MADURAI KAMARAJ UNIVERSITY
University with Potential for Excellence
Re Accredited by NAAC with "A++" Grade in the 4rd Cycle
DIRECTORATE OF DISTANCE EDUCATION
www.mkudde.org

Programme Project Report for M. Sc PHYSICS (6044)

I. About the Department

The Department of Physics in the Directorate of Distance Education of Madurai Kamaraj University is having full-fledged laboratory for both General and Electronics. The course started in the year of late 1970s. The department currently offers both U.G. and P.G programs in physics.

II. Program Overview:

The physics department is committed to impart quality education for both in theoretical as well as experimental physics with special emphasis on 'learning by doing' for socio-economic growth and "reach to not reach".

Owing to their wide-ranging and comprehensive training, there is a high demand for physics graduates in many walks of life. Potential career prospects range from research and development at universities, research institutions and in industry to positions in the field of information and communications or in management consultancy. The ideal basis for taking advantage of these opportunities is for students to follow up their B.Sc. degree with a research-oriented M.Sc. programme that gives them in-depth specialist knowledge and understanding of the scientific methods employed in physics along with insights into neighboring fields (depending on the choice of modules). In addition, the M.Sc. lays the foundations for a later doctorate

III. Objectives of the Program

➢ To impart quality education in physics to students so as they become globally competitive physicist.

➢ To make the students to accept the challenges in physics and can effectively disseminate the physics knowledge to coming generations.

➢ To create strong interest in physics so as students can further develop themselves through self-study.

➢ To create a sense of ethical responsibilities among students.

➢ a) To enabling as a master mind in Physics. Because physics as a father of the science.

➢ b) Physics as fundamental science and mandatory subject for engineering and medical. Hence the post graduate teacher should be an acknowledgeable person.

> ➢ c) If you know physics you can study any other subject but other specialization can't be do.

IV. Program Target Groups

Those who are have completed B. Sc physics and not to pursue further by the family situation. Those who are working as a science teacher in the school, to improve their knowledge and they are the ignition to the future of India.

To provide Higher Education to diverse section of society as an instruments of democratizing Education

To provide Education to such section of society, which are unable to get education through face-to-face education?

To educate the society, which are deprived educations due to crossing of their age limit

To increase the Gross Enrollment Ratio of State and in turn to Nation

To provide the opportunity to employed person to increase their education Qualification

To provide education of person (Male & Female) working in their business, Housewife or Agriculture

To provide alternative Cost effective non formal Channel for tertiary Education

To encourage the people for Online Transaction

V. Program Requirements

1. Candidate who have passed under graduate in B. Sc Physics as a major subject and recognized by University Grand Commission.

2. Marks required a student must have passed in his/her Under-Graduate degree;

VI. Degree Overview

M.Sc. Physics or Master of Science in Physics is a postgraduate Physics course. Physics is a natural science that involves the study of matter and its motion through space time, along with related concepts such as energy and force. More broadly, it is the general analysis of nature, conducted to understand how the universe behaves. The duration of M.Sc. in Physics is mostly of two academic years

The basic laws of physics are applied in advancements in many areas including modern medical and space-related technologies, climate research as well as energy generation and storage. As the study of physics continues to evolve through new discoveries, we need inquisitive minds to explore the connections between traditional and emerging research areas, including medical and nano-scale physics, and biophysics.

Day to day lesson plan of each Course on the day registration Distribution of Printing Material of Course on the day of Registration of students Regular Monitoring of students by faculty members on Phone/Video Calling Fixing the date of Examination Schedule, Quiz, and Annual Examination Calling the Students in University Campus for Face to face Interaction, especially when seminar/ conference organization related to their subject

Deputing concern faculty to divisional place and calling all the students of concern subject for face to face interaction, conduction of classes, midterm review, solving the queries of students

VII.   Degree Title **M.Sc. in PHYSICS**

VIII. Duration of the Program All students must complete the program within two years. The program is dedicated to maintaining a full year-round program with four semesters. In all the four semester the students may be engaged in mandatory core and optional courses;

IX.   Program Structure The M. Sc Program in Physics is designed as core, elective and SSS course papers; for each semester there may be 4 core papers, two elective papers and one SSS paper. There one of the core paper must be a practical as part of this program. Summary Description

M.SC PHYSICS			
COURSE CODE	**COURSE**	**NATURE**	**CREDIT**
SEMESTER - I			
MPHAC11	MATHAMATICAL PHYSICS – I	CORE	5
MPHAC12	CLASICAL MECHANICS	CORE	5
MPHAC13	APPLIED ELELCTRONICS	CORE	5
MPHAC1P	PRACTICAL - I	CORE	4
MPHAT11 / MPHAT12	COMPUTER ORIENTED NUMERICAL METHODS / COMPUTER PROGRAMMING IN C++	ELELCTIVE	4
SEMESTER – II			
MPHAC21	MATHEMATICLA PHYSICS – II	CORE	5
MPHAC22	STATISTICAL MECHANICS AND THERMODYNAMICS	CORE	5
MPHAC23	ELECTRO MAGNETIC THEORY	CORE	5
MPHAC2P	PRACTICAL – II	CORE	4
MPHAT13 / MPHAT14 / MPHAT15	NANO-PHYSICS / INTRODUCTION TO PARTICLE / MEDICAL PHYSICS	ELELCTIVE	4
SEMESTER – III			
MPHAC31	SOLID STATE PHYSICS -I	CORE	5
MPHAC32	QUANTUM THEORY –I II	CORE	5
MPHAC33	MOLECULAR PHYSICS	CORE	5
MPHAC3P	PRACTICAL - III	CORE	4
MPHAT16 MPHAT17	NON-CONVENTIONAL ENERGY SOURCE / INTRODUCTION TO NANOTECHNOLOGY	ELELCTIVE	4
SEMESTER – IV			
MPHAC41	SOLID STATE PHYSICS – II	CORE	5
MPHAC42	QUANTUM THEORY –II	CORE	5
MPHAC43	NUCLEAR & PARTICLE PHYSICS	CORE	5
MPHAC4P	PRACTICAL - III	CORE	4
MPHAT18 / MPHAT19	APPLIED OPTICS AND LASER PHYSICS / FIBER OPTIC COMMUNICATION	ELELCTIVE	4
		Total	92

X. Details of Syllabi each course has a detailed syllabus structured in terms of Units. The detailed syllabus for all core and optional courses has been attached in the Annexure I.

XI. Time Table for Contact Classes theory &Practical

The ODL Regulations insists of minimum 60 hours per semester of which 60 hours are for contact theory class and 60 hours for practical purpose. The following table demonstrates the time allotment for both contact theory and practical totaling 12hours per week; for a semester there may be available 5 months and one round of contact/counseling class per month is enough to achieve the required hours.

Week/Hours		9:00 AM – 10:30 PM	11:15 AM – 1:15 PM	2:00 PM – 4:00 PM
Week I	Day I	Core I	Core II	Core III
	Day II	Core IV	Elective I	core
Week II	Day I	Practical Training	Practical Training	Practical Training
	Day II	Practical Training	Practical Training	Practical Training

Per Week 9.00 – 10.30 10.30 – 12.00 1.00 – 2.30 2.30 – 4.00 Day 1 C1 C2 / Discussion Forum C3 E1 Day 2 C1 C2 / Discussion Forum C3 E1

XII. Evaluation Procedures

➢ Principles of Evaluation the rubrics of evaluation of the program will be based on the following principles:
> Proof of Initiative,
> Active immersion,
> Interaction;

Use of DIE - Describe,

> Interpret,

> Evaluate;

> utilizing variety of sources;

Analytical Approach.

