

**SCHEME OF EXAMINATION
AND
COURSE OF STUDY**

**CHOICE BASED CREDIT SYSTEM
(CBCS)**

M. Sc. (PHYSICS)

(w.e.f. 2022-2023)



**DEPARTMENT OF PHYSICS
GURUKUL KANGRI VISHWAVIDYALAYA, HARIDWAR**

GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR
M.Sc. PHYSICS SYLLABUS (w. e. f. 2022-23)
(CBCS Pattern)

| S. N. | Course/Paper Code | Course/Paper Title | Periods per week | | | Credit | Evaluation Scheme | | | Maximum Marks (M.M.) |
|--|-----------------------|-------------------------------------|------------------|---|---|-----------|----------------------------|----|-----|----------------------|
| | | | | | | | Continuous Assessment (CA) | | ESE | |
| | | | L | T | P | | CT | TA | | |
| M.Sc. I Year | | | | | | | | | | |
| Semester – I | | | | | | | | | | |
| 1 | MPH-C101 | Mathematical Physics | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 2 | MPH-C102 | Classical Mechanics | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 3 | MPH-C103 | Quantum Mechanics –I | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 4 | MPH-C104 | Computational Methods & Programming | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 5 | MPH-C151 | Lab. Course (General Physics Lab.) | - | - | 9 | 4 | 15 | 15 | 70 | 100 |
| 6 | MPH-C152 | Lab. Course (Computational Lab.) | - | - | 9 | 4 | 15 | 15 | 70 | 100 |
| | | | | | | 24 | TOTAL | | | 600 |
| Semester – II | | | | | | | | | | |
| 1 | MPH-C201 | E.M. Theory & Electrodynamics | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 2 | MPH-C205 | Physics & Vedic Thought | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 3 | MPH-C203 | Quantum Mechanics –II | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 4 | MPH-C204 | Electronic Devices & Circuits | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 5 | MPH-C251 | Lab. Course (Gen. Electronics Lab.) | - | - | 9 | 4 | 15 | 15 | 70 | 100 |
| 6 | MPH-C252 | Lab. Course (Minor Project/Seminar) | - | - | 9 | 4 | 15 | 15 | 70 | 100 |
| | | | | | | 24 | TOTAL | | | 600 |
| M. Sc. II Year | | | | | | | | | | |
| Semester – III | | | | | | | | | | |
| 1 | MPH-C301 | Statistical Mechanics | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 2 | MPH-C302 | Atomic & Molecular Physics | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| ELECTIVES (TWO THEORY & TWO LAB.)* | | | | | | | | | | |
| 3 | MPH-E303/ MPH-E305 | ELECTIVE-I | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 4 | MPH-E304/ MPH-E306 | ELECTIVE-II | 4 | 1 | - | 4 | 20 | 10 | 70 | 100 |
| 5 | MPH-E351/ MPH-E353 | Lab. Course (Elective-I Lab.) | - | - | 9 | 4 | 15 | 15 | 70 | 100 |
| 6 | MPH-E352/ MPH-E354 | Lab. Course (Elective-II Lab.) | - | - | 9 | 4 | 15 | 15 | 70 | 100 |
| | | | | | | 24 | TOTAL | | | 600 |
| Semester – IV | | | | | | | | | | |
| 1 | MPH-C401 | Physics of Nuclei & Particles | 4 | - | - | 4 | 20 | 10 | 70 | 100 |
| 2 | MPH-C402 | Solid State Physics | 2 | - | - | 4 | 20 | 10 | 70 | 100 |
| ELECTIVES (ONE THEORY & ONE LAB.)* | | | | | | | | | | |
| 3 | MPH-E403/ MPH-E404 | ELECTIVE-III | 4 | - | - | 4 | 20 | 10 | 70 | 100 |
| 4 | MPH-E451/ MPH-E452 | Lab. Course (Elective-III Lab.) | - | - | 9 | 4 | 15 | 15 | 70 | 100 |
| ELECTIVES (Dissertation or Two theory paper one each from Electives IV & V) | | | | | | | | | | |
| 5 | | ELECTIVE-IV | 4 | - | - | 4 | 20 | 10 | 70 | 100 |
| 6 | | ELECTIVE-V | 4 | - | - | 4 | 20 | 10 | 70 | 100 |
| 7 | MPH-E460 | Dissertation/Major Project | - | - | - | 8 | - | - | - | 200 |
| | | | | | | 24 | TOTAL | | | 600 |
| TOTAL CREDITS | | | | | | 96 | G. TOTAL | | | 2400 |

