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MATHEMATICAL PHYSICS- I -MPHAC11

Credits: 5 Teaching Hours: 4 hrs / week

Objectives:

1. To develop knowledge in mathematical physics and its applications.
2. To develop expertise in mathematical techniques required in physics.
3. To enhance problem solving skills.
4. To enable students to formulate, interpret and draw inferences from mathematical solutions.

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 Pn(x) and Jn(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

Course Outcomes:

CO1: Solve the partial differential equations

CO2: Evaluate second order linear differential equations and apply it for solving physicsproblems

CO3: Explain the concept of Gamma functions

CO4: Analyse the concept of Bessel functions and its properties

CO5: Apply Legendre functions and its properties

Course Content:

Course Outcomes:At the end of the course, the student will be able to

CO1: Explain the properties of linear vector space and matrices and apply them to analyze a broad range of physical models

CO2: Test the infinite series for convergence

CO3: Interpret the characteristics of complex functions

CO4: Evaluate residues and definite integrals

CO5: Expand the periodic functions using Fourier series and apply integral transforms to various

physical problems

Course Code and Title: **MPHAC11** MATHEMATICAL PHYSICS- I			
Class	MSc (Physics)	Semester	I
Cognitive Level	K-1	Remember	10
	K-2	Understand	30
	K-3	Apply	20
	K-4	Analyse	15
	K-5	Evaluate	15
	K-6	Create	10

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CLASSICAL MECHANICS - MPHAC12

Credits : 5 **Teaching Hours: 4 Hours / week**

Objective:

1. To emphasize the mathematical formulation of mechanic's problems and to physically interpret the solutions.
2. To apply the fundamental concepts of classical mechanics to the particle systems and rigid bodies.
3. To lay the solid background of mathematical methods to employ in modern physics.
4. To develop problem solving and critical thinking skills.

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
Websites :

1. NPTEL Course by Prof. V. Balakrishnan :https://nptel.ac.in/courses/122106034/Course Outcomes:

At the end of the course, the students will be able to

CO1 Appraise the different types of constraints present in the system and set up generalizedcoordinates.

CO2 Analyze the two body central force problem using Lagrangian formalism

CO3 Formulate the kinematics of rigid body

CO4 Formulate the mechanical system as eigenvalue equation

CO5 practice the Hamiltonian formalism and the Hamilton Jacobi formalism.

Class MSc (Physics) Semester **MPHAC12** CLASSICAL MECHANICS

Course Code and Title: **MPHAC12** CLASSICAL MECHANICS			
Class	MSc (Physics)	Semester	I
Cognitive Level	K-1	Remember	--
	K-2	Understand	--
	K-3	Apply	35
	K-4	Analyse	35
	K-5	Evaluate	20
	K-6	Create	10

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APPLIED ELECTRONICS - MPHAC13

Credits: 5 **Teaching Hours: 4 hrs / week**

Objectives:

1. To enhance comprehension capabilities of students through understanding of electronic devices and to give clear understanding of operational amplifier and its importance.
2. To understand the physical construction, working and operational characteristics ofsemiconductor devices.
3. To introduce the basic building blocks of linear integrated circuits & digital converters

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

Course Outcomes:

CO1 Students will acquire knowledge in two port networks, Thevenin's, Norton andMillers theorem. To develop the skill to analyses the electronic circuits

CO2 Improved understanding of FET, different types of MOSFET and their application. To develop the skill to design the circuit based on FET and MOSFET

CO3 To enhance the knowledge in Op-amp and their applications. To develop skill to designthe circuit based on Op-amp

CO4 Student will develop the skill to use the universal gate to design logical circuit and tosimply by the circuit using K-map

CO5 Enhanced knowledge in different types of flip-flops and designing the different types ofcounters and Registers using flip flop

Course Code and Title: PHYC ELECTRONICS

Course Code and Title: **MPHAC13** ELECTRONICS			
Class	MSc (Physics)	Semester	I
Cognitive Level	K-1	Remember	10
	K-2	Understand	20
	K-3	Apply	20
	K-4	Analyse	20
	K-5	Evaluate	20
	K-6	Create	10