➢ Methods of Evaluation the students will be assessed by two pronged evaluation methods:
   a) Continuous Internal Evaluation;
   b) End-of-semester evaluation.
   c) Integration of Continuous and End-of-semester evaluation,the following points have been incorporated for effecting the integration of continuous and end-of-semester evaluation

a) Continuous Internal Evaluation Aiming to assess values, skills and knowledge imbibed by students, internal assessment is to be done by the concerned faculty-member. It would comprise the following steps:

There may be three different modes of continuous internal assessment:

    i.   Book Review (BKR)
    ii.   Problem Solving (PS)
    iii.   Writing Assignment (WRA)

Components for internal evaluation are to have a time-frame for completion (by students), and concurrent and continuous evaluation (by faculty-members).
The evaluation outcome may be expressed either by pre-determined marks
The evaluation reports submitted by all the faculty-members are to be reviewed, from time to time, by the Examination Committee under the chairmanship of Director in order to ensure transparency,

iv.   Fair-play and accountability.
Following the review by the Examination Committee, the outcome of internal evaluation will be announced or displayed on the Notice Board and / or web-site as per the time frame or academic calendar.

b) End-of-semester evaluation: -

This is to be carried out at the end of first semester, and will aim to assess skills and knowledge acquired by students through class-room interaction. The evaluation can be in the form of written examination, or term paper assignment. Evaluation process should be verifiable and transparent. Towards this end, the following steps have been adopted:

All the students pursuing this program have to undergo external evaluation at the end of first semester as per syllabi;

With regard to written examination the internal faculty may associate themselves with the external examiners in the examination process.

In the case of written examination, the format of question paper is attached in annexure could be moderated by the Examination Committee.

Answer-books or –sheets are to be 'encoded' (before being passed on to examiner / evaluator, and decoded (before tabulation).

(c) Integration of Continuous and End-of-semester evaluation The following points have been incorporated for effecting the integration of continuous and end-of-semester evaluation: ¬

➢ Relational weightage assigned to internal evaluation is 40 percent.

> ➢ Relational weightage assigned to end of semester evaluation is 60 percent.
> ➢ Following the integration of internal and external evaluations, the results may be expressed in marks

As soon as the integration of internal and external evaluations has been completed, the results should be announced, in keeping with the academic calendar, to facilitate students' academic or occupational pursuits.

3. Description of Evaluation

PATTERN OF EXAMINATIONS

A) Scheme for Internal Exam-Theory
   a. Internal marks = Maximum 25 marks
      i. Two Assignments - 12.5 marks each
         Total - 25 Marks

b) Scheme for External Exam-Theory
   a. External Examination – Maximum 75 marks
      Grand Total 100 marks

Passing Minimum - Theory
   1. 50% of the aggregate (Internal + External)
   2. 34 marks out of 75 is the pass minimum for the External.

c)Scheme for Internal Exam-Practical

   a) Scheme for Internal Exam-Practical

   Records as an Internal marks = Maximum 40 marks

d) Scheme for External Exam-Practical

External Examination –60% marks Maximum

Records   - 25%

Viva voice   -10%

Grand Total   -100 marks

Passing Minimum - Practical

1. 50% of the aggregate (Internal + External)

2. 21 marks out of 60 is the pass minimum for the External

Note: There is no passing minimum for internal assessment marks.

Description of Evaluation

This table lists all the components that make up the course assessment and their weightage. The column headed Qual. Mark indicates the percentage of marks that a student must have secured for declaring him as passed in that course.

Description of Program Evaluation	% Weightage	Qual. Mark
Internal-Theory Seminars & Writing Assignment	**25%**	**No minimum**
External -Theory 3 hour Theory examinations	**75%**	**34 marks**
Total	**100%**	
Internal-Practical Skill in handling experiments – Record	**30%**	**No minimum**
External- Practical 3 hours laboratory examinations	**60%**	**21 marks**
Viva-voce	**10%**	
Total	**100%**	

XII. Program Facilities

1. Library & Documentation Unit:

The Directorate has a full-fledged state of the art reference library of standard text and reference books and research journals and well-established documentation unit having NSS, NFHS and Census data.

2. Career Development Committee:

The Director may constitute a Career Development Committee consisting of at least three faculty members of the Directorate to look after the career opportunities of the students of the program. This Committee may undertake necessary initiatives in enhancing capabilities and skills such as English Language proficiency, computer and documentation skills, and competency in project writing; it may organize, if possible, campus recruitment in collaboration with NGO sector and print and visual media.

Practical: LOG BOOK - DDE

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Physics – Electronics - Lab -DDE

I M.Sc., Physics	Major Paper- I	Marks :100
Semester I	MATHEMATICAL PHYSICS-I	Hrs/Week : 6
Code: MPHAC11		INT: 25, EXT: 75

Unit I: Vectors

Integral forms of gradient, divergence and curl-line, surface and volume Integrals Gauss, Stokes's and Green's theorem (plane)- statement and proof-scalar, gravitational and centrifugal potentials- applications- curvilinear coordinates-gradient, divergence and curl in Cartesian, spherical, cylindrical coordinates-equation of continuity- equation of heat flow in solids.

Unit II: Linear vector space and Matrices

Linear vector space-subspace, and dimensions-linearly dependent, independent and orthogonality vectors-inner product Space-Gram-Schmitt's orthoganalization method- Hilbert space-Schwartz inequality.

The Algebra of matrix- special matrices (orthogonal, unitary and Hermition), properties and applications-solution of linear equation- linear transformation - Eigen values and Eigen Functions-Caley-Hamilton's theorem and applications Diagonalisation- Kronecker sum and product of matrix- Dirac and Pauli's matrix.

Unit III: Fourier series, Fourier integrals and Fourier transform Dirichlets condition- determination of coefficients-function having arbitrary period half range expansion in some typical wave form-applications of Fourier series in forced vibrations-Fourier integral-Representation of more complicated periodic phenomena-Fourier transform-Properties of Fourier transform (Linearity, similarity, modulation, convolution and Parseval's indentity)-Fourier transform of derivatives Fourier sine and cosine transform of derivatives-Function of two or three variables Infinite Fourier transform- Some applications of 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-Rodrigue's formula for Legendre 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 equation, Laplace equation and Poisson equations-non homogenous equation-Green's function-symmetry of Green function-Green function for Poisson equation-Laplace equation and Helmholtz equation-applications of Greens function in scattering problem.

TEXT BOOK:

1. Mathematical Physics and Classical Mechanics, Sathyaprakash, Sultan Chand

&Sons, 2005

REFERENCE BOOKS:

1. Mathematical Physics, Eugene Butkov, Addition Wesley

2. Applied Mathematics for Engineers and Physicist, Pipes and Harvil

3. Matrices and Tensors, A.W.Joshi II Edition, Wiley Eastern Ltd, 1984

4. Chemical Applications 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)

7. Mathematical methods for Physics J.Mathews and R.C Walker, AddisonWesley, 2nd Edition.

8. Advanced Engineering Mathematics, Erwin Kreyszig,IV Ed, New Age

International

9. Mathematical Physics, H.K.Dass IV Ed,2004 S.Chand & company Ltd

I M.Sc., Physics	**Major Paper- II**	Marks :100
Semester I	CLASICAL MECHANICS	Hrs/Week : 6
Code: MPHAC12		INT: 25, EXT: 75

Objectives:

☐ To know classical mechanical methods and theories

☐ To understand classical mechanical transformations, oscillations and concepts

☐ To apply them to solve physics problems

Unit –I Lagrangian and Hamiltonian methods Generalized coordinates - Lagrangian equation of motion- Variational principle and Lagrangian equation of motion – Hamiltonian equation of motion – Cyclic coordinates and Routh's procedure – Physical significance of the Hamiltonian – Hamiltonian equations form variational principle-The principle of least action - Simple applications.

UNIT –II Central field motion

Motion under a central force – General features of central force motion- Reduction of two body central force problem to the equivalent one body problem- Equation of amotion in a central field. Equation of orbit in a central field- condition for closed orbit (Bertrand's theorem)- The virial theorem- Kepler's law of planetary motion-scattering in a central force field- Rutherford's Alpha Particle Scattering.

Unit III Canonical Transformations The equation of Canonical Transformations - examples of Canonical Transformations – Harmonic Oscillator- Lagrange and Poisson bracket – Equation of motion in Poisson bracket notation- Liouville's theorem.

Unit-IV Small oscillations

Formulation of the Problem-Eigen value equation and the principle axes Transformation Frequencies of free vibrations and normal Coordinates-Free vibrations of a linear triatomic molecule and some macroscopic applications.

