theory: Crystal – Symmetry operators – Crystallographic Point Groups.
UNIT XIII	**THEORY OF PROBABILITY**
	Probability Definitions, Simple Properties – Random Variables.
UNIT XIV	**PROBABILITY DISTRIBUTION**
	Binomial Distribution – Poisson Distribution – Gauss's Normal Distribution – Central limit theorem.

Books For Study

1. Essential Mathematical Methods for Physicists, George B. Arfken, Hanes J.Weber, Frank E. Harris, 7th Edition, Elsevier, 2012.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, Wiley, 2014.

References
1. Mathematical Physics, B.D. Gupta, Vikas Publishing House Pvt. Ltd, 2010.
2. Mathematical Physics, Sathyaprakash, Sultan Chand, 2013.

3. Topics in Mathematical Physics-Parthasarathy H, Ane Books Pvt.Ltd 2007. 5. Chemical Applications of Group Theory, F. Albert Cotton, Addison Wiley, 2006.	
Mode of Evaluation	Assignment/Seminar/Written Examination

34523	ELECTROMAGNETIC THEORY
Objectives	*The main objective of this paper is to impart the understanding on the fundamental aspects of electromagnetic theory to the students.*
Outcome	On successful completion of the course, a student will be able to • Describe the electro and magnetostatics Maxwell's equations and propagation of EM waves • Describe the reflection, refraction, dispersion and scattering of electromagnetic waves
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on reflection, refraction, dispersion, scattering and microwaves are prerequisite.
	***BLOCK I*: ELECTRO AND MAGNETOSTATICS MAXWELL'S EQUATIONS AND PROBAGATION OF EM WAVES**
UNIT I	**ELECTRO AND MAGNETOSTATICS**
	Basics-Electrostatics and Magnetostatics. - Wave equation in terms of scalar and vector potential – Transverse nature of electromagnetic wave.
UNIT II	**FIELD EQUATIONS AND CONSERVATION LAWS**
	Maxwell's equations – Poynting theorem - Conservation of energy and momentum, continuity equation.
UNIT III	**ELECTROMAGNETIC WAVES AND WAVE PROPAGATION**
	Propagation of plane electromagnetic waves in (a) free space, (b) Isotropic and Anisotropic non- conducting medium and (c) conducting medium-skin depth.
	BLOCK II*: *REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVES
UNIT IV	**REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVES**
	Boundary conditions at the surface of discontinuity - Reflection and refraction of electromagnetic waves at the interface of non-conducting media.
UNIT V	**FRESNEL'S EQUATION**

	Fresnel's equations – Reflection and transmission coefficients at the interface between two dielectric media.
UNIT VI	**POLARIZATION**
	Brewster's law and degree of polarization -Total internal reflection.
	BLOCK III*: *DISPERSION AND SCATTERING OF EM WAVES
UNIT VII	**DISPERSION OF ELECTROMAGNETIC WAVES**
	Normal and Anomalous dispersion – Dispersion in Gases – Experimental demonstration of Anomalous dispersion in gases- Solids and Liquids.
UNIT VIII	**CLASUSIUS MOSSOTTI EQUATION**
	Clasusius-Mossotti relation – Lorentz formula.
UNIT IX	**SCATTERING OF ELECTROMAGNETIC WAVES**
	Scattering and scattering parameters - Theory of scattering of e-m waves – polarization of scattered Light – coherence and incoherence of scattered light.
	BLOCK IV*: *MICROWAVES, DYNAMICS OF CHARGED PARTICLES AND PLASMA PHYSICS
UNIT X	**WAVE GUIDES**
	Wave guides: Rectangular and cylindrical waveguides.
UNIT XI	**MICROWAVES**
	Generation of microwaves – Klystron – Magnetron – Gunn diodes – Resonant cavities.
UNIT XII	**DYNAMICS OF CHARGED PARTICLES**
	Lienard-Wiechert potential-E.M fields from retarded potentials of moving point charge-e.m. fields of uniformly moving point charge- Radiation from moving charges.
UNIT XIII	**PLASMA PHYSICS**
	Introduction - Conditions for plasma existence – occurrence of plasma – charged particles in uniform constant electric field, in homogeneous magnetic fields, simultaneous homogeneous electric and magnetic fields, in nonhomogeneous magnetic fields.

UNIT XIV	MAGNETOHYDRODYNAMICS
	Magnetohydrodynamics – magnetic confinement -pinch effect- Instabilities- plasma waves.

Book For Study

1. Electromagnetic theory and Electrodynamics – Satya Prakash, Kedarnath Ramnath & Co, 2007
2. Introduction to Electrodynamics- D.J.Griffith, Pearson Education Ltd.-4rd Edn., 2014.

References

1. Electromagnetics – Kraus & Carver, TMH, 1973.
2. Electromagnetic fields and waves – Paul Lorain & Dale R.Corson, CBS publishers, NewDelhi, 1986.
3. Foundations of Electromagnetic theory – Reitz, Milford & Frederick, Narosa publishing House, 1986.
4. Introduction to electromagnetic theory- Chopra and Agarwal, (1984).
5. Classical Electrodynamics, J.D.Jackson, Wiley Eastern Limited, New Delhi, 1978.

Mode of Evaluation	Assignment/Seminar/Written Examination

34524	**ADVANCED ELECTRONICS AND PHYSICS LABORATORY - II**
Objectives	*The main objective of this practical paper is to exercise the practical in various advanced electronics and advanced analytical experiments to the students.*
Outcome	On successful completion of the course, a student will be able to • Understand the basic operations in electronic circuits • Develop the programming skills of Microprocessor • Understand the concept of ICs manufacturing • Appreciate the applications of Microprocessor programming • Understand the basic principles of the experiments • Understand simple concepts to demonstrate an experiment
Schedule	Contact Hours: 120 hours
Prerequisite	Basic knowledge on transistor, diode, amplifier, oscillators, semiconductor, spectrometer and microscope are prerequisite.
	(Any Fifteen of the following) 1. Half adders and Full adders. 2. Integrator and Differentiator circuits using IC 741. 3. Active filters using IC 741. 4. D/A converters (a) Ladder network (b) Weighted resistor method. 5. A/D converter. 6. Encoder - Decoder circuits. 7. Square wave, Sine wave and Triangular wave generators using IC. 8. Multiplexer circuits. 9. Flip – Flop circuits using IC. 10. Powder photograph – X-ray method.