I M.Sc., Physics Major Paper- 9 Marks :100

SEMESTER II PRACTICAL –I - MPHAC1P

General Physics **Hrs/Week :8**

Code:MPHAC1P **INT:40, EXT:60**

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

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Semester I MAJOR ELECTIVE

COMPUTER PROGRAMMING IN C++ - MPHAT12

Credits: 5 **Teaching Hours: 4 hrs / week**

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,

Course Outcomes:

CO1 Students will acquire knowledge on computer, machine language, C++, various data types, operators and control structures

CO2 Introduction to computational methods especially in C++ to solve different types of problems in Physics. To compose C++ programs using functions and classes in details

CO3 Introduction to I/O operations, classes for file stream operations to work with files anderror handling

CO4 To enhance the knowledge in numerical methods - function approximation problem to deal with the problems in physics, Numerical calculus and estimation of errors. Introduction to solve the scientific problems in science with C++ as a tool

CO5 Students will be familiar with programming tactics, numerical methods and their implementation handling methods. The modeling of classical physical systems to quantum systems, as well as to data analysis such as linear and nonlinear fits to data sets

Course Code and Title : **MPHAT12** PROGRAMMING IN C++

Class	MSc (Physics)	Semester I	
Cognitive Level	K-1	Remember	5%
	K-2	Understand	15%
	K-3	Apply	20%
	K-4	Analyse	15%
	K-5	Evaluate	15%
	K-6	Create	30%

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MATHEMATICAL PHYSICS- II - MPHAC21

Credits: 5 **Teaching Hours: 4 hrs / week**

Objectives:

1. To develop knowledge in mathematical physics and its applications.
2. To develop expertise in mathematical techniques required in physics.
3. To enhance problem solving skills.
4. To enable students to formulate, interpret and draw inferences from mathematical solutions

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

Books for reference:

1. **Mathematical Methods for Physicists: A Concise Introduction – Tai L. Chow,** Cambridge University Press, 2003.
2. **Mathematical Methods in the Physical Science – Mary L. Boas,** John Wiley & Sons, Inc., 2006.
3. **Advanced Engineering Mathematics – Erwin Kreyszig,** V Edn. (New Age Publishers, New Delhi, 1996)

Course Outcomes:

CO1: Solve the partial differential equations
CO2: Evaluate second order linear differential equations and apply it for solving physics problems
CO3: Explain the concept of Gamma functions
CO4: Analyse the concept of Bessel functions and its properties
CO5: Apply Legendre functions and its properties

Course Content: **Course Code and Title: MPHAC14** MATHEMATICAL PHYSICS- II

Class	**MSc (Physics)**	**Semester**	**II**
Cognitive Level			
K-1		Remember	10
K-2		Understand	20
K-3		Apply	20
K-4		Analyse	20
K-5		Evaluate	20
K-6		Create	10

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STATISTICAL MECHANICS and THERMODYNAMICS – MPHAC22

Credits: 5 **Teaching Hours: 4 hrs /week**

Objectives:

To describe the state of 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 behaviour of its micrsocopic constituents
To describe the statistical thermodynamic parameter for ideal gas solids

Unit-II:
Thermodynamic Potential:

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 macrostates – 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

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ELECTROMAGNETIC THEORY – MPHAC23

Credits : 5 **Teaching Hours: 4 hrs / week**

Objectives:

1. To develop theoretical knowledge in electromagnetism.
2. To develop skills on solving analytical problems in electromagnetism.
3. To understand the electromagnetism of radiating and relativistic systems.
4. To give basics of ideas about relativity.

Unit I: Electrostatics: Coulomb's law; the electric field – line, flux and Gauss's Law in differential form - the electrostatic potential; conductors and insulators; Gauss's law - application of Gauss's law – curl of E - Poisson's equation; Laplace's equation – work and energy in electrostatics – energy of a point charge distribution – energy of continuous charge distribution – induced charges – capacitors. Potentials: Laplace equation in one dimension and two dimensions – Dielectrics – induced dipoles – Gauss's Law in the presence of dielectrics.