Unit –V Hamilton- Jacobi theory Hamilton-Jacobi equation – Applications: Harmonic Oscillator and Kepler's Problem – The Hamilton –Jacobi equation for Hamilton's characteristic's function-

Action and Angle variables- Harmonic Oscillator problem using action and angle variables- Kepler's problem in action- Angle variable

TEXT BOOK:

1. Classical Mechanics, H. Goldstein, II edn. (1980, Narosa). World student Edn

Chapter: 3, 6 ,8,9,10 revelent sections.

REFERENCE BOOKS:

1. Mechanics, L.D. Laudau and E.M. Lifshitz

2. Classical Mechanics, T.W.B. Kibble

3. Classical Mechanics, N.C. Rana and P.S. Juog

I M.Sc., Physics	**Major Paper- III**	Marks :100
Semester I	APPLIED ELECTRONICS	Hrs/Week : 6
Code: MPHAC13		INT: 25, EXT: 75

COURSE OBJECTIVES:

□ To be familiar with various semiconductor devices and amplifier systems

□ To understand various wave generators, wave shaping systems

□ To develop skills in handling combinational sequential circuits

UNIT I SEMICONDUCTOR DEVICES
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 – switch – amplifier – small – signal FET models – CMOS devices.

UNIT II AMPLIFIER SYSTEMS
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.

UNIT III WAVE FORM GENERATORS AND WAVESHAPING
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.

UNIT IV DIGITAL CIRCUITS AND SYSTEMS
Combinatorial – Digital circuits: Standard Gate assembling Binary adders – Arithmetic functions – Digital comparators – Parity checker – Generators – Decoder - Demultiplexer –Data selector – multiplexer encoder – Read only Memory (ROM) – Two dimensional addressing of a ROM – ROM applications – programmable ROMs. – Erasable PROMS –programmable array logic – programmable logic arrays. Sequential circuits and systems: A1 Bit memory – The circuit properties of a Bistable Latch – The clocked SR Flip flops. J - K, – T -, and D - type Flip flops – shift registers – Ripple counters – Synchronous and Asynchronous counters – Application of counters.

UNIT V VERY LARGE SCALE INTEGRATED SYSTEMS
Dynamic MOS shift registers – Ratioless shift register stages – CMOS Domino logic - Random Access Memory (RAM) – Read - write memory cells – Bipolar RAM cells – Charge coupled

device (CCD) – CCD structures – Integrated - Injection logic – Microprocessors and Microcomputers.

TEXT BOOK:

1. Micro Electronics (II ed.), Millman, J &Grabel, A.: Tata McGraw Hill, 2002, ISBN 0-

07- 463736-3.

Unit – I Chapter- 4

Unit – II Chapter-14

Unit – III Chapter-7 & 8

Unit – IV Chapters-9

Unit – V Chapters-15

REFERENCE BOOK:

1. Digital Principles and application (VI ed.) Malvino, A.P. & Leech, D andGoutamSaha

: Tata McGraw Hill, 2006, ISBN 0-07- 060175-5.

I M.Sc., Physics	PRACTICAL - I	Marks :100
Semester I	ELECTRONICS	Hrs/Week : 6
Code: MPHA1P		INT: 40, EXT: 60

Any eight Experiments

1.FET Amplifier

2.Amplitude modulation

3. Operational amplifier characteristics

4. Phase shift oscillator

5.Wien Bridge oscillator

6.Saw tooth wave generator

7. Emitter follower

8.UJT –Relaxation oscillator

9. Two stage RC coupled amplifier – With and without feedback

10.. Wave shaping circuits

11. Passive filter circuits - low high and band pass filters.

12. Determination of Planck's constant

I M.Sc., Physics Major Paper- 5 (a) Marks :100

I M.Sc., Physics	MAJOR ELECTIVE –I	Marks :100
Semester I	COMPUTER ORIENTED NUMERICAL METHODS	Hrs/Week : 6
Code: MPHAT11		INT: 25, EXT: 75

Unit I

Iterative methods: Introduction – beginning an Iterative method- the method of successive bisection- Newton Rapson Iterative method-the second method- The method of successive approximation- comparison of Iterative methods.

Unit- II

Solution of simulation algebraic equation - introduction-the gauss elimination method pivoting-III condition equations. Refinement of the solution obtained by Gaussian elimination- the Gauss-Seidal iterative method – an algorithm to implement the Gauss-Seidal Method-Comparison of direct and iterative methods.

Unit – III

Interpolation: Lagrange Interpolation-difference Tables-Truncation error in interpolation least squares approximation of function- linear regression- Algorithm for linear regression.

Unit – IV

Differentiation and integration: Formulae for numerical integration – Simpson's Rule Gaussian Quadrature Formulae-Numerical solution of Differential Equations-Higher order equation.

Unit – V

Application to specific problem: program for solution of an equation by iterative method (Newton Raphson method) - Solution of simultaneous equation - Calculation of mean and variance - Calculation of correlation Coefficients-Linear regression - Solution of first order differential equation (Runge-Kutta method) - Solution of II order differential equation (Runge- Kutta method) - Evaluation of Definite integrals (Trapezoidal and Simpson rule) -Evaluation on inverse of a matrix - Evaluation of matrix polynomial. (Programs in C++ only)

TEXT BOOKS:

1. Computer oriented Numerical methods V.Rajaram II Edition 1989 Prentice Hall of India.

 Pvt.Ltd

2. Numerical Method for Scientific and Engineering Computation by M.K Jain S.R.K

 Iyengar, and R.K Jain, New Age International publishers.

REFERENCE BOOKS:

1. Elementary Numerical Analysis An Algorithmic Approach-S.D Conte & Carl de Boor,

 third Edition-McGraw Hill International company (1983)

2. Numerical Methods for Engineers – Steven C.Chopra. Raymond P.Canale-Second edition -

 McGraw Hill International Editions(1990)

I M.Sc., Physics	MAJOR ELECTIVE –1I	Marks :100
Semester I	COMPUTER PROGRAMMING IN C++	Hrs/Week : 6
Code: MPHAT12		INT: 25, EXT: 75

UNIT I: INTRODUCTION

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

UNIT II: FUNCTIONS, PROGRAM STRUCTURES & ARRAYS

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

UNIT III: POINTERS, STRUCTURES & UNIONS

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

UNIT IV: CLASSES AND OBJECTS

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

UNIT V: INHERITANCE AND POLYMORPHISM

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

TEXT BOOK:

1. D. Ravichandran, Programming with C++, Third edition, Tata McGraw Hill

Publishing Company Ltd.,2011.

Unit I-Ch.3, 4 &5 (Sec.3.1, 3.4, 3.7-3.14, 4.2, 4.4, 4.6, 4.8, 5.1., 5.1.1. - 5.1.3., 5.2, 5.4)

Unit II-Ch. 6 & 7 (Sec.6.2 – 6.9, 6.18, 7.2 – 7.8)

Unit III-Ch.8 & 9 (Sec.8.1 - 8.3, 8.6 – 8.9, 9.2, 9.4, 9.6 - 9.10)

Unit IV-Ch.10 & 11 (Sec.10.1 – 10.10, 11.2, 11.3)

Unit V-Ch.12 & 14 (Sec.12.1 – 12.5, 12.7, 14.1 -14.4, 14.8)

REFERENCE BOOKS:

1. YashavantKanettkar, Let us C++, 2nd edition, BPB Publications, 2013.

2. E. Balagurusamy, Object Oriented Programming with C++, 6th edition,

I M.Sc., Physics	**MAJOR –1V**	Marks :100
Semester II	MATHEMATICAL PHYSICS-II	Hrs/Week : 6
Code: MPHAC21		INT: 25, EXT: 75

Objectives:

☐ To know various Mathematical techniques

☐ To understand various Mathematical concepts

☐ To apply these techniques and concepts to solve Physics problems

UNIT I: COMPLEX VARIABLES

Analytic Function-Cauchy-Riemann Equation-C-R in polar form-complex line Integral Cauchy integral Theorem-Cauchy integral formula-derivative of analytic function (nth derivative)-expansion of analytic function-singular points and their classification- Singular point – Isolated singularity – Removal of singularity -Laurent's series

UNIT II COMPLEX INTEGRATION

Cauchy-Residue theorem – Residue – Calculation of residue at simple poles and poles of higher order – Evaluation of definitive integrals – Integration around unit circle – rectangular Contour-Jordan lemma – Semicircular contours – Poles on the real axis-integral of the form $\delta N\ F(x)\ dx$.

