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DIRECTORATE OF DISTANCE EDUCATION

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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 δN 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