	11. Resistivity measurements of thin films. 12. Hall effect – Mobility and Hall constant determination. 13. Dielectric constant – Microwave frequency using klystron. 14. Determination of Curie point – Ferromagnetic material. 15. Susceptibility by Guoy's method. 16. Susceptibility by Quincke's method. 17. Reflection grating spectrometer. 18. Any of the experiments of equal standard.

III SEMESTER

34531	MOLECULAR SPECTROSCOPY
Objectives	*The main objective of this paper is to impart understanding on the fundamental thoughts of Atomic and Molecular Spectroscopy in physics to the students.*
Outcome	On successful completion of the course, a student will be able to • Appreciate the principles of spectroscopy in the different regions of the electromagnetic spectrum • Apply the concepts of group theory to molecular vibrations • Relate the theory of spectroscopy to the study of molecular structure
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on bonding in solids and spectroscopy are prerequisite.
	BLOCK I: SYMMETRY ASPECTS OF MOLECULAR ORBITALS AND ROTATIONAL SPECTRA
UNIT I	**MOLECULAR ORBITAL THEORY**
	Valence bond theory – Molecular orbital theory- Heitler London theory for Hydrogen molecule - Hybridization – SP – SP^2 & SP^3 Hybrids.
UNIT II	**ROTATIONAL SPECTRA OF DIATOMIC MOLECULE**
	Rotational energy of a diatomic molecule – Rigid and non-rigid rotators – isotopic substitution.
UNIT III	**STARK EFFECT**
	Stark effect – its importance in microwave spectroscopy – quadrupole hyperfine interaction.
UNIT IV	**ROTATIONAL SPECTRA OF POLYATOMIC MOLECULES**
	Rotational spectra of polyatomic molecules – pure rotational Raman spectra – diatomic linear molecule – symmetric top molecules.
UNIT V	**MOLECULAR STRUCTURE**
	Molecular structure – using IR & Raman spectroscopy.
	BLOCK II: VIBRATIONAL PROPERTIES
UNIT VI	**VIBRATIONAL SPECTRA**
	Vibrational spectra of diatomic and polyatomic molecules – Information on molecular constitution from IR studies.
UNIT VII	**VIBRATIONAL RAMAN SPECTRA**

	Vibrational Raman spectra – Vibrational course structure – Rotational course spectra.
UNIT VIII	**FRANCK-CONDON PRINCIPLE**
	Franck – Condon principle – intensity distribution – portrait parabolae – disassociation - predisassociation – mutual exclusion principle.
	BLOCK III: NON LINEAR SPECTROSCOPIC PHENOMINA
UNIT IX	**HYPER RAMAN EFFECT**
	Non linear Raman Phenomena-Hyper Raman effect- Classical treatment – Experimental techniques- Stimulated Raman Scattering.
UNIT X	**INVERSE RAMAN EFFECT**
	Inverse Raman Effect-Coherent Anti-Stoke's Raman Scattering-Photo acoustic Raman Scattering.
UNIT XI	**MULTIPHOTON SPECTROSCOPY**
	Multi photon spectroscopy-two photon absorption- Multiphoton absorption. X-ray spectra; rotational and vibrational spectra of diatomic molecules.
	BLOCK IV: RESONANCE SPECTROSCOPY
UNIT XII	**NUCLEAR RESONANCE**
	Interaction between spin and magnetic field – Nuclear resonance – Bloch equations - Chemical shift – Dipole –Dipole interaction and spin lattice interaction.
UNIT XIII	**ESR AND NQR SPECTROSCOPY**
	ESR-NQR (principle only) spectroscopy and its application.
UNIT XIV	**MOSSBAUER SPECTROSCOPY**
	Mossbauer spectroscopy - applications – Electronic structure – molecular structure – crystal symmetry and molecular structures.

Book For Study

1. Handbook of Spectroscopy,1- 4 Volume, 2nd Edition., 2014, Gunter Gauglitz , David S. Moore , John Wiley & Sons, Inc.,
2. Atomic and Molecular Spectroscopy Basic Concepts and Applications, By Rita Kakkar, 2015 Cambridge University Press.
3. Condensed-Phase Molecular Spectroscopy and Photophysics, Anne Myers Kelley, 2012, Wiley.
4. Raman Spectroscopy and its Application in Nanostructures, Shu-Lin Zhang , 2012, John Wiley & Sons, Inc.,

References	
1. Handbook of High-resolution Spectroscopy,Martin Quack ,Frederic Merkt, 2011, John Wiley & Sons, Inc., 2. Raman, Infrared, and Near-Infrared Chemical Imaging, Slobodan Sasic , Yukihiro Ozaki , 2010, John Wiley & Sons, Inc., 3. Molecular structure and spectroscopy, G.Aruldhass, Prentice Hall of India, New Delhi – 2001. 4. Atomic and Molecular Spectroscopy, Mool Chand Guptha, New age International Publishers, New Delhi, (2001). 5. Instrumental methods of Chemical analysis, H.Gaur, Prgati Prakasan, Ist Edition, 2001. 6. Principles of Instrumental Analysis, Skoog, Holler and Nieman, Harcourt College Publishers, 5th edition, 2003. 7. Instrumental methods of analysis, Willard et al., CBS publishers, 2005. 8. Hand book of analytical instrumentation, R.S. Khandapur, McGraw Hill, (2006). 9. Chemical Applications of Group Theory F.A.Cotton (2009) Wiley student edition.	
Mode of Evaluation	Assignment/Seminar/Written Examination

34532	QUANTUM MECHANICS-II
Objectives	*The main objective of this paper is to impart in depth knowledge on the advanced theories of quantum mechanics to the students.*
Outcome	On successful completion of the course, a student will be able to • Apply principles of quantum mechanics to calculate observables on known wave functions • Grasp the concepts of spin and angular momentum, as well as their quantization- and addition rules • Explain physical properties of elementary particles, nucleons, atoms, molecules and solids (band structure) based on quantum mechanics
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on uncertainty and quantum concepts are prerequisite.
	BLOCK I: THEORY OF ANGULAR MOMENTUM
UNIT I	**ANGULAR MOMENTUM**
	Angular momentum of a system of particles – Commutation relations.
UNIT II	**MATRIX REPRESENTATION OF ANGULAR MOMENTUM**
	Matrix representation of angular momentum – Pauli spin matrices.
UNIT III	**ADDITION OF ANGULAR MOMENTA**
	Addition of two angular momenta – C.G. coefficients for j = ½ system only.
	BLOCK II: SELF CONSISTENT FIELD
UNIT IV	**CENTRAL FIELD APPROXIMATION**
	Central field approximation – Thomson-Fermi Model of the Atom.
UNIT V	**IDENTICAL PARTICLES**
	Identical particles – Bosons and fermions – Symmetric and anti-symmetric wave functions.
UNIT VI	**HARTREE EQUATION**