UNIT III TENSORS

Scalar, vector and tensors – difference between a tensor and a transformation matrix – second rank tensor – Definition – Examples – Contra variant, covariant and mixed tensors – Tensors in higher ranks- addition, multiplication and contraction of tensor Quotient law-metric tensor– Tensors in EM theory – Invariance of Maxwell's equations. Dirac delta function: Definition – properties – Delta sequence - Examples – Delta calculus.

UNIT IV: GROUP THEORY

Definition and nomenclature-rearrangement theorem-cyclic groups- Abelian groups - sub group and co sets - conjugate elements and class structure-identification of symmetry element and operations-molecular point groups-matrix representation of symmetry operations – the Great orthogonality theorem – character of representation-character table-generating symmetry operation-construction of character tables-irreducible representation of C2v and C3v

groups-symmetry species-specifications-SU(2) and SU(3) groups in elementary particles.

UNIT V: PROBABILITY

The binomial distribution- the normal or Gaussian distribution-distribution of sum of normal variables - application to experimental measurements-the standard deviation about the mean.

TEXT BOOKS:

1. Mathematical Physics and Classical Mechanics, Sathya Pakash, Sultan Chand &sons, 2005

2. Matrices and Tensors, A.W. Joshi

3. Chemical applications of Group theory, F. Albert Cotton, II Ed.,

4. Probability, Seymour Lipschutz, Kanchan Jain, Schaum's outline series, McGraw Hill

I M.Sc., Physics	**MAJOR –V**	Marks :100
Semester II	STATISTICAL MECHANICS AND	Hrs/Week : 6
Code: MPHAC22	THERMODYNAMICS	INT: 25, EXT: 75

Objectives:

☐ To describe the state of the system at equilibrium under various physical parameters.

☐ To discuss the physical properties of matter in bulk on the basis of the dynamical behavior of its microscopic constituents.

☐ To describe the statistical thermodynamic parameters for ideal gas and solids.

UNIT: I

Thermodynamic Potential – The laws of thermodynamics and their consequences – Combined first and second law of thermodynamics –The Helmholtz function and the Gibbs function – Thermodynamic potentials – Maxwell's relations – Stable and unstable equilibrium – Phase transition – The Clausius-Clapron equation – The third law of thermodynamics (Nernst Heat theorem).

UNIT: II

Application of Thermodynamics - Chemical potential – Phase equilibrium and phase rule – The Gibbs-Duhem Equation – Dependence of vapour pressure on total pressure – Surface tension – Vapour pressure of a liquid drop – The reversible voltaic cell – Thermodynamics of Blackbody radiation – Thermodynamics of magnetism.

UNIT: III

Statistical Mechanics - The Statistical basis of thermodynamics –Energy states and energy levels – Microstates and macro-states – Thermodynamic probability - Contact between statistics and the thermodynamics: physical significance of the number –Ensemble: Phase space of a system - Lowville's theorem and its consequences - Canonical, Micro canonical, Grand canonical – density of states and connection to entropy.

UNIT: IV

Statistical Thermodynamics– Statistics: Bose-Einstein, Fermi-Dirac and Maxwell Boltzmann statistics – The statistical interpretation of entropy. Distribution function: Bose Einstein, Fermi-Dirac, Maxwell-Boltzmann– Comparison of distribution functions for indistinguishable particles – The partition function of a system – Thermodynamic properties of a system.

UNIT: V

Statistical Thermodynamics - Applications – The monoatomic ideal gas – The Sackur Tetrode equation for the monoatomic ideal gas – The distribution of molecular velocities – The Principle of equipartition energy –The quantized linear oscillator – The Einstein theory of the Specific heat capacity of a solid – The Debye theory of the specific heat capacity of solid – Black body radiation.

TEXT BOOK:

 1. Thermodynamics, Kinetic theory and Statistical Thermodynamics - F. W. Sears

and G. L. Salinger, third edition, Narosa Publishing House,2013.

UNIT: I : Chapter 7

UNIT: II : Chapter 8

UNIT: III : Chapter 11 and Ensembles* - reference book (1)

UNIT: IV : Chapter 11

UNIT: V : Chapter 12 and 13

 REFERENCE BOOKS:

1. Statistical Mechanics -R K Pathria&Paul D. Beale, Elsevier-Academic Press, 3rd

Edition, 2011

2. Fundamentals of Statistical and Thermal Physics - Frederick Reif, McGraw-Hill

(e-Book: https://www.scribd.com/doc/205016520/Reif-Fundamentals of statistical and

thermal physics).

3. Fundamentals of Statistical Mechanics – BB Laud, New Age International

Publisher

I M.Sc., Physics	**MAJOR –VI**	**Marks :100**
Semester II	ELECTROMAGNETIC THEORY	**Hrs/Week : 6**
Code: MPHAC23		**INT: 25, EXT: 75**

Objectives

☐ To be familiar with electrom Sagnetic theory

☐ To understand electromagnetic concepts

☐ To apply these theory and concepts to solve the Physics problems

UNIT I - ELCTROSTATICS

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

UNIT II - MAGNETOSTATICS

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

UNIT III - ELECTRODYNAMICS

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

UNIT-IV-ELECTROMAGNETIC WAVES

Waves in one dimension –Thewave equation – sinusoidal waves -Electromagnetic waves in vacuum-The wave equation for E and B-Monochromatic plane waves –energy and momentum in electromagnetic waves- electromagnetic waves in Matter- propagation in linear media – reflection

and transmission at normal incidence- absorption and dispersion -electromagnetic waves in conductors.

UNIT-V –POTENTIALS AND FIELDS

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

TEXT BOOKS:

1. John R.Reitz, Fredrick J.Milford, Robert W.Christy, Foundations of Electromagnetic

theory, Third edition,Norosa Publishing House,New Delhi,1989.

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

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

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

Private Limited,2012.

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

UNIT – IV Ch.9 (9.1.1,9.1.2 ,9.2.1-9.2.3,9.3.1,9.3.2 &9.4.1)

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

REFERENCE BOOKS:

1. Paul Lorrain and Dale Corson, Electromagnetic Fields and waves, 2

ndEdition, CBS

Publishers & distributors,1986

2. Edward C.Jorden, Keith, G.Balmin,Electromagnetic waves and Radiating systems,

Edward, Prentice-Hall of India.,New Delhi,1988.

I M.Sc., Physics	PRACTICAL –II	Marks :100
Semester II	GENERAL PHYSICS	Hrs/Week : 6
Code: MPHA2P		INT: 40, EXT: 60

Any Eight experiments

1. Error Analysis and least squares

2. Refractive index of liquid using hollow prism

3. Cauchy's constants

4. Hyperbolic fringes

5. Elliptical fringes

6. Anderson's bridge

7. Mutual inductance using Carey Foster's bridge

8. Numerical integration

9. Wien's bridge

10. Owen's bridge

11. Optic bench- Biprism Experiment

12. Michelson's Interferometer.

13. Physical characteristics of thermistor

I M.Sc., Physics	**Major Elective –III**	Marks :100
Semester II	NANO PHYSICS	Hrs/Week : 6
Code: MPHAT13		INT: 25, EXT: 75

To be familiar with basic concepts of Nano Physics

☐ To understand various techniques used in Nano Physics

☐ To apply these concepts and techniques for practical applications

Unit I

Introduction – Nano structures – Nano crystalline materials - Electron microscopy – Electron microscope – General consideration for imaging – Analytical and imaging techniques –Sample preparation – Advantages and Disadvantages of electron microscopes – Transmission electron microscope – Background – High resolution Transmission electron microscopy –Preparation and visualization of samples – Imaging simulation – Particle size analysis –Scanning electron microscope – detection of secondary electrons - detection of Backscattered electrons - Secondary electron imaging – Microscope imaging – Scanning probe microscopy – Imaging structures.