L = Lecture P = Practical CT =Cumulative Test TA =Teacher Assessment
ESE= End Semester Examination

*
LIST OF ELCETIVES

| Elective – I / II | | Elective - III | |
|--------------------------|---|-------------------------------------|--|
| Course/ Paper Code | Course/ Paper Name (02 Theory + 02 Practical) | Course/ Paper Code | Course/Paper Name (01 Theory + 01 Practical) |
| MPH-E303 | Digital Electronics & Microprocessor | MPH-E403 | Communication Electronics-II |
| MPH-E304 | Communication Electronics-I | MPH-E404 | Electrical Atmospheric and Modeling |
| MPH-E305 | Fundamental Atmospheric Physics | MPH-E451 | Lab. Course (Communication Electronics-II Lab.) |
| MPH-E306 | Advanced Atmospheric Physics | MPH-E452 | Lab. Course (Advanced Atmospheric Physics Lab.) |
| MPH-E351 | Lab. Course (Digital Electronics & Microprocessor Lab.) | ELECTIVE-IV& V (Any two) | |
| MPH-E352 | Lab. Course (Communication Electronics-I Lab.) | MPH-E411 | Physics of Nano Materials |
| MPH-E353 | Lab. Course (Atmospheric Physics-I Lab.) | MPH-E412 | Electronic Devices |
| MPH-E354 | Lab. Course (Atmospheric Physics-II Lab.) | MPH-E413 | Renewable Energy Sources |
| | | MPH-E414 | Optoelectronics and Lasers |

DISTRIBUTION OF MARKS FOR PRACTICAL/MAJOR PROJECT/ SEMINAR/ DISSERTATION

Distribution of marks for Practical / Dissertation shall be as follows:

| Practical Examination | | Minajor Project | | Dissertation | |
|----------------------------|-----------|------------------------|-----------|------------------------------|------------|
| Experiment/ Programming | 40 | Project/Report | 40 | Report Evaluation | 80 |
| Viva-voce | 20 | Viva-voce/Presentation | 20 | Viva-voce/Presentation | 60 |
| Record | 10 | Record | 10 | Seminar (Internal) # | 40 |
| | | | | Diary (Periodic Assessment)# | 20 |
| TOTAL | 70 | TOTAL | 70 | TOTAL | 200 |

Note:

1. Marks in the Dissertation shall be awarded jointly by the external and internal examiners after viva-voce examination.
- 2.# There shall be a seminar on dissertation work of the candidate to be evaluated by a Departmental Committee chaired by H.O.D.
- 3.#The supervisor will assess the student's work periodically and the marks shall be awarded for diary.

M.Sc. (Physics)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- PEO 1. Post-Graduates will have a quality education with theoretical and experimental knowledge of Physics to enrich towards higher learning.
- PEO 2. Post-Graduates will have an exposure of learning through educational visit, interaction with renowned persons through guest lectures, seminar, workshop and conferences.
- PEO 3. Post-Graduates will have an exposure of model making which in turn creates confidence, make them technically sound, self-disciplined, socially, and environmentally concerned.
- PEO 4. Exposure to different scientific instruments and, techniques, and also of different software, enable post-graduates to utilize them in research based work.
- PEO 5. Exposes to personality development, quantitative and counseling sessions are possible sources for carrier options and employability.

PROGRAM OUTCOMES (POs)

- PO 1. Apply the advanced knowledge gained through the various domains of Physics in solving basic and advance problems
- PO 2. Identify and analyze the problem related to allied fields with the help of computational/ analytical/statistical techniques.
- PO 3. Develop strong practical, analytical and mathematical skills and ability to solve scientific problems.
- PO 4. Capability in organizing and presenting the acquired knowledge coherently both in oral and written discourse.
- PO 5. Develop small projects and enhance confidence by presentation.
- PO 6. Apply research-based knowledge and methods including design of experiments, analysis and interpretation of data to conduct research related to fundamental and application aspects.
- PO 7. Postgraduates will have motivation to opt for higher studies in physics and will be able to apply for various positions in scientific and academic institutions or civil services examinations, etc.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- PSO 1. Acquire a comprehensive knowledge and sound understanding of the fundamentals and advancement in the Physics.
- PSO 2. Acquire a range of quantitative skills and knowledge of different computer applications/ programmes, helpful for mathematical and scientific problems.
- PSO 3. Acquire presentation skills and confidence while working individually and as a team by participation in seminar and other group activities.
- PSO 4. Develop skills and knowledge in conducting research on fundamental and application aspects of physics at higher degree and also they must be well qualified to obtain employment in different R & D and scientific industries.