	Hartree equation – Hartree-Fock Equation – Alkali atoms Doublet intensity and doublet separation - Periodic Table.
	BLOCK III: RELATIVISTIC QUANTUM MECHANICS
UNIT VII	**KLEIN-GORDAN EQUATION**
	Klein-Gordan equation – Application to Hydrogen atom.
UNIT VIII	**RELATIVISTIC HAMILTONIAN**
	Dirac's Relativistic Hamiltonian – Dirac matrices and properties.
UNIT IX	**DIRAC PARTICLE**
	Spin of a Dirac particle – Negative energy states.
	BLOCK IV:ELEMENTS OF FIELD QUANTIZATION AND SCATTERING THORY
UNIT X	**RELATIVISTIC AND NON-RELATIVISTIC FIELD**
	Elements of field quantization for non-relativistic field – Quantization of relativistic field.
UNIT XI	**KLEIN-GORDAN FIELD**
	Klein Gordon field - Dirac Field – Quantization of Electromagnetic field.
UNIT XII	**SCATTERING CROSS SECTION**
	Scattering cross section – scattering amplitude.
UNIT XIII	**BORN APPROXIMATION**
	Optical Theorem – Born approximation.
UNIT XIV	**DIFFUSION SCATTERING**
	Scattering by screened Coulomb potential – Diffusion Scattering – Particle wave analysis.
Book For Study	

1. Quantum Mechanics II: Advanced Topics, S.Rajasekar, R.Velusamy, CRC Press, 2015. 2. Quantum mechanics – L.Schiff, Mc-Graw Hill, 1968. 3. Quantum mechanics – B.N.Srivastava, Pragati prakashan, 1975. 4. Text book of quantum mechanics, P.M. Mathews and K.Venkatesan, McGraw Hill, New Delhi, 1975. 5. Quantum Mechanics – G.Aruldhas – PHI Learning Private Limited, New Delhi 2009.	
References	
1. Quantum mechanics - V.K. Thangappan, Wiley Eastern, 1985. 2. Quantum electrodynamics - P. G. Puranik, S.Chand & co, 1980. 3. A text book of quantum mechanics – A.K. Ghatak & Lokanathan, Mc Millan, 1977. 4. Quantum mechanics- Devanathan,Alpha Science International Ltd, United Kingdom (2011).	
Mode of Evaluation	Assignment/Seminar/Written Examination

34533	**MICROPROCESSOR AND ELECTRONIC INSTRUMENTATION**
Objectives	*This course is designed to provide students with the necessary foundation for entry-level industrial applications in process monitoring and controlling, with an emphasis on analysis, problem solving, exposure to open-ended problems and design methods. At the end of the course, students will be able to design an application based on microcontrollers or microprocessors.*
Outcome	On successful completion of the course, a student will be able to • Develop the programming skills of microprocessor • Appreciate the applications of microcontroller programming
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on instrumentation and programming are prerequisite.
	BLOCK I:MICROPROFESSOR ARCHITECTURE (8085 AND 8086)
UNIT I	**MICROPROCESSOR ARCHITECTURE (8085)**
	Introduction, Intel 8085 : Architecture, Instruction Cycle, Timing Diagram: Op-code fetch, Memory read & Memory write – Instruction Set : Instruction and Data Format, Addressing Modes, Status Flags, Instructions Set, Data Transfer, Arithmetic, Branching, and Logical group operations – Interrupts.
UNIT II	**MICROPROCESSOR ARCHITECTURE (8086)**
	Architecture of 8086, Pin diagram and pin function, Register organization, Minimum and Maximum mode operation of 8086.
	BLOCK II: PROGRAMMING OF MICROPROCESSOR AND MICRO-CONTROLLER
UNIT III	**INSTRUCTIONS (8085)**
	Instructions for 8085 – Software development tools – Assembly language programs with data transfer, arithmetic, logical, bit level instructions and branch instructions.
UNIT IV	**INTERRUPTS AND STACK OPERATIONS OF 8085**
	Interrupts and interrupt service routines-Subroutine – Flow charting – Loops – Pseudo instructions – Stack Operations- Programming and applications: Traffic control system.

UNIT VI	**MICRO-CONTROLLER 8051**
	Introduction to 8 bit micro-controller, Architecture of 8051- Hardware features of 8051 - Signal description of 8051-General Purpose and Special Function Registers- Oscillator and clock circuit-I/O Port-Memory organization and I/O addressing by 8051, Interrupts of 8051.
UNIT VI	**8051 INSTRUCTION SET AND PROGRAMMING**
	Instructions set of 8051-Programming of 8051 (Simple Arithmetic and Logical programs).
	BLOCK III:INTERFACING DEVICES
UNIT VII	**INTRODUCTION TO INTERFACING DEVICES**
	Address space partition - Memory & I/O Interfacing – Data transfer schemes – Interrupts - I/O Ports.
UNIT VIII	**INTERFACING DEVICES (8255 AND 8259)**
	Programmable Peripheral Interface:8255 – Programmable Interrupt Controller :8259.
UNIT IX	**INTERFACING DEVICES (8257 AND 8251)**
	Programmable DMA Controllers:8257 – Programmable Communication Interface:8251.
UNIT X	**MICROPROCESSOR APPLICATIONS**
	A/D Sub systems - Applications – Temperature monitoring and Stepper motor control.
	BLOCK IV: **ELECTRONIC INSTRUMENTATION**
UNIT XI	**AMPLIFIERS AND COMPARATORS**
	Instrumentation amplifiers, Sample and hold circuits, Comparators, – D/A – Weighted resistor method – Resistor ladder net work method – A/D – Successive approximation method.
UNIT XII	**TEMPERATURE TRANSDUCERS**
	Classification of transducers - Temperature transducers: thermo-resistive transducers, thermoelectric, p-n junction, chemical thermometry.
UNIT XIII	**DISPLACEMENT TRANSDUCERS**

	Displacement transducers: potentiometer, resistive strain gauges, capacitive displacement transducer, LVDT transducers.
UNIT XIV	**PHOTOELECTRIC TRANSDUCERS**
	Photoelectric transducers: photovoltaic cell, photoconductive cell- Piezoelectric transducers.