Unit II

Atomic force microscopy – Theory – Piezoelectric ceramic transducer – AFM instrumentation – Imaging modes – Measuring images with AFM – Resolutions in Atomic force microscope - Probe surface interactions - Surface contamination – Electrostatic forces –Surface material properties – Vibrating sensing mode – Torsion modes – Mechanical surface modification – Electrical surface modification - Atomic force microscopy for nanoparticles –Qualitative analysis – Techniques – Direct growth by Chemical vapour deposition of AFM tips – CVD MWNT tip preparation - CVD SWNT tip preparation – Sample preparation –Nanolithography – Adhesive mask technique – Photolithography – resolution in projection systems – Limitations – Perspectives – Electron beam lithography – Electron energy deposition in matter – Spatial-phase-locked Electron beam lithography

Unit III

Fabrication of nanostructures – Milling – Lithographic processes – Lift-off process – Vapour phase deposition methods of fabrication – Plasma-assisted deposition methods of fabrication– DC glow

discharge – Magnetron sputtering – Vacuum arc deposition – Nanofabrication by scanning probe techniques – By Scanning force probes – Electrical structure generation by

SFM – By Scanning tunneling microscope – Growth and characterization techniques –Molecular beam epitaxy – MBE apparatus – MOVPE – Liquid phase methods – Colloidal methods – Sol-gel methods – basic process –Electro deposition

Unit IV

Properties of individual nanoparticles – Metal nanoclusters – Magic numbers - Theoretical modelling of nanoparticles – Geometric structure – Electronic structure – Reactivity – Fluctuations – Magnetic clusters – Bulk to Nano transition – Carbon nanostructures – Carbon molecules – Carbon clusters – Carbon nanotubes – Applications of carbon nanotubes

Unit V

Quantum Wells, Wires and Dots – Preparation of quantum nanostructures – Size and dimensionality effects – Excitons – Single electron tunneling – Applications –Superconductivity – Microelctro mechanical systems – Nanoelectromechanical systems

TEXT BOOKS:

1. Instrumentations and Nanostructures by A.S. Bhatia, NuTech books, 2009

Unit I – Page 192-194, 201 -204, Page 1 – 26, Page 52 – 64

Unit II – Page 65 – 86, Page 124 – 151

Unit III – Page 219 – 249

2. Introduction to Nanotechnology by Charles P. Poole Jr and Frank J. Owens, Wiley

Student edition, Reprint 2008

Unit IV – Page 72 – 89, Page 103 – 132

Unit V – Page 226 – 256, Page 332 – 345

I M.Sc., Physics	**Major Elective –IV**	Marks :100
Semester II	INTRODUCTION TO PARTICLE	Hrs/Week : 6
Code: MPHAT14		INT: 25, EXT: 75

UNIT I

Historical introduction- Origin of isospin and strangeness.

UNIT II

Relativistic kinematics - Decay and two body scattering, Relativistic wave equation–Klein Gordon and Dirac equations.

UNIT III

Symmetry: Discrete and Continuous groups - classification of particles - mesons, baryons and quarks - SU(n) symmetry - origin of colors.

UNIT IV

Electromagnetic interactions- Feynman rules for electrodynamics - electron-electron and electron-nucleon scattering - Rosen-Bluth formula - Deep inelastic scattering – introduction to Proton model, Weak interactions - Fermi theory - CP violation – introduction to neutrino oscillations.

UNIT V

Brief discussion of electro-weak theory - symmetry breaking - Higgs mechanism and the origin of mass - QCD and the standard model. Interface between particle physics and astrophysics – cosmology – big bang theory - dark matter - origin of dark energy.

REFERENCE BOOKS:

1. Particle Physics by Griffiths.

2. Quarks and Leptons by Halzen and Martin.

3. Quantum Mechanics by L. I. Schiff.

4. Nuclear and Particle Physics by W. E. Burcham and M. Jobes.

I M.Sc., Physics	**Major Elective –V**	Marks :100
Semester II	MEDICAL PHYSICS	Hrs/Week : 6
Code: MPHAT15		INT: 25, EXT: 75

Unit I

Sound in Medicine: General properties of sound, the body as a drum (percussion in medicine) The stethoscope, ultrasound pictures of the body, ultrasound to measure motion, physiological effects of ultrasound in therapy, the production of speech. Physics of the ear and hearing: The outer ear, the middle ear, the inner ear, sensitivity of the ears, testing your hearing, deafness and hearing aids

Unit II

Light in Medicine: Measurement of light and its units, applications of visible light in medicine, applications of ultraviolet and infrared light in medicine, Lasers in Medicine applications of microscopes in medicine. Physics of eye and vision: Focusing elements of the eye, some other elements of the eye, the retina – the light detector of the eye, how sharp are your eye? Optical illusions and related phenomena, defective vision and its correction, colour vision and chromatic aberration, instruments used in ophthalmology.

Unit-III

Ionising radiation and dosimetry: Generation of radiation, Interaction of charged particles with matter, interaction of high energy photons with matter, radiation depth of interaction, range, attenuation curves, dose and exposure measurement, maximum permissible levels, overview of measurement methods: film dosimeters, thermo luminescent dosimetry (TLD), dose measurement during radiography.

Unit-IV

Radioisotopes and nuclear medicine: Diagnosis with radioisotopes, isotopes, half-life, nuclear radiations, energy of nuclear radiations, units of activity, isotope generators, principles of measurement: counting statistics, sample counting, liquid scintillation counting, non-imaging investigations examples: haematological measurements, Glomerular filtration rate, radionuclide imaging, bone imaging, dynamic renal function.

Unit-V

Image Production: Radionuclide imaging: the gamma camera, energy discrimination, collimation, image display, single-photon emission tomography (SPET), positron emission tomography (PET), ultrasonic imaging: pulse–echo techniques, tissue interaction with ultrasound, transducer arrays, applications: Doppler imaging, CT imaging: absorption of Xrays, data collection, image reconstruction, beam hardening, spiral CT.

TEXT BOOKS:

1. Medical Physics–John R.Cameron& James G.Skofronick (John Wiley&Sons,New

York1978)

2. B.H. Brown, R.H. Smallwood, D.C. Barber, P.V. Lawford, and D.R. Hose, Medical

Physics and Biomedical Engineering, Institute of Physics Publishing, 1999

3. S.A. Kane, Introduction to Physics in Modern Medicine, CRC Press, 2009

REFERENCE BOOKS:

1. F.M. Khan, and J.P. Gibbons, Khan's the physics of radiation therapy. Lippincott

Williams and Wilkins, 2014.

2. P. Suetens, Fundamentals of Medical Imaging. Cambridge university press, 2017.

3. W.J. Meredith, and J.B. Massey, Fundamental Physics of Radiology. ButterworthHeinemann, 2013.

II M.Sc., Physics	**MAJOR –VII**	Marks :100
Semester III	SOLID STATE PHYSICS- I	Hrs/Week : 6
Code: MPHATC31		INT: 25, EXT: 75

☐ 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

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

TEXT BOOK:

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

Unit I-Ch. 1& 2 (pg3-19, 29-34, 36,37,48,49)

Unit II-Ch. 3 (pg55-62, 66-79, 83-90)

Unit III-Ch. 4 & 5(pg107-111, 117-130, 133-137)

Unit IV-Ch. 6 & 7(146-155, 156-159, 164-167, 176-186)

Unit V-Ch.8 & 9. (pg199-206, 209-212, 235-242, 244-252,262)

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REFERENCE BOOKS:

1. S.O.Pillai ,Solid state physics - V Edition New Age Int. Ltd.

2. J.P. Srivastava, Elements of Solid state physics- Prentice-Hall of India Pvt. Ltd.

II M.Sc., Physics	**MAJOR –VIII**	Marks :100
Semester III	QUANTUM MECHANICS – I	Hrs/Week : 6
Code: MPHAC32		INT: 25, EXT: 75

COURSE OBJECTIVES:

☐ To understand basic concepts in Quantum Mechanics.

☐ To throw light on the formulation of Schrodinger, Dirac and Heisenberg mechanics

☐ To have a glimpse of perturbation theory and its applications.

☐ To study in detail, the effect of magnetic and electric field on quantum particles.

UNIT I: EQUATION OF MOTION OF MATTER WAVES

Time independent Schrodinger equation – Schrodinger equation for a free particle – Time dependent Schrodinger equation – Physical interpretation of wave function – Normalized and orthogonal wave functions – Solution of Schrodinger equation – Stationary state solution – Expectation values – Probability current density – Superposition of plane waves –Formulation of Schrodinger equation in momentum representation – Uncertainty principle –one dimensional square well potential – Linear Harmonic oscillator – Hydrogen atom.