| M. Sc. I Year | | MPH-C101 | | Semester-I | |
|----------------|--|--|---|--------------------|---------------|
| | | MATHEMATICAL PHYSICS | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

• **Learning Objectives**

The purpose of this paper is to introduce students to different methods of mathematical physics. The course structure of this paper include the study matrices, tensors, complex variables, special functions, integral transformations and differential equations in greater detail.

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

MATRICES & TENSORS

Orthogonal, Hermitian, Unitary and Normal matrices, Pauli and Dirac matrices, Orthogonality conditions, Tensor analysis: Introduction and definitions (Covariant and contravariant tensors, Addition, Multiplication & rank of tensors, Contraction, Direct product, Quotient rule), Pseudo and dual tensors, Levi-Civita symbol, Metric tensor, Christoffel symbols as derivatives of the metric tensor.

(12 Lectures)

UNIT-II

COMPLEX VARIABLES

Functions of complex variables, Analytic function, Cauchy integral theorem and Cauchy integral formula, Taylor and Laurent series, Theorem of residues, Contour integrals and definite integrals.

(12 Lectures)

UNIT-III

SPECIAL FUNCTIONS

Legendre, Bessel, Hermite, Laguerre equations and their solutions & polynomials, Recursion relations, Orthogonality and generating functions, Associated Legendre polynomials.

(12 Lectures)

UNIT-IV

INTEGRAL TRANSFORMS

First and second order shifting theorems, Fourier series, Fourier integral, Fourier transforms (FT), Dirac-delta functions and its FT, Laplace transforms (LT), Inverse LT by partial fractions, LT of derivative and integral function .

(12 Lectures)

UNIT-V

PARTIAL DIFFERENTIAL EQUATION

Laplace equation and its solution in rectangular, cylindrical and spherical co-ordinates; Poisson equation (Green's function solution), Two dimensional wave equation, Vibrating membrane (rectangular and circular).

(12 Lectures)

Text Books / Reference Books

1. Mathematical Physics - B.S. Rajput
2. Mathematical Methods for Physics - G Arfken
3. Mathematical Methods for Physics- G.Arfken
4. Applied Mathematics for Physicists & Engineer- Pipes & Harvil
5. Matrices and Tensors for Physicists- A .W. Joshi
6. Advanced Engineering Mathematics- E. Kreyszig
7. Mathematics for Physicists- Mary L . Boas
8. Special functions - E.D. Rainville
9. Special functions –W. W. Bell

10. Mathematical Methods for Physicists & Engineers- K.F. Reily, MPH Hobson & SJ Bence

- **Learning Outcomes:** *With the methods to be taught in this course, students will acquire all the mathematical skills those are necessary to solve problems in classical mechanics, quantum mechanics, electrodynamics, solid state physics, nuclear/particle physics and other fields of theoretical physics. The students will be able to work with vectors, tensors, different types of functions, transformations and series upon the successful completion of this paper.*

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

| | |
|------------|--|
| CO1 | Analyze the Matrices and Tensors. Analyze characteristics of matrices and its different types and also solve linear equations. Realize the basics of Tensor Analysis and its applications. |
| CO2 | Evaluate complex Algebra and complex integration |
| CO3 | Understand special functions to solve the physics problems. Solve Linear Differential equations and discuss the properties of special functions. |
| CO4 | Solve Partial Differential Equations, FT and LT |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| CO- PO Matrix: Mathematical Physics MPH-C101 | | | | | | | | | | | |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C101) | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |

3 – Strong Correlation 2 – Medium Correlation 1 – Low Correlation

| M. Sc. I Year | | MPH-C102 | | | Semester-I | |
|---------------------|--|--|---|--------------------|---------------|--|
| CLASSICAL MECHANICS | | | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 | |

- **Learning Objectives** - This course is designed to make students enable to deal with the Variational & least action principle, Lagrangian and Hamiltonian formalism for different classical systems with the importance of concepts such as generalized coordinates, constrained motion and canonical transformations. This paper also deals with the motion under central forces to know about conservative and central-conservative force as well as to establish that Kepler's laws of planetary motion. It also delineate with the linear approximation to any dynamical system near equilibrium and to derive and solve the wave equation for small oscillations.