Book For Study

1. Fundamentals of Microprocessors and Microcomputers - B. Ram, 8th Edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2010.
2. Microprocessors and Microcontrollers – A.Nagoor Kani, , 2nd Edition, Mc Graw Hill Education, 2012.
3. Transducers and Instrumentation, D.V.S.Murthy, 2nd Edition, PHI Learning Private Limited -New Delhi, 2008.

References

1. Microprocessor Architecture, Programming and Applications- R. Gaonkar, Pearson, 1998
2. Advanced Microprocessor and Principles- A.K. Ray, K.M. Bhurchandi, 3rd Edition, Tata Mc Graw Hill Publication Co. Ltd. New Delhi. 2003.

Mode of Evaluation	Assignment/Seminar/Written Examination

34534	**ADVANCED ELECTRONICS AND PHYSICS LABORATORY - III**
Objectives	*The main objective of this practical paper is to exercise the practical in various advanced electronics and advanced analytical experiments to the students.*
Outcome	On successful completion of the course, a student will be able to • Understand the basic operations in electronic circuits • Develop the programming skills of Microprocessor • Understand the concept of ICs manufacturing • Appreciate the applications of Microprocessor programming • Understand the basic principles of the experiments • Understand simple concepts to demonstrate an experiment
Schedule	Contact Hours: 120 hours
Prerequisite	Basic knowledge on transistor, diode, amplifier, oscillators, semiconductor, spectrometer and microscope are prerequisite.
	(Any Fifteen of the following) 1. Study of Counters. 2. Monostable multivibrator using op-amp. 3. Astable multivibrator using op-amp and using IC 555. 4. Schmitt trigger using op-amp. 5. Voltage comparator. 6. Demultiplexer. 7. Logic gates using IC's. 8. Young's modulus – Cornu's method. 9. Refractive index of liquid by laser.

	10. Optical absorption studies using lasers. 11. Determination of wavelength of a laser source by diffraction grating. 12. Determination of Charge of an electron using spectrometer. 13. Thermal expansion using optical air wedge. 14. Ultrasonic interferometer. 15. Electron spin resonance spectrometer. 16. Magnetic Hystersis loop tracer. 17. Measurements and inverse square law verification. 18. Any of the experiments of equal standard.

IV SEMESTER

34541	**CONDENSED MATTER PHYSICS**
Objectives	*The objective of the course is to impart knowledge about crystalline structures, lattice vibrations, dielectrics, magnetism and superconductivity to the students. Understanding the content of this course will be useful for the students to carry out research work after the completion of Master's degree.*
Outcome	On successful completion of the course, a student will be able to • Calculate reciprocal lattice vectors for typical high symmetrical crystals and the relationship between Miller indices (hkl) and the distance between the lattice planes is to be understood • Energy band structure should be explained in terms of the periodic potential and illustrated by using Kronig-Penny model • Classification into metals, semiconductors and insulators anchored in the energy band structure
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on bonding in solids and crystal structure are prerequisite.
	BLOCK I: **CRYSTAL STRUCTURE AND LATTICES**
UNIT I	**CRYSTAL STRUCTURE**
	Crystalline solids – Crystal lattice and crystal structure, Symmetry elements, Ordered Phase of Matter.
UNIT II	**CRYSTAL SYSTEMS**
	Translation & Orientation Order, Space lattice, Unit cell and primitive cell – Bravais lattice, Crystal systems.
UNIT III	**LATTICES**
	Type of lattices: SC, BCC, FCC, HCP – Miller indices – Reciprocal lattice - Wigner-seitz cells – bonding in solids.
	BLOCK II: LATTICE VIBRATIONS, BAND THEORY OF SOLIDS AND DIELECTRIC PROPERTIES OF MATERIALS
UNIT IV	**LATTICE VIBRATIONS**
	Lattice vibrations – Diatomic lattices – Phonons.

UNIT V	**FREE ELECTRON FERMI GAS**
	Electrical properties of metals – Free electron gas in three dimensions –
	Fermi energy – Hall effect.
UNIT VI	**BAND THEORY OF SOLIDS**
	Band theory of solids – Kronig–Penny model – Semiconductors – Classification – Fermi energies of impurity semiconductors.
UNIT VII	**DIELECTRIC PROPERTIES OF MATERIALS**
	Polarization – Local electric field, Clausius-Mosotti relation – Polarization field – Lorentz field.
UNIT VIII	**DIELECTRIC CONSTANT AND POLARIZABILITY**
	Dielectric constant – Polarizability: Electronic, Ionic- Piezo – Pyro and ferro electric properties of crystals.
	BLOCK III*: *MAGNETISM
UNIT IX	**PARAMAGNETISM**
	Classification of magnetic materials – Langevin's theory of paramagnetism – Quantum theory of paramagnetism.
UNIT X	**FERROMAGNETISM**
	Ferromagnetism – Weiss Molecular Field Theory – Ferromagnetic domains.
UNIT XI	**ANTIFERROMAGNETISM AND FERRIMAGNETISM**
	Antiferromagnetism – Neel's Theory – Ferrimagnetism and ferrites.
UNIT XII	**MAGNETIC MATERIALS**
	Spin waves – Hard and soft magnetic materials.
	BLOCK IV: SUPERCONDUCTIVITY
UNIT XIII	**SUPERCONDUCTIVITY – EXPERIMENTAL SURVEY**
	Introduction – Meissner effect – Isotope effect – Type I and Type II superconductors.
UNIT XIV	**SUPERCONDUCTIVITY – THEORETICAL SURVEY**

	London equations – Coherence length – BCS Theory – Cooper pair – Normal tunneling and Josephson Effect – High temperature superconductors.
Book For Study	