UNIT II: MATRIX FORMULATION OF QUANTUM MECHANICS

Matrix algebra – types of matrices – Hermitian and unitary matrices – Hilbert space – Dirac's bra and Ket notation. Physical meaning of matrix elements – Equations of motion –Schrodinger picture – Heisenberg picture – Interaction picture – Poisson brackets and Commutator brackets – Matrix theory of Harmonic oscillator.

UNIT III: GENERAL FORMALISM OF QUANTUM MECHANICS

Linear Operator-Eigen functions and Eigen values- Hermitian Operator-postulates of quantum mechanics- Dirac's notation- Equations of motion.

UNIT IV: ANGULAR MOMENTUM STATES

Commutation relations for the generators – Choice of representation, Construction of angular momentum matrices – Combination of Angular momentum states – Eigen values of the total Angular momentum – Clebsch Gordan coefficients – Recursion relations – Construction procedure – $j1 = 1/2$, $j2 = 1/2$

UNIT V APPROXIMATION METHODS FOR BOUND STATES

Stationary perturbation theory – non degenerate case – First order perturbation – Evaluation of first order Energy – Evaluation of first order correction to wave function –Zeeman effect without electron spin – First order stark effect in hydrogen atom – Variation method: Expectation value of the energy – Application to excited states – Ground State of Helium atom – Variation of the parameter Z.

TEXT BOOKS:

1. Quantum Mechanics (III ed.), Schiff, L.I.: McGraw Hill, 1968, ISBN-0-07-085643-5.

2. Quantum Mechanics, Satya prakash& Swati Satya: KedarNath Ram Nath& Co, 2006.

3. Quantum Mechanics Aruldhas, J, Prentice – Hall of India, 2002, ISBN81- 203-1962.

REFERENCE BOOKS:

1. A Text Book of Quantum Mechanics, Mathews, P.M. &Venkatesan, K., Tata McGraw

Hill, 1978, ISBN 0-07-096510-2.

2. Quantum Mechanics (II ed.), Bransden, B.H. &Joachain, C.J: Pearson

Education, 2005.ISBN 81-297-0470-6.

3. Quantum Mechanics (III ed.), Merzbacher, E: John Wiley, 2004, ISBN9971- 51-281-5.

4. Introduction to Quantum Mechanics Ghatak, A: Macmillan, 1996, ISBN0333- 92419

II M.Sc., Physics	**MAJOR –IX**	Marks :100
Semester III	MOLECULAR SPECTROSCOPY	Hrs/Week : 6
Code: MPHAC33		INT: 25, EXT: 75

UNIT I: MOLECULAR SYMMETRY

Molecular spectroscopy – introduction – experimental methods – information derived from work on gases – applications – symmetry operations – symmetry elements

UNIT II: ROTATION OF MOLECULES

Classification of Molecules-Interaction of radiation with rotating molecule-Rotational spectra of rigid diatomic molecules-Isotope effect in rotational spectra –Intensity f rotational lines Non-rigid rotator-Vibrational excitational effect-Linear polyatomic molecules-Symmetric top molecules-Asymmetric top molecules-Stark effect- Quadrupole hyperfine interactions Microwave spectrometer-Information derived from rotational spectra

UNIT 3: INFRARED SPECTROSCOPY

Vibrational energy of a diatomic molecule- Infrared spectra; Preliminaries –Infrared section rules-Vibrating diatomic molecules-Diatomic vibrating rotator- Asymmetry of rotation Vibration band-vibration of polyatomic molecules-More about un-harmonicity-Fermi resonance-Hydrogen bonding-Rotation-Vibration spectra of polyatomic molecules-Normal modes of vibration in crystal- Solid state effects-Interpretation of vibrational spectra-Group frequencies-Inversion vibration of ammonia-IR spectrophotometer-Instrumentation-Sample handling techniques.

UNIT 4: RAMAN SCATTERING

Theory of Raman Scattering-Rotational Raman Spectra-Vibrational Raman spectra-Mutual exclusion principle-Raman spectrometer-Sample handling techniques-Fiber coupled Raman spectrometer-Polarization of Raman scattered light- Single crystal Raman spectra-Structure termination using IR and Raman spectroscopy.

UNIT 5: ELECTRONIC SPECTRA OF DIATOMIC MOLECULES

Vibrational coarse structure- Vibrational analysis of band systems-Deslandres table –Progressions and Sequence-Information derived from vibrational Analysis-Frank-Condon principle - Intensity of vibrational electronic spectra - Rotational fine structure of electronic, vibration spectra- The Fortrat parabola –Dissociation-Pre Dissociation-Electronic angular momentum in diatomic Molecules-Photo electron spectroscopy.

TEXT BOOK:

1. Molecular structure and spectroscopy, G. Aruldhas, prentice Hall of India 2001

2. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata McGraw-Hill Education, 1994

II M.Sc., Physics	PRACTICAL –III	Marks :100
Semester III	ELECTRONICS	Hrs/Week : 6
Code: MPHA3P		INT: 40, EXT: 60

Any eight Experiments

1. Universal NAND and NOR gates

2. Verification of De Morgan's theorem and Boolean functions

3. Active filters –Low, High and band pass filter

4. IC 555 Timer – Square wave generation

5. Solve simultaneous equation (Two variables only) using IC 741

6. JK flip-flop-Up and Down counters

7. Half adder and Full adder circuits using IC's

8. Optimization of Boolean functions-Karnaugh Map Method

9. Notch filter using IC and study of it's characteristic.

10. Microprocessor based Experiments-Addition, subtraction and Multiplication

11. Study of Wide band amplifier

12. Ring counter

II M.Sc., Physics	**Major Elective –VI**	Marks :100
Semester III	NON-CONVENTIONAL ENERGY	Hrs/Week : 6
Code: MPHACT16		INT: 25, EXT: 75

Objectives:

☐ To be familiar with various forms of non-conventional energy

☐ To understand the salient features of non-conventional energy

☐ To appreciate the various applications of non-conventional energy

UNIT: I

Classification of energy resources – Consumption trend of primary energy sources –importance of non-conventional energy sources – Advantages and disadvantages of conventional energy sources – salient features of non-conventional energy sources –Environmental aspects of energy –World energy status.

UNIT: II

Solar Energy Basics – Introduction – The Sun as a source of energy – Extraterrestrial and Terrestrial radiations – Spectral distribution of solar radiation –Depletion of solar radiation – Measurements of solar radiation – Solar collectors –Classification – Liquid flat plate collector – tubular collector – Solar water heater – Box type solar cooker

UNIT: III

Wind energy – Introduction – Global winds – Local winds – nature of winds –Wind turbine siting – Major applications of wind power – Horizontal axis wind turbine – Environmental aspects – Wind energy programme in India

UNIT: IV

Biomass Energy – Introduction – useful forms of biomass, their composition and fuel properties – Biomass resources – Biomass gasification – Downdraft type – Updraft type –Biogas production from waste biomass – Availability of raw materials and gas yield - Biomass energy programme in India

UNIT: V

Geothermal energy – Introduction – Applications – Origin and distribution of geothermal energy – Tidal energy - Origin and nature of tidal energy – Limitations of tidal energy –Ocean thermal energy – Origin and characteristics of resource - Ocean thermal energy conversion technology.

TEXT BOOK:

Non-Conventional Energy resources, B H.Khan, McGraw Hill, 2nd edition, 2009.

UNIT: I : 1.3 – 1.5, 1.8 – 1.10 & 1.13

UNIT: II : 4.1, 4.2, 4.4 – 4.7, 5.1, 5.1.1, 5.1.4, 5.1.7, 5.2 & 5.6.1

UNIT:III : 7.1.1, 7.1.2, 7.2, 7.2.1, 7.3, 7.4, 7.7.1, 7.12 & 7.13

UNIT: IV : 8.2, 8.3, 8.6, 8.6.1, 8.6.2, 8.9, 8.9.6 & 8.11

UNIT: V : 9.1, 9.2, 10.1, 10.1.1, 10.1.2, 10.3, 10.3.1, 10.3.2

REFERENCE BOOKS:

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

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

II M.Sc., Physics	**Major Elective –VII**	Marks :100
Semester III	INTRODUCTION TO NANOTECHNOLOGY	Hrs/Week : 6
Code: MPHAT17		INT: 25, EXT: 75

☐ To impart the basics knowledge on nanotechnology

☐ To develop the understanding on the exotic properties of nanostructured materials

☐ To emphasize the importance and development of nanotechnology in various field.