Unit II: Magnetostatics: Lorentz force – magnetic fields – magnetic forces – currents – Biot-Savart Law – divergence and curl of B – Ampere's Law – comparison of magneto statics and electrostatics – Magnetic vector potential. Magnetization: effect of magnetic field on atomic orbit – Ampere's Law in magnetized materials – ferromagnetism.

Unit III: Electromotive force – Ohm's Law – electromotive force – motional emf – Faraday's Law – induced electric field – inductance – energy in magnetic field – Maxwell's equation – continuity equation – Poynting theorem. Electromagnetic waves in vacuum: waves in one dimension – wave equation – sinusoidal waves – reflection and transmission – Polarization.

Unit IV: Electromagnetic waves: The wave equation for E and B – Monochromatic Plan waves – energy and momentum in electromagnetic waves – electromagnetic waves in matters –TE waves in rectangular wave guides – the co-axial transmission line. Potentials: potentials and fields – scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form.

Unit V: The special theory of relativity – Einstein's postulates – geometry of relativity – Lorentz transformations – Relativistic mechanics – proper time and proper velocity – Relativistic energy and momentum – Relativistic kinematics.

Text Book:

Introduction to Electrodynamics – David J. Griffiths, 4th Edition, Pearson

Unit I : Pages; 59-78, 83-84, 91-101, 105-112, 113-116, 167-170, 181-184
Unit II: Pages; 212-247, 269-277, 282-286, 291-295
Unit III: Pages; 300-338, 360-364, 387-398
Unit IV: Pages; 398-410, 433-436, 553-561, Unit V : Pages 479-502, 509-518

Books for Reference:

1. Fundamentals of Electromagnetic Theory, Third edition, Narosa Publishing House, New Delhi – John R.Reitz, Frederick J Milford and Robert W.Christy, 1998
2. Classical Electrodynamics – J.D. Jackson, II Edition, Wiley Eastern Limited, 1993
3. Electromagnetic Fields and Waves – P.Lorrain and D.Corson
4. Electromagnetic – B. Laud

Course Outcomes:

CO1: Students will acquire enhanced knowledge in electrostatic mechanics. They will develop problem solving skill using Poisson and Laplace equations. They will also understand the effect of dielectric media

CO2: Enhanced knowledge in magnetostatic process and their applications. Also will have enhanced knowledge in magnetic materials

CO3: Will have enhanced understanding of electromagnetic wave propagation, reflection, transmission and polarization

CO4: Students will have improved understanding about wave guides. Also will have enhanced understanding Gauge transformation

CO5: Enhanced knowledge in relativistic theory

Course Code and Title: MPHAC16 ELECTROMAGNETIC THEORY

Class Cognitive LevelMSc (Physics)	**Semester**	**II**
K-1	Remember	10%
K-2	Understand	30%
K-3	Apply	30%
K-4	Analyse	15%
K-5	Evaluate	15%
K-6	Create	

I M.Sc., Physics Major Paper- 9 Marks :100

SEMESTER II PRACTICAL –II – MPHAC2P

General Physics **Hrs/Week :8**

Code:MPHAC2P **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

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I M.Sc., Physics Major Paper- 10 (a) Marks :100

Semester II MAJOR ELECTIVE –MPHAT13

NANO PHYSICS

Code: MPHAS21 **INT:25, EXT:75** **Hrs/Week :6**

Objectives:

 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

II M.Sc., Physics	MAJOR –VII	Marks :100
Semester III	SOLID STATE PHYSICS- I	Hrs/Week : 6
Code: MPHAC31		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 EffectTEXT 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)

2771

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 Fission Mass Yield-Emission of Delayed Neutrons- Energy Released in the Fission -Fission of Lighter Nuclei - Chain Reaction- Neutron Cycle in a Nuclear Reactor Nuclear 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 –III	**Marks :100**
Semester III	NON - ELECTRONICS	**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, CO2 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