1. Solid State Physics – Structure and properties of Materials – M.A. Wahab, Second edition, Narosa publishers. 2005. 2. Introduction to Solid State Physics – Charles Kittel, 7th Edition, John Wiley & Sons. (1971).	
References	
1. Solid State Physics – S.O. Pillai, Wiley Eastern Ltd. (2005). 2. Solid State Physics – B.S. Saxena, R.C. Gupta and P.N. Saxena – Pragati Prakasham – Meerut. 3. Solid State Physics – A.J. Dekkar, Macmillan India Ltd., 1600. 4. Solid State Physics – S.L. Kahani, C. Hemaranjani – Sulton Chand & Sons.	
Mode of Evaluation	Assignment/Seminar/Written Examination

34542	**NUCLEAR AND PARTICLE PHYSICS**
Objectives	*The main objective of this paper is to impart understanding on the fundamental knowledge of Nuclear & particle physics to the students.*
Outcome	On successful completion of the course, a student will be able to • Identify the fundamental models of nuclear structure that are used to describe various modes of nuclear excitation • Lay out the foundation that allows interpreting the observations obtained in typical nuclear structure experiments
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on particle, atom and nucleus are prerequisite.
	BLOCK I: NECLEAR DECAY AND NUCLEAR MODELS
UNIT I	**NECLEAR DECAY – ALPHA AND GAMMA DECAY**
	Gamow's Theory of Alpha decay – Gamma decay – Internal Conversion Nuclear Isomerism.
UNIT II	**NECLEAR DECAY – BETA DECAY**
	Fermi's theory of Beta decay – Kurie plots – Selection rules – Electron capture – Parity violation in Beta decay - Neutrinos – Measurement of neutrino helicity.
UNIT III	**NUCLEAR LIQUID DROP AND COLLECTIVE MODELS**
	Liquid Drop model – Bohr Wheeler theory – Schmidt lines – Magnetic dipole moment – Electric quadrupole moment – Collective Model.
UNIT IV	**NUCLEAR SHELL MODEL**
	Shell model – Single particle model, its validity and limitations – Rotational Spectra - Magic numbers – Spin – orbit coupling - Angular momentum of nucleus ground states – Magnetic Moments of the shell model.
	BLOCK II: NECLEAR FISSION, FUSION
UNIT V	**NUCLEAR REACTION AND MECHANISM**
	Nuclear Fission and Fusion. Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions: Simple theory of deuteron – Tensor forces (qualitative).

UNIT VI	**NUCLEAR FORCE**
	Nature of nuclear force, form of nucleon-nucleon potential, charge independence and charge symmetry of nuclear forces - Normalization of deuteron wave functions.
UNIT VII	**PARTIAL WAVE ANALYSIS**
	Method of partial wave analysis and phase shifts - Effective range theory – n-p scattering at low energies– Yukawa's meson theory of nuclear forces.
	BLOCK III: REACTION CROSS SECTIONS AND NUCLEAR REACTORS
UNIT VIII	**REACTION CROSS SECTIONS**
	Nuclear cross sections – Compound nuclear formation and breakup – Resonance scattering cross section.
UNIT IX	**NEUTRONS**
	Interaction of neutron with matter – Thermal neutrons – neutron cycle in a thermo nuclear reactor – Critical size.
UNIT X	**NUCLEAR REACTORS**
	Types of nuclear reactors - cylindrical and spherical- sub-nuclear particles (elementary ideas only) – source of stellar energy – controlled thermo nuclear reactions.
	BLOCK IV: ELEMENTARY PARTICLES
UNIT XI	**FUNDAMENTAL INTERACTIONS IN NATURE**
	Classification of fundamental forces – Particle Directory and quantum numbers (Charge, spin, parity, iso-spin, strangeness etc).
UNIT XII	**CLASSIFICATION OF ELEMENTARY PARTICLES**
	Leptons, Baryons and quarks. Spin and parity assignments, isospin, strangeness.
UNIT XIII	**GEL-MANN-NISHIJIMA RELATION**
	The fundamental interactions – Translations in space – Rotations in space – SU(2) and SU(3) groups – Charge conjugation – Parity – Gell-Mann-Nishijima formula.

UNIT XIV	SYMMETRIES
	Time reversal–CPT invariance- Applications of symmetry arguments to particle reactions, Parity non-conservation in weak interaction; Relativistic kinematics.

Book For Study

1. Introduction to Elementary Particle Physics, Alessandro Bettin, 2nd Edition, 2014, Cambridge University Press.
2. Nuclear and Particle Physics, Claude Amsler, 2015, Iop Publishing Limited.
3. Modern Particle Physics, Mark Thomson, 2013, Cambridge University Press.

References

1. Nuclear and Particle Physics: An Introduction, 2nd Edition, Brian R. Martin, 2009, John Wiley & Sons, Inc.
2. Introduction to Nuclear and Particle Physics: Solutions Manual for Second Edition, C. Bromberg, Ashok Das, Thomas, 2006, Ferbel,World Scientific, Pvt Ltd
3. Modern Physics- R.Murugeshan Kiruthiga Sivaprasath, 2008, S.Chand & Company Ltd, New Delhi,30th Revised Multicolour edition.
4. Introductory Nuclear Physics-Samuel S.M. Wong, 2005, Printice Hall of India Pvt Ltd,New Delhi.
5. Nuclear Physics (Principle and applications)-J.S.Lilly, 2001, John Wiley & Sons (ASIA)Pte Ltd,Singapore.
6. Fundamentals and Nuclear Physics, Jean – Louis Basdevant, James Rich and Michel Spiro, 2005, Springer.