Unit-I: Introduction to nanoscience

History and importance of nanotechnology, opportunity at the nanoscale, length and time scale in structures, difference between bulk and nanoscale materials and their significance, properties at nanoscale, optical, electronic, magnetic and chemical.

Unit-II: Nanostructures and dimensions

Classification of nanostructures: zero-, one-, two- and three-dimensional nanostructures, size dependency in nanostructures, quantum size effects in nanostructures, chemistry of tailored nano shapes, quantum dots, nanowells, nanoribbons and nanowires.

Unit-III: Synthesis of nanomaterials

Synthesis of nanomaterials, top down and bottom-up approach, method of nanomaterials preparation, wet chemical routes of synthesis: reduction, sol-gel, hydrothermal, sonochemical synthesis, physical routes, physical vapor deposition (PVD), chemical vapor deposition (CVD), laser ablation, sputtering. (Basic concept only)

Unit-IV: Characterization of nanomaterials

Scanning electron microscope (SEM), transmission electron microscope (TEM), comparing SEM, TEM and SPM for different classes of nanomaterials (Basic concept only).

Unit-V: Applications of nanomaterials Nanotechnology in energy systems, textiles, food and health care, agriculture, automotive industry, solar technology, pharmaceutical and drugs, nanoelectronics, nanosensors and devices.

TEXT BOOKS:

1. T. Pradeep, Nano: The Essentials, 1st Ed., McGraw Hill, 2007.
2. Chattopadhyay, Banerjee, Introduction to Nanoscience and Nanotechnology, PHI, 2009.

REFERENCE BOOKS:
1. C. Binns, Introduction to Nanoscience and Nanotechnology, Vol. 14, John Wiley & Sons, 2010.
2. A.K. Bandyopadhyay, Nano Materials, New Age International Publisher.
3. P.C. Poole Jr, and F.J. Owens, Introduction to Nanotechnology, John Wiley & Sons, 2003.
4. R. Kelsall, I.W. Hamley, and M. Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005.

II M.Sc., Physics	**MAJOR –X**	Marks :100
Semester III	SOLID STATE PHYSICS – II	Hrs/Week : 6
Code: MPHAC41		INT: 25, EXT: 75

UNIT I: PLASMONS, POLARITONS AND POLARONS

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

excitons

UNIT II: SUPERCONDUCTIVITY

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

UNIT III: DIELECTRICS AND FERROELECTRICS

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

UNIT IV: DIA, PARA, FERRO AND ANTIFERROMAGNETISM

Quantum theory of Dia, Para Magnetism-HundRule-Ferromagnetic order-Curie point and the exchange integral - Magnons – Neutron Magnetic Scattering – Ferrimagnetic order –Anti-ferromagnetic order - Ferromagnetic Domains –Anisotropy Energy- - single Domain Particles – Magnetic bubble domains.

UNIT V: POINT DEFECTS

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

TEXT BOOK:

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

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

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

Unit III-Ch. 13(pg380-413)

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

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

REFERENCE BOOKS:

1. S.O.Pillai,Solid state physics – 5th EditionNew Age Int. Ltd.

2. M.A.Wahab, Solid state physics- 2nd EditionNarosa Publishing House Pvt. Ltd.

3. S.O. Pillai, Problems and Solutions in Solid State Physics, New Age International,

New Delhi.,1994.

4. M. Ali Omar, Elementary Solid State Physics-Principles and Applications, Addison Wesley, London, 1974.

5. H.P. Myers, Introductory Solid State Physics, 2nd Edition, Viva Book, New

Delhi,1998.

II M.Sc., Physics	**MAJOR –XI**	Marks :100
Semester III	QUANTUM MECHANICS – II	Hrs/Week : 6
Code: MPHAC42		INT: 25, EXT: 75

COURSE OBJECTIVES:

☐ To understand advanced level - Quantum Mechanics.

☐ To acquire knowledge on approximation methods employed in solving quantum

mechanical problems.

☐ To throw light on relativistic mechanics and quantum theory of radiation.

☐ To have a glimpse of perturbation theory and its applications.

UNIT I QUANTUM THEORY OF SCATTERING

Representations of quantum system - General Formulation of Scattering Theory Born Approximation – Condition for validity of Born Approximation – Scattering by a screened coulomb potential: Rutherford's scattering formula from Born approximation – Partial wave analysis (Theory only).

UNIT II TIME DEPENDENT QUANTUM APPROXIMATIONS

Time-Dependent perturbation theory – First order perturbation – Perturbation constant in time – Physical significance – Transition probability – Fermi's golden rule – Harmonic perturbation – Adiabatic approximation – Sudden approximation.

UNIT III IDENTICAL PARTICLES AND SPIN

Identical particles – Physical meaning of identify – Symmetric and antisymmetric wave functions – Construction from unsymmetrized function – Distinguishability of identical particles – Exclusion principle – Connection with statistical mechanics – Pauli's spin matrices for an electron and their properties – Electron spin matrices for an electron and their properties – Electron spin functions – Symmetric and antisymmetric wave function of a hydrogen molecule.

UNIT IV RELATIVISTIC WAVE EQUATIONS

Schrodinger's relativistic equation for a free particle – Klien-Gordon equation – E.M. potentials – Separation of the equation – Energy levels in a Coulomb field – Dirac's relativistic equation –

Dirac matrices – Free particles solution – Charge and current densities – Magnetic moment of the electron – Spin angular momentum of the electron – Approximate reduction (spin-orbit energy) – Negative energy states.

UNIT V QUANTUM THEORY OF RADIATION

Transition probability for emission and absorption – Einstein's coefficients in a radiation field – Einstein's transition probabilities for absorption and emission in a radiation field.

TEXT BOOK:

1. Quantum Mechanics (III ed.), Schiff, L.I.: McGraw Hill, 1968, ISBN-0-07-085643-5.

REFERENCE BOOKS:

1. Quantum Mechanics, Satyaprakash& Swati Satya:KedarNath Ram Nath& Co, 2006.

2. A Text Book of Quantum Mechanics,Mathews, P.M. &Venkatesan, K., Tata McGraw

Hill, 1978, ISBN 0-07-096510-2.

3. Quantum Mechanics Aruldhas, J.- Prentice–Hall of India, 2002, ISBN 81-203-1962-1.

4. Quantum Mechanics (II ed.), Bransden, B.H. &Joachain, C.J.: Pearson Education, 2005.

ISBN 81-297-0470-6.

5. Quantum Mechanics (III ed.), Merzbacher, E.: John Wiley, 2004, ISBN 9971-51-281-5.

6. Introduction to Quantum Mechanics,Ghatak, A.: Macmillan, 1996, SBN 0333-92419-3.

II M.Sc., Physics	**MAJOR –XII**	Marks :100
Semester III	NUCLEAR AND PARTICLE	Hrs/Week : 6
Code: MPHAC43		INT: 25, EXT: 75

Unit-I: The Q Equation:

Introduction - Types of Nuclear Reactions- The Balance of Mass and Energy in Nuclear Reaction- The Q Equation- Solution of the Q Equation- Centre of Mass Frame in Nuclear Physics. The Nucleus -Introduction, Rutherford scattering and Estimation of the Nuclear size- Nuclear Radius- Nuclear spin- Moments and Statistics.

Unit-II: Radioactivity

Alpha Rays: Range of α-particles, Disintegration Energy of Spontaneous α-Decay, Barrier penetration. Beta Rays: Introduction - Continuous β-ray Spectrum-- Pauli's Neutrino Hypothesis- Fermi's Theory of Beta Decay- The Detection of Neutrino Parity Non-conservation in Beta Decay- Gamma Emission: Introduction, - γ-ray Emission-Selection Rules, Internal Conversion, Nuclear Isomerism.