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

LAGRANGIAN FORMALISM AND VARIATIONAL PRINCIPLE

Mechanics of a particle and system of particles, Conservation laws, Constraints, Degree of freedom, Generalised coordinates, D'Alembert's principle, Lagrange's equation of motion from D'Alembert's principle, Application of Lagrange's equation of motion to a particle and system of particles, Conservation theorem, Hamilton's variational principle, Euler-Lagrange's differential equation.

(12 Lectures)

UNIT-II

HAMILTONIAN FORMALISM

Need of Hamiltonian procedure, Legendre's transformation and Hamiltonian equations of motion, Physical significance of Hamiltonian, Cyclic coordinates, Hamiltonian equations in cylindrical and spherical coordinates and their applications, Application of Hamiltonian equation of motion to a particle and system of particles.

(12 Lectures)

UNIT-III

LEAST ACTION PRINCIPLE AND CANONICAL TRANSFORMATIONS

The principle of least action (no proof), Canonical or contact transformations, Their advantages and examples, Condition for a transformation to be canonical, Infinitesimal contact transformations (ICT), Poisson's Brackets: Definition and properties, Invariance with respect to canonical transformations, Equation of motion in Poisson Bracket form, Jacobian's identity.

(12 Lectures)

UNIT-IV

MOTION UNDER CENTRAL FORCES

Equivalent one body problem, General features of central force motion, Study of orbits, Virial Theorem, Kepler's laws of planetary motion, Laplace-Runge-Lenz vector, Unbound motion, Scattering in a central force field, Lagrangian and Hamiltonian formulation of relativistic mechanics.

(12 Lectures)

UNIT-V

MECHANICS OF RIGID BODIES AND THEORY OF SMALL OSCILLATIONS

Coordinates for rigid body motion, Euler's angles, Angular momentum of a rigid body, Moments and products of inertia, Principal axes transformation, Euler's equation of motion of a rigid body, Stable and unstable equilibriums, Lagrange's equation of motion for small oscillations, Normal co-ordinates and normal mode, Frequencies of vibration, Free vibration of linear triatomic molecules.

(12 Lectures)

Text Books / Reference Books

1. Classical Mechanics- N.C Rana and P.S. Joag (Tata Mcgraw-Hill, 1991)
2. Classical Mechanics- H. Goldstien (Addison Wesley, 1980)
3. Mechanics- A. Sommerfeld (Academic Press, 1952)
4. Introduction to Dynamics- I. Perceival and D. Richards (Cambridge Univ. Press)

- **Learning Outcomes**- Upon successful completion of this course, it is intended that a student will be able to learn completely about Lagrangian and Hamiltonian formulation of classical mechanics. This course will make students able to state the conservation principles involving momentum, angular momentum and energy and to understand that they follow from fundamental equations of motion. It will also provide them a deep understanding of Newton's laws and motion of a

particle under central force field. With the completion of the course, the students will also be able to understand the mechanics of rigid bodies and motion of small oscillations in a diversified scenario.

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

| | |
|------------|--|
| CO1 | Understand the concepts of generalized coordinates and momenta and apply the D'Alembert's principle to obtain equation of motion for a given system. Apply Lagrangian and Hamiltonian formulation to find the equation of motion. |
| CO2 | Understand Canonical transformations and use Hamilton-Jacobi formalism to solve mechanical systems. Solve Poisson bracket and small oscillation problem |
| CO3 | Learn conservation principles involving momentum, angular momentum and energy and to understand that they follow from fundamental equations of motion. |
| CO4 | Define the classification of orbits and able to solve central force problems. Interpret the dynamics of a rigid body. Understand the mechanics of rigid bodies and motion of small oscillations in a diversified scenario. |

Course Articulation Matrix

Mapping of Course Outcomes (COs) With Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

| CO-PO Matrix: Classical Mechanics TMPH-102 | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C102) | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |

3 – Strong Correlation 2 – Medium Correlation 1 – Low Correlation

| M. Sc. I Year | | MPH-C103 | | Semester-I | |
|----------------|--|--|---|--------------------|---------------|
| | | QUANTUM MECHANICS – I | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

• **Learning objectives**

The main objective of this course is to make students aware about the basic formulations in quantum mechanics. There are many different types of representations of state and operators that are very useful in studying the notions of quantum mechanics deeply. The course let know the students about the Schrödinger equation and its applications in diverse situations including bound state problems. The study of different types of operators such as Hermitian operators, unitary operator and angular momentum operator along with Eigen function and Eigen values are the integral part of this course. In this course, the students will also be able to study the wave functions of system of identical particles in greater detail.