Mode of Evaluation	Assignment/Seminar/Written Examination

34543	**MATERIALS SCIENCE**
Objectives	*The main objective of this paper is to impart an interdisciplinary understanding on the fundamental scientific principles and concepts of materials that are essential for both practice and advanced study in the field of Materials Science.*
Outcome	On successful completion of the course, a student will be able to • Obtain the basis for understanding the link between different processing techniques and the characteristics of materials • Provide insight into some of the steps in the production of semiconductor devices • Provide an introduction to experimental methods that are used in parts of materials science
Schedule	Contact Hours: 16 hours
Prerequisite	Basic knowledge on material and thin films are Prerequisite.
	BLOCK I: MATERIAL BEHAVIOUR
UNIT I	**ELASTIC BEHAVIOUR OF MATERIAL**
	Elastic, Inelastic and Viscoelastic behaviour of materials – tensile strength, toughness, elongation, plastic deformation, hardness, creep and fatigue.
UNIT II	**POLYMERS**
	Polymers - Structure and Properties - Addition and condensation polymerization – Polymer types.
UNIT III	**APPLICATION OF POLYMERS**
	Application of polymers - Corrosion and Oxidation of metals – Prevention - Corrosion resistance materials.
	BLOCK II: THIN FLIMS
UNIT IV	**VACUUM PUMPS**
	Kinetic Theory of gases – Gas Transport and Pumping – Vacuum Pumps – Rotary, Diffusion and Turbo molecular Pumps – Pirani and Penning Gauges.
UNIT V	**THIN FILMS BY EVAPORATION**

	Thin films by Thermal evaporation – Thickness measurement – Quartz crystal method.
UNIT VI	**THIN FILMS BY EPITAXY**
	Epitaxy – Structural Aspects – Lattice Misfit and Imperfections – Liquid Phase Epitaxy – Vapour Phase Epitaxy – Epitaxy of compound semiconductors – Applications.
	BLOCK III: OPTICAL MATERIALS
UNIT VII	**PRINCIPLES OF LASER**
	Principles of Laser - Population inversion in three level and four level systems – Resonators-Q-switching and Mode locking.
UNIT VIII	**TYPES OF LASER**
	Solid state lasers – Ruby and Nd-YAG - Semiconductor lasers – GaAs/AlGaAs semiconductor laser – Gas lasers – He-Ne and CO_2 Lasers.
UNIT IX	**NON-LINEAR OPTICAL PROPERTIES OF MATERIALS**
	Electro-optic Effect – Pockel's effect, Kerr effect – Second harmonic generators – Electro-optic Modulators – Photorefractive Materials – Acousto-optic effect.
	BLOCK IV: COMPOSITE AND SMART MATERIALS
UNIT X	**COMPOSITE MATERIALS**
	Introduction – Polymer-matrix composites – Cement-matrix composites – Carbon-matrix composites – Metal-matrix composites – Ceramic-matrix composites.
UNIT XI	**APPLICATIONS OF COMPOSITE MATERIALS**
	Applications – Structural – Electronic – Thermal – Electrochemical – Environmental – Biomedical.
UNIT XII	**SMART MATERIALS**
	Amorphous and glassy materials – Structure – Preparation methods and novel properties.
UNIT XIII	**APPLICATIONS OF SMART MATERIALS**

	Shape memory alloys – Working mechanism – Pseudo elasticity – Applications – Nickel-Titanium (Nitinol) alloys – Material characteristics of Nitinol.
UNIT XIV	**MICRO ELECTRO MECHANICAL SYSTEMS**
	Introduction to Micro Electro Mechanical Systems (MEMS) – Silicon, porus Silicon and Silicon oxide based MEMS –Fabrication of piezoelectric and Piezo-resistive MEMS materials – Application to micro-actuators and microaccelerometers.

Book For Study

1. Materials Science and Engineering – V. Raghavan, 6th Edition, PHI Learning, 2015.
2. Materials Science and Thin Films – Milton Ohring, 2nd Edition, ELSER, 2009.
3. Laser and Non Linear Optics- B.B. Laud, 3rd Edition, New Age International Limited, 2011.
4. Composite Materials: Science and Applications – Deborah.D.L. Chung, ANE-Books, New Delhi, 2011.
5. Smart Material Systems And MEMS: Design And Development Methodologies- Vijay K.Varadan, K.J. Vinoy, S. Gopalakrishnan, Wiley India, 2011.

References

1. Introduction to Materials Science for Engineers – James F. Shackelford, Madanapalli K. Muralidhara, Pearson India, 2006
2. Handbook of Thin Film Deposition: Principles, Methods, Equipment and Applications- Seshan, 2nd Edition, William Andrew Publishing, 2002.

Mode of Evaluation	Assignment/Seminar/Written Examination

34544	**ADVANCED ELECTRONICS AND PHYSICS LABORATORY - IV**
Objectives	*The main objective of this practical paper is to exercise the practical in various advanced electronics and advanced analytical experiments to the students.*
Outcome	On successful completion of the course, a student will be able to • Understand the basic operations in electronic circuits • Develop the programming skills of Microprocessor • Understand the concept of ICs manufacturing • Appreciate the applications of Microprocessor programming • Understand the basic principles of the experiments • Understand simple concepts to demonstrate an experiment
Schedule	Contact Hours: 120 hours
Prerequisite	Basic knowledge on transistor, diode, amplifier, oscillators, semiconductor, spectrometer and microscope are prerequisite.
	(Any Fifteen of the following) 1. BCD to 7 segment display and BCD decoder. 2. Shift register and ring counter. 3. Operation of 7489 RAMS. 4. Arithmetic operations – Microprocessor 8085. 5. Logical operations - Microprocessor 8085. 6. Code conversion - Microprocessor 8085. 7. Determination of Plank’s constant using photocell apparatus. 8. e/m by Millikan’s oil drop method. 9. e/m by Thompson’s oil drop method.

	10. Thermal Conductivity of a bad conductor (Lees Method). 11. Hydrogen spectrum and Rydberg's constant. 12. Determination of BH and M using magnetometers. 13. Determination of Stefan's constant. 14. Fabrey-Perot interferometer. 15. Solar cell characteristics. 16. Polarizability of liquids – Hollow prism – Spectrometer. 17. Determination of specific rotatory power of a liquid using polarimeter. 18. Any of the experiments of equal standard.

e. 3. Duration of the Programme:

The Programme for the degree of Master of Science in Physics shall consist of two academic years divided into four semesters. Each semester consists of Three Theory Papers and One Practical Paper. Each Theory course carries 4 credits and Practical course also carries 4 credits. Hence, the total credits per semester are 16 and the total credits of the programme are 64.

e. 4. Faculty and Support Staff Requirements:

The required Faculty and Supporting Staff details for the degree of Master of Science in Physics programme are given below:

Staff category	Required
Core Faculty	3
Faculty for Specialization	2
Laboratory Assistant	1
Clerical Assistant	1

e. 5. Instructional Delivery Mechanisms:

The instructional delivery mechanisms of the programme includes SLM - study materials, face to face contact session for both theory and practical courses of the programme, e-content of the study materials in the form of CD, MOOC courses and virtual laboratory, wherever applicable.

e. 6. Identification of Media:

The SLM - designed study materials will be provided in print media as well as in the form of CD which carries electronic version of the study material in addition to MOOC and virtual laboratory courses.

e. 7. Student Support Services:

The student support services will be facilitated by the head quarter i.e., Directorate of Distance Education, Alagappa University, Karaikudi and its approved Learning Centres located at various parts of Tamil Nadu. The pre-admission student support services like councelling about the programme including curriculum design, mode of delivery, fee structure and evaluation methods will be explained by the staff at head quarter and Learning Centres. The post-admission student support services like issuance of identity card, study materials, etc. will be routed through the Learning Centres. The face to face contact sessions of the programme for both theory and practical courses will be held at the head quarter only. The conduct of end semester examinations, evaluation and issuance of certificates will be done by the Office of the Controller of Examinations, Alagappa University, Karaikudi.

***f.* Procedure for Admission, Curriculum Transaction and Evaluation:**

f. 1. Procedure for Admission:

A candidate who has passed B.Sc., Degree Examination with Physics or Applied Physics as main course of study of any University or any of the B.Sc., degree examination with specialization such as Applied Physics, Electronics, Nuclear Physics, Biophysics, Nanoscience or any other specialization in Physics of some other University accepted by the syndicate as equivalent thereto, subject to such condition as may be prescribed therefore shall be permitted to appear and qualify for the M.Sc. Degree in Physics of this University after a course of study of two academic years.

f. 2. Curriculum Transactions:

The classroom teaching shall be through conventional lectures, use of OHP, power point presentations, web-based lessons, animated videos, etc. The lecture shall be such that the student

should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

For practical courses exclusive study materials containing the requirements, procedure for the experiments will be issued to the learners. In the laboratory, instruction shall be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

The face to face contact sessions will be conducted **only at head quarter** as per the following schedule:

Course Type	**Face to Face Contact Session per Semester (in Hours)**
Theory Courses (3 courses with 4 credits each)	48 (16 hrs per course)
Practical Courses (1 course with 4 credits)	120
Total	**168**

The above mentioned **face to face contact session (only at head quarter) is compulsory** for all the students who have enrolled in M.Sc. Physics Programme through Distance Learning Mode.

g. 3. Evaluation:

The examinations shall be conducted separately for theory and practical's to assess the knowledge acquired during the study. There shall be two systems of examinations viz., internal and external examinations. In the case of theory courses, the internal evaluation shall be conducted as Continuous Internal Assessment via. Student assignments preparation and seminar, etc. The internal assessment shall comprise of maximum 25 marks for each course. The end semester examination shall be of three hours duration to each course at the end of each semester. In the case of Practical courses, the internal will be done through continuous assessment of skill in demonstrating the experiments and record or report preparation. The external evaluation consists of an end semester practical examinations which comprise of 75 marks for each course.

f. 3.1. Distribution of Marks for Theory Course: (CIA 25 marks + ESE 75 marks)

The internal assessment shall comprise a maximum of 25 marks for each course. In addition to continuous evaluation component, the end semester examination, which will be a written examination of at least 3 hours duration to each course, would also form an integral component of the evaluation. The ratio of marks to be allotted to continuous internal assessment and to end semester examination is 25:75. Student must have earned 75% of attendance in each course for appearing for the examination. Attendance need not be taken as a component for continuous assessment, although the student should put in a minimum of 75% attendance in each course.

The components for continuous internal assessment for theory course are:

Seminar (1 per course)	-	05 marks
Assignment (2 per course)	-	20 marks
Total	-	25 marks

Question paper pattern for end semester examination of theory course:

M.Sc. Physics
345XY: Course title
(2018-19 onwards)

Time: 3 Hours Max. Marks - 75

PART A: Answer all questions. All questions carry equal marks. (10 × 2 = 20 marks)
PART B: Answer all questions either (a) or (b). (5 × 5 = 25 marks)
PART C: Answer any three questions. (3 × 10 = 30 marks)

f. 3.2. Distribution of Marks for Practical Course: (CIA 25 marks + ESE 75 marks)

The evaluation of practical course, wherever applicable, will also be based on continuous internal assessment for 25 marks and an end-semester practical examination for 75 marks. The continuous assessment for practical course consists of the execution of laboratory experiments, understanding and demonstration of experiments, preparation of laboratory observation note book along with seminar/model practical, etc.

CIA	**Marks**
Execution of laboratory experiments, understanding and demonstration of experiments, preparation of laboratory	25

observation note book along with
seminar/model practical, etc.

ESE **Marks**

Circuit Diagram / Diagram / Formula / Tables	10
Observation	20
Results	20
Viva - voce in practical	15
Record Note	10
Total	75

The candidate failing in any course(s) will be permitted to appear for each failed course(s) in the subsequent examination.

f. 3.3. Passing Minimum:

- For internal Examination, the passing minimum shall be 40% (Forty Percentage) of the maximum marks (25) prescribed for UG and PG Courses.
- For External Examination, the passing minimum shall be 40% (Forty Percentage) of the maximum marks (75) prescribed for UG and PG Courses.
- In the aggregate (External + Internal), the passing minimum shall be 40% for UG and 50% for PG courses.

g.3.4. Classification of Successful Candidates

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First class. All other successful candidates shall be declared to have passed in the Second class.

Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in First class with Distinction provided they pass all the examinations prescribed for the course at the first appearance.

Candidates who pass all the examinations prescribed for the programme in the first instance and within a period of two academic years from the year of admission to the programme only are eligible for University Ranking.

A candidate is deemed to have secured first rank provided he/she

(i) should have passed all the courses in first attempt itself

(ii) should have secured the highest overall grade point average (OGPA)

f. 3.5. Marks and Grading:

Once the marks of the CIA and end-semester examination for each of the courses are

available, they will be added. The marks, thus obtained will then be graded as per the scheme provided in Table 1.