Unit-III: Model of Nucleus

Liquid Drop Model of Nucleus: Introduction, Binding Energies of Nuclei; Weizsacker's Semi-empirical Mass Formula, Mass Parabolas: Prediction of Stability Against β-decay - Stability limits - Barrier Penetration-Decay probabilities for Spontaneous Fission- Nucleon Emission.

Shell Model of Nucleus:

Introduction-The Evidence that led to the Shell Model-Main assumptions of the Single-Particle Shell Model-Spin-orbit Coupling in Nuclei -The Single Particle Shell Model-Parabolic Potential - Square Well Potential- Predictions of the Shell

Model.

Unit-IV: Nuclear energy and force

Nuclear Energy -Introduction- Neutron Induced Fission- Asymmetrical FissionMass Yield- Emission of Delayed Neutrons- Energy Released in the Fission -Fission of Lighter Nuclei -Chain Reaction- Neutron Cycle in a Nuclear ReactorNuclear Reactors. Nuclear Force: Introduction, The Ground State of the Deuteron- Magnetic Dipole and Electric Quadrupole Moments of the Deuteron - Central and Non-Central

Forces: Exchange Forces: Meson Theory of Nuclear Forces-Nucleon-Nucleon Scattering.

Unit V: Elementary particles.

Classification of elementary particles – particle interaction- conservation laws isospin-hypercharge-strangeness- Charge conjugation Time Reversal – The CPT Theorem -SU3 Symmetry-Quark theory

TEXT BOOKS:

1. Nuclear physics-An Introduction – S.B.Patel – New Age International (P) Limited

 (Reprint 2003)

2. Nuclear Physics – D.C. Tayal, Himalaya Publishing House, (reprint 2007)

REFERENCE BOOKS:

1. Nuclear Physics – Theory and experiment – R.R. Roy and B.P. Nigam – New

 Age International (P) Ltd., (2001 Edi)

2. Nuclear Physics-V. Devanathan–(Narosa Publishing House, New Delhi,

 2006)

 3. M.L. Pandya and R.P.S. Yadav, ―Elements of nuclear physics‖, Kedarnath

 Ram nath publishers, 1996

4. Introduction to Nuclear Physics – Harold Enge.

5. Nuclear physics – Irving Kaplan – (Narosa Publishing House,1987)

II M.Sc., Physics	PRACTICAL –VI	Marks :100
Semester III	GENERAL PHYSICS	Hrs/Week : 6
Code: MPHA4P		INT: 40, EXT: 60

Any Eight Experiments

1. Study of Susceptibility measurements-Guoy balance method

2. Study of Susceptibility measurements-Quincke's method

3. Hall effect

4. Dielectric parameter of a given liquid

5. Ultrasonic study of liquids.

6. Refractive index of a liquid using laser light

7. Laser based diffraction experiments

8. Experiments using fiber optic kit

9. Arc spectrum – constant deviation spectrograph

10. Refractive index of a liquid using newton's rings

11. Interference spectral analysis

12. Ultraviolet spectral analysis

II M.Sc., Physics	**Major Elective –VIII**	Marks :100
Semester III	APPLIED OPTICS AND LASER PHYSICS	Hrs/Week : 6
Code: MPHAT18		INT: 25, EXT: 75

UNIT-I: PHYSICAL OPTICS, PHOTONIC CRYSTALS AND METAMATERIALS

Wave motion, superposition of waves, interference, diffraction, polarization, basics of coherence theory, temporal and spatial coherence, statistical properties of laser speckle patterns, information processing using speckle patterns, laser speckle contrast imaging.

Photonics crystals – 2D & 3D, colloidal photonic crystals, light propagation through disordered media, localization of light, photonic glass, random lasing, optical metamaterials, optical properties of metal dielectric composites, electric and magnetic metamaterials, negative index metamaterials, nonlinear optics with metamaterials.

UNIT–II: APPLICATIONS OF OPTICAL TECHNIQUE

Image formation (first – order optics), aberrations, prisms and mirrors, stops and apertures, basic optical devices, the design of optical systems: general, aplanatic points, solid immersion lens, numerical aperture increasing lens. Mie scattering technique, AFM colloidal probe technique, magnetic chaining technique, knife edge scanning to measure laser beam profile, knife edge scanning based liquid refractometer.

UNIT-III: OPTICAL MICROSCOPY & IMAGING TECHNIQUES

Basics of optical microscopy, bright field and dark field microscopy, polarizing microscopy, phase contrast microscopy, fluorescence microscopy, fluorescence confocal microscopy, light sheet fluorescence microscopy, nonlinear optical microscopy, two photon fluorescence microscopy.

UNIT-IV: BASIC PRINCIPLES AND TYPES OF LASERS

Principles of lasers, population inversion, conditions of lasing action, characteristics of a laser coherence, monochromaticity, divergence, intensity, Einstein's coefficients, laser pumping, two and three level laser systems. Solid state lasers: Ruby laser, Nd: YAG Laser, semiconductor lasers, features of semiconductor lasers, diode lasers, gas laser : He-Ne laser, CO_2 laser, liquid lasers; dye lasers.

UNIT–V: LASER PROPERTIES, PRODUCTION AND APPLICATIONS OF LASERS

Laser pumping, resonators, vibrational modes of resonators, numbers of modes/unit-volume, open resonators, control resonators, Q factor, losses in the cavity, threshold condition, quantum yield, model locking (active and passive), Ether drift and absolute rotation of the earth-laser isotope separation, laser range finder-laser in pollution detection, holography optical communication, optical fiber.

TEXT BOOKS:

1.M.Bornand, E. Wolf, Principles of Optics, 7th Ed., Cambridge University Press 1999.

2.J.D. Joannopoulos, R.D. Meade, J.N. Winn, Photonic Crystals: Molding the Flow of

light, 2nd Ed, Princeton University Press, 2008.

3.V.Shalaevand W. Cai, Optical Metamaterials: Fundamentals & Applications, 2nd Ed.,

Springer, 2010.

4.W.J. Smith, Modern Optical Engineering, 3rd Ed., McGraw Hill, 2000.

5.B.B. Laud, Lasers and Nonlinear Optics, 3rd Ed., New Age Int. Pub. 2011.

REFERENCE BOOKS:

1. A.K. Ghatak and K.Thyagarajan, Optical electronics, Cambridge University Press,

1989

2. Seigman, Lasers, 3rd Ed., Oxford Univ, Press 1986

3. Maitland and Dunn, Laser Physics. N.H. Amsterdam, 1969

4. J. Hecht, The laser Guidebook 1986

5. O. Seelto, Principles of Laser, 5th Ed., Springer Publication 2010.

II M.Sc., Physics	**Major Elective –IX**	Marks :100
Semester III	FIBER OPTIC COMMUNICATION	Hrs/Week : 6
Code: MPHAT19		INT: 25, EXT: 75

Unit –I OVER VIEW OF OPTICAL FIBER COMMUNICATION

Forms of communication system-The evolution of fiber optic Systems-Elements of an optical fiber transmission link-Optical fiber modes and configurations-Fiber types-Rays and modes step index fiber structure –single mode fibers-Graded index numerical aperture(NA)

Unit –II FIBR MATERIALS AND FABRICATIONS

Glass Fibers-Halide glass fibers-Active glass fibers – Plastic – Clad glass fibers-Plastic fibers – Fiber Fabrication –Outside vapour phase oxidation-Vapour phase axial deposition-Modified chemical vapor deposition – Double – Crucible method.

Unit –III OPTICAL SOURCE AND DETECTOR

Energy Bands- Intrinsic and Extrinsic material – The PN junction –Direct and indirect band gap-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 photo detectors – Avalanche photodiode.

Unit –IV POWER LAUNCHING, COUPLE AND SIGNAL DEGRADATION

Source to fiber power launching – source output pattern power – power launching verses wavelength- Equilibrium numerical aperture – Non-imaging microsphere laser diode to fiber coupling fiber to fiber joints – Mechanical misalignment.

UNIT – V FIBER AND FACE PREPARATION

Fiber and face preparation – Attenuation Units-Absorption-Scattering Losses-Bending losses Core and cladding losses- Signal distortion in optical wave guide –Fiber splicing –Splicing techniques-Optical fiber connectors.

TEXT BOOK:

1. Optical fiber Communication by Gerd Keiser – Second edition – McGrew – Hill

International Edition 1991. Chapter 1 ,2,4,5