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

SCHRÖDINGER WAVE MECHANICS AND APPLICATION

Motion of wave packet, Schrödinger equation, Normalised and orthogonal wave functions, Stationary state solution, Expectation values of dynamical variables, Probability current density, Ehrenfest's theorem, Momentum eigen functions and their applications, Coordinate and momentum representation, Rectangular potential barrier and its applications to α - decay, Particle in 1-D infinite deep potential well. **(12 Lectures)**

UNIT-II

BOUND STATE PROBLEMS

One dimensional and three dimensional harmonic oscillators, One dimensional finite square well, Spherically symmetric systems and potentials, Rigid rotator, Hydrogen atom and its normal state. **(12 Lectures)**

UNIT-III

OPERATORS

Algebra of operators, Linear operators, Eigen function and eigen values of operators, Orthogonal and complete set of eigen function, Dirac, Bra and Ket space, Heisenberg's uncertainty relations derived from operators, Hermitian operator and its properties, Matrix representation of operators, Change of basis functions, Unitary and similarity transformations, Equation of motion. Schrödinger, Heisenberg and interaction pictures. **(12 Lectures)**

UNIT-IV

ANGULAR MOMENTUM

Commutation Algebra, Commutation relation between position and momentum, Commutation relation for orbital angular momentum (L), Spin angular momentum (S) and total angular momentum (J), Eigen value spectrum for J^2 and J_z , Matrix elements of J_x , J_y , J_z , Addition of angular momentum. **(12 Lectures)**

UNIT-V

IDENTICAL PARTICLES AND SPIN

Physical meaning of identity, Exchange symmetry of wave functions, Symmetric and antisymmetric wave functions, Pauli's exclusion principle and its connection with statistical mechanics, Collision of identical particles, Spin angular momentum, Effect of spin on energy states of an atom (He-atom), Spin orbit interaction and spin correction, Symmetric and antisymmetric wave functions of hydrogen molecule (H_2). **(12 Lectures)**

Text Books / Reference Books

1. Quantum Mechanics - L. I. Schiff (McGraw-Hill)
2. Quantum Mechanics - Merzbacher
3. Quantum mechanics - B. Craseman and J D Powell (Addison Wesley)
4. Quantum Mechanics - Mathews and Venkatesan
5. Modern Quantum Mechanics - J.J. Sakurai

• **Learning outcomes**

After taking this course students will be able to appreciate the beauty of quantum mechanics by knowing all types of representations of operators and ways to apply them in different problems. The most important thing students will learn from

this course is how to solve the hydrogen atom problem by using quantum mechanics. Students will be knowing about different types of operators such as Pauli spin matrices and unitary operators which are very important in nuclear and particle physics as well as atomic and molecular physics. The students will know about total energy and wave function of identical particles with a clear picture of the wave function of fermions and bosons.

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

| | |
|------------|---|
| CO1 | Inspect about quantum mechanics and classical mechanics. |
| CO2 | Conceptualize Schrodinger equations and their applications to different realistic problems. Interpret the conditions and Evaluate problems in Schrödinger's Equation. |
| CO3 | Develop idea of matrix formulation of quantum mechanics. Compare the Schrödinger's, Heisenberg and Interaction pictures. Appreciate the importance and implication of vector spaces, dirac ket bra notations, eigen value problems, generalized uncertainty principle in quantum mechanics. |
| CO4 | Interpret angular momentum both spin and orbital. Better understanding of the mathematical foundations of angular momentum of a system of particles. |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| CO PO Matrix: Quantum Mechanics TMPH-104 | | | | | | | | | | | |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C103) | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |

| M. Sc. I Year | | MPH-C104 | | Semester-I | |
|----------------|--|--|---|--------------------|---------------|
| | | COMPUTATIONAL METHODS AND PROGRAMMING | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

Learning Objectives- The course is designed to develop an understanding of the elements of numerical methods among students. The main objective of this course is to provide students with an introduction to the field of numerical analysis and to derive appropriate numerical methods to solve interpolation based problems. This course also aims to deal with the numerical differentiation and integration as well as to deal with functions. Derive Problem solution using C programming.