Table 1: Grading of the Courses

Marks	Grade Point	Letter Grade
96 and above	10	S+
91 – 95	9.5	S
86 – 90	9.0	D++
81 – 85	8.5	D+
76 – 80	8.0	D
71 – 75	7.5	A++
66 – 70	7.0	A+
61 – 65	6.5	A
56 – 60	6.0	B
50 – 55	5.5	C
Below 50	0	F

From the second semester onwards the total performance within a semester continuous performance starting from the first semester is indicated respectively **Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)**. These two are calculated by the following formula.

$$GPA = \frac{\sum_{i=1}^{n} Ci\ Gi}{\sum_{i=1}^{n} Ci}$$

Where ‘Ci’ is the Credit earned for the course ‘i’ in any semester; ‘Gi’ is the Grade Point obtained by the student for the course ‘i’ and ‘n’ is the number of courses **passed** in that semester. **CGPA** (Cumulative Grade Point Average) = Average Grade Point of all the Courses starting from the first semester to the current semester.

f. 3.6. Maximum Duration for the Completion of the Course:

The maximum duration for completion of M.Sc. Degree in Physics Programme shall not exceed ten semesters.

f. 3.7. Commencement of this Regulation:

These regulations shall take effect from the academic year 2018-2019 i.e., for students who are to be admitted to the first year of the programme during the academic year 2018-2019 and thereafter.

f. 4. Fee Structure:

The programme has the following Fee Structure:

Sl. No.	Fees Detail	Amount in Rs.		Nature of Fees
		First Year	Second Year	
1	Admission Processing Fee	300	-	Non- Refundable
2	Course Fee	20,000	20,000	Non- Refundable
3	ICT Fee	150	150	Non- Refundable
	TOTAL	**20,450**	**20,150**	Non- Refundable

The above mentioned fee structure is exclusive of Examination fees.

***g.* Requirement of the Laboratory Support and Library Resources:**

A well-equipped Physics Laboratory for M.Sc. Physics (Distance Learning Mode) programme was established at the Department of Physics, Alagappa University, Karaikudi with all the necessary equipments for conducting face to face contact sessions for Practical courses. The students who have enrolled in M.Sc. Physics Programme through Distance Learning Mode have to compulsorily attend the face to face contact session for Practical Courses at the said Physics Laboratory in the head quarter **only**.

Directorate of Distance Education, Alagappa University, Karaikudi houses an exclusive Library facility with adequate number of copies of books in relevant titles for M.Sc. Physics programme. The Central Library of Alagappa University is also having good number of reference books. The books available at both the libraries are only for reference purpose and not for lending services.

h. **Cost Estimate of the Programme and the Provisions:**

The cost estimate of the programme and provisions for the fund to meet out the expenditure to be incurred in connection with M.Sc. Physics Programme are as follows:

Sl. No.	Expenditure Heads	Approx. Amount in Rs.
1	Programme Development (Single Time investment)	**20,00,000**
2	Programme Delivery (Per Year)	**24,00,000**
3	Programme Maintenance	**5,00,000**

i. **Quality Assurance Mechanism and Expected Programme Outcomes:**

i. 1. University's Moto:

'Excellence in Action'

i. 2. University's Vision Statement:

Achieving Excellence in all spheres of Education, with particular emphasis on "PEARL"- Pedagogy, Extension, Administration, Research and Learning.

i. 3. University's Objectives:

- Providing for Instructions and Training in such Branches of Learning as the University may determine.
- Fostering Research for the Advancement and Dissemination of Knowledge

i. 4. University's Quality Policy:

Attaining Benchmark Quality in every domain of 'PEARL' to assure Stakeholder Delight through Professionalism exhibited in terms of strong purpose, sincere efforts, steadfast direction and skillful execution.

i. 5. University's Quality Quote:

Quality Unleashes Opportunities Towards Excellence (QUOTE)

i. 6. Programme's Review Mechanism:

The quality of the programme depends on scientific construction of the curriculum, strong-enough syllabi, sincere efforts leading to skillful execution of the course of the study. The ultimate achievement of M.Sc. Physics programme of study may reflect the gaining of

knowledge and skill in Physics subject. And all these gaining of knowledge in Physics may help the students to get new job opportunities, upgrading in their position not only in employment but also in the society, make students feel thirsty to achieve in research in the fields associated with Physics discipline, achieving in competitive examinations on the subject, etc.

The benchmark qualities of the programme may be reviewed based on the performance of students in their end semester examinations. Apart from the end semester examination-based review, feedback from the alumni, students, parents and employers will be received and analyzed for further improvement of the quality of M.Sc. Physics Programme.

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MINUTES OF THE MEETING OF THE BOARD OF STUDIES IN PHYSICS FOR M.Sc. PHYSICS (DISTANCE EDUCATION MODE) PROGRAMME HELD ON 23.06.2017

The Board of Studies Meeting for M.Sc. Physics (Distance Education Mode) programme was held on 23.06.2017 at 11:00 a.m. in the Directorate of Distance Education, Alagappa University, Karaikudi.

The following members were present:

1. Dr. G. Ravi - Chairman
   Professor and Head, Department of Physics
   Alagappa University, Karaikudi
2. Dr. R. Sivakumar - Member
   Assistant Professor, Department of Physics
   Alagappa University, Karaikudi
3. Dr. S. Sankar - Member
   Professor, Department of Physics
   Anna University, MIT Campus
   Chennai
4. Dr. S. Rajashabala - Member
   Associate Professor
   Department of Theoretical Physics
   Madurai Kamaraj University, Madurai

At the outset, the Chairman of the Board, Dr. G. Ravi, has extended a very warm welcome to all the Members of the Board and briefly narrated the need and significance of designing the regulation and syllabi for M.Sc. Physics (Distance Education mode) programme.

The board appreciated the Vice-Chancellor for taking efforts in revising the curriculum and syllabi of the said programme.

After detailed discussion and deliberations, the Board has unanimously resolved to approve the regulation and revised syllabi of the M.Sc. Physics (Distance Education mode) programme to be introduced in the Directorate of Distance Education.

The board resolved to include internal assessment mark 25 and annual examination mark 75, during the implement of this revised syllabi.

The detailed revised syllabi and the regulations are enclosed in the Appendix.

The Chairman of the Board thanked the Members of the Board for the deliberations made in the meeting.

Name of the Member	**Signature**
Dr. G. Ravi	G. Ravi 23/6/17
Dr. R. Sivakumar	R. Sivakumar 23/06/2017
Dr. S. Sankar	Sankar 23/6/17
Dr. S. Rajashabala	S. Rajashabala 23/6/17