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

COMPUTATIONAL METHODS

UNIT-I

SOLUTIONS OF ALGEBRAIC & TRANSCENDENTAL EQUATIONS

Algebraic & transcendental equations, Numerical solution, Method of bisection, Method of false position, Newton-Raphson iteration, Direct iterative method, Convergence. **(12 Lectures)**

UNIT-II

INTERPOLATION & CURVE FITTINGS

Errors in polynomial interpolation, Finite differences, Differences of a polynomial, Newton's formula for interpolation, Central differences, Interpolation formulae- Gauss's, Stirling & Bessel formula- Interpolation with unevenly space points- Lagrange's interpolation formula, Errors in Lagrange's interpolation formula, Curve fitting - Least square curve fitting, Weighted least square approximation. **(12 Lectures)**

UNIT- III

NUMERICAL DIFFERENTIATION AND INTEGRATION

Numerical differentiation, Errors in numerical differentiation, Cubic spline method, Numerical integration Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule- use of cubicsplines, Newton's cotes integration, Gaussian integration. **(12 Lectures)**

C PROGRAMMING

UNIT- IV

Computer languages, Introduction to algorithm, C character set, Identifiers and key words, Data types, Declarations, Expressions, Statements and symbolic constants, #include, #define, Preparing and running a complete C program; Arithmetic, Relational, Logical, Assignments and conditional operators; Precedence rule, Associative law; If-else, Switch, Break, Continue statements; While, Do-while, For statements, Nested loops; Go to statements; One and two dimensional arrays, Basic concept of pointer. **(12 Lectures)**

UNIT- V

Functions: Defining and accessing, Formal and actual parameters, Function prototypes, Recursion, Storage classes (basic concept); Structures: Defining and processing; Data files: Open, Close, Create, Process. **(12 Lectures)**

Text Books / Reference Books

1. Introductory Methods of Numerical Analysis - Sastry
2. Numerical Methods in Engg. & Sciences - Grewal B.S. Khanna Pub. N Delhi
3. Numerical Analysis - Rajaraman
4. Computers Today - Byron D.H. Mc Hill
5. Programming in ANSI C - E. Balaguruswamy, TMH
6. Numerical Method for Scientific & Engg Computation - Jain, Iyengar, Wiley, 1987

Learning Outcomes - After the completion of the course, students will be able to understand the theoretical and practical aspects of the use of numerical analysis in solving different problems those are not possible to solve analytically. The students will become proficient in implementing numerical methods for a variety of multidisciplinary applications such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. The students will also have expertise to understand the syntax of C language and to develop the programme using it for the solution of a particular problem.

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

| Course Outcomes (Cos) | |
|------------------------------|--|
| CO-1: | Acquire knowledge and apply it to solve simultaneous linear equations. Students will be able to understand the theoretical and practical aspects of the use of numerical analysis in solving different problems those are not possible to solve analytically. |
| CO-2: | The students will become proficient in implementing numerical methods for a variety of multidisciplinary applications such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. |
| CO-3: | The students will understand the logic to make a programme. |
| CO-4: | The students will also have expertise to develop the programme using C Language. Acquire knowledge on C programming. Write, Compile, Execute and Troubleshoot programs using C |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| CO PO Matrix: Computational Methods and Programming MPH-C104 | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |
| CO2 | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |
| CO3 | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |
| CO4 | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |
| Average CO (MPH-C104) | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |

| M. Sc. I Year | | MPH-C151 | | Semester-I | |
|----------------|--|--|---|--------------------|---------------|
| | | Lab Course (GENERAL PHYSICS LAB) | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 |

LIST OF EXPERIMENTS

1. Michelson Interferometer
2. Feby-Perot Interferometer
3. C.D. Spectrometer
4. Verification of Cauchy's relation
5. Ultrasonic interferometer
6. Magnetic Susceptibility
7. B-H Curve
8. Planck's constant
9. Four-Probe method
10. Lande 'g' factor using E.S.R. Spectrometer
11. Hall coefficient
12. Determination of Dielectric Constant
13. Design and study of different Network theorems
14. Determination of Hall Life of 'In'
15. Determination of range of Beta-rays from Ra and Cs
16. X-ray diffraction by Telexometer
17. Determination of Ionization Potential of Lithium
18. Determination of e/m of electron by Zeeman Effect using Feby Perot Etalon
19. (a) Measurement of wave length of He-Ne Laser light using ruler
(b) Measurement of thickness of thin wire with laser
20. To study Faraday effect using He-Ne Laser
21. (a) To find the conductivity (Dark and Phtoconductivity) of a thin film semiconductor at room temperature, low temperature and high temperature
(b) To study the photointensity and photospectral variation of photoconductivity of a thin film semiconductor

- Note:**
1. Students are required to perform atleast **ten** experiments from the above list.
 2. In practical examination the student shall be required to perform **one** experiment from the list.
 3. Experiment shall carry **40 Marks** and **20 Marks** shall be assigned for viva-voce examination. **10 Marks** shall be reserved for practical record.
 4. No batch for practical class shall consist of more than **20** students.
 5. The number of students in a batch allotted to an examiner for practical examination shall not exceed **12-15** students.
 6. Addition/deletion in the above list of **some experiments of similar nature** may be made in accordance with the facilities available with the approval of **H.O.D.**

| M. Sc. I Year | | MPH-C152 | | Semester-I | |
|----------------|--|--|---|--------------------|---------------|
| | | Lab Course (COMPUTATIONAL LAB) | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 |

LIST OF PROGRAMMES

LIST-A NA PROGRAMMING

1. To deduce errors involved in polynomial interpolation
2. Algebraic and transcendental equations using bisection, iterative method of false position
3. To implement Bessel's function, Newtons, Stirling, Lagrange's.
4. Implement numerical differential using trapezoidal, Simpson 3/8 rules
5. Integration by trapezoidal rule and midpoint rule
6. Quadratic interpolation using Newton's forward difference formula
7. To find roots of $f(x)=0$ using Bisection method
8. To find roots of $f(x)=0$ using Newton-Raphson method
9. To find roots of $f(x)=0$ using Secant method
10. To show frequency chart, regression analysis, Linear square fit and Polynomial fit
11. To implement method of least square fitting

LIST-B SOLUTION OF PHYSICS PROBLEMS IN C PROGRAMMING

1. Motion of object that falls freely
2. Motion of projectile in horizontal direction
3. Motion of satellite around a planet
4. Motion of body attached to spring
5. Motion of damped harmonic oscillator
6. Fourier sum of harmonic waves
7. Diffraction in N-slits grating
8. Electric field due to N point charges
9. Motion of a charge particle in a uniform magnetic field
10. Growth of current in LR circuit
11. Oscillations in LCR circuit

- Note:**
1. Students are required to perform atleast **ten** programmes each from the above lists **A** and **B**.
 2. In practical examination the student shall be required to perform **two** programmes one each from the **list A** and **list B**.
 3. Programmes shall carry **40** Marks and **20** Marks shall be assigned for viva-voce examination. **10** Marks shall be reserved for record.
 4. No batch for practical class shall consist of more than 20 students.
 5. The number of students in a batch allotted to an examiner for practical examination shall not exceed 12-15 students.
 6. Addition/deletion in the above list of **some experiments of similar nature** may be made in accordance with the facilities available with the approval of H.O.D.

| M. Sc. I Year | MPH-C201 | Semester-II |
|---------------|--|-------------|
| | E.M. THEORY & ELECTRODYNAMICS | |

| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
|----------------|--|--|---|--------------------|---------------|
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of three sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of 6 marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Learning objectives

One of the objectives of this course is to introduce electrostatics and magnetostatics in detail. It develops the concepts in electric field and scalar potential as well as magnetic field and vector potential. The unified description of these two i.e. electrodynamics in view of the Maxwell's equations is another objective of this course. The students will not only learn about fields (i.e. electric, magnetic and electromagnetic), but also about the radiations from various types of dipoles and localized sources. They will be taught to calculate power radiated in each case. Students will then be introduced by the formation and characteristics electromagnetic waves and their propagation in detail.

UNIT-I

ELECTROSTATICS

Boundary value problems, Conductor and uniqueness theorem, Method of images, Image and induced surface charge, Force and energy, Problem of sphere and charge, Multipole expansion potential- Monopole and dipole terms in detail, Electric fields of a dipole, Dielectrics- dielectric parallel, Force and energy in dielectric system.

(12 Lectures)

UNIT-II

MAGNETOSTATICS AND FIELDS IN MATTER

The divergence and curl of B, Ampere's law, Magnetic vector potential, Boundary conditions and multipole expansion, Magnetisation-Dia, para and ferromagnets, Effect of Magnetic field in atomic orbits, Bound currents and their interpretation, Magnetic field inside matter, Ampere's law in magnetised materials, Linear and nonlinear media.

(12 Lectures)

UNIT-III

ELECTRODYNAMICS

Maxwell's equation and magnetic charge, Equation inside matter, Boundary conditions, Potential formulations, Scalar and vector potentials, Gauge transformations, Coulomb and Lorentz gauge, Lorentz force law in potential form, Energy and momentum, Newton's third law in electrodynamics, Poynting theorem.

(12 Lectures)

UNIT-IV

ELECTROMAGNETIC WAVES

Polarisation, Boundary condition, Reflection and refraction, E.M. waves in nonconducting media, Monochromatic plane wave in vacuum, Energy and momentum of E.M. waves, Reflection and transmission at normal incidence and at oblique incidence, Electromagnetic waves in conductors.

(12 Lectures)

UNIT-V

ELECTROMAGNETIC RADIATION

Dispersion -Frequency dispersion, Frequency dependence of ϵ , μ and σ in nonconductors. Waveguides: Rectangular and circular waveguides. Coaxial transmission line, Dipole radiation, Retarded potentials, Electric dipole radiation.

(12 Lectures)

Text Books / Reference Books

1. Introduction to Electrodynamics - Griffith D.J
2. Classical Electricity and Magnetism - Panofsky & Phillips
3. Classical Electrodynamics -Bittencourt
4. Electricity & Magnetism - A. Kip, McGraw Hill

Learning outcomes

After the completion of this course, students are able to know about electromagnetic fields of different sources. The use of four vectors and tensors throughout in different derivations make students enable to deal with advance level courses in theoretical physics. During this course, the students come to know about the difference between covariance and invariance of various physical quantities. One of the major advantages of this course is that it is closely related to the real life where the electromagnetic waves are playing important role in our day-to-day routine. This course also make students enable to learn about the wave guides and transmission.

| Course Outcomes (Cos) | |
|-----------------------|---|
| CO-1: | After the completion of this course, students are able to know about electromagnetic fields of different sources. |
| CO-2: | The use of four vectors and tensors throughout in different derivations make students enable to deal with advance level courses in theoretical physics. |
| CO-3: | During this course, the students come to know about the difference between covariance and invariance of various physical quantities. |
| CO-4: | One of the major advantages of this course is that it is closely related to the real life where the electromagnetic waves are playing important role in our day-to-day routine. |
| CO-5: | This course also make students enable to learn about the wave guides and transmission |

Course Articulation Matrix

Mapping of Course Outcomes (COs) With Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

| CO-PO Matrix: E.M. Theory & Electrodynamics MPH-C201 | | | | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C104) | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |

| M. Sc. I Year | | MPH-C205 | | | Semester-II |
|----------------------|--|--|---|--------------------|--------------------|
| | | PHYSICS & VEDIC THOUGHT | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 30 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of three sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of 6 marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

SCIENTIFIC UNDERSTANDING OF VEDAS

Vedangas, Symbolism in Vedas, The Vedic Gods(Devas)

(Rg. 1.164.44, Atharva 10.8.31, Rg. 10.5.7,10.190.1), Common threads between Modern Physics and Vedic Thoughts, Introduction of Sulbha Sukta and Yajna.

(6 Lectures)

UNIT-II

ENERGY

(Rg.10.72.4, 10.90.16, 10.130.1, 1.164.13, 10.82.6, Atharva 10.8.10,11.1.1)

(Yajul 12-24,25; Rg.2.2.9;Rg 3-1-9; Rg. 8.19.7), Physics and Thought Energy, Agnisulta Rig (1, 1-9)

(6 Lectures)

UNIT-III

HEAT, LIGHT, MEGNETISM, ELECTRICITY AND ATOMIC THEORY

(Rg.10.45.1, 10.45.3, 2.1.1),(Yaju. 23.5.2, Rg. 10.81.3, 10.72.6) (Rg. 5-89 Supta; Rg. 8-101,1.2; Rg1.88,1-5)

(6 Lectures)

UNIT-IV

COSMIC RAYS

Yayo group(heat waves), Marichi group, Vayu group, Marut group, Ribhu group (Rg.10.140.1, 10.45.8, 1.136.3, 5.59.7, 5.57.4, 5.54.3, 5.55.3, 1.88.1, 2. 34.3, 2.34.2, 1.31.1, 1.64.5, 1.164.47, 1.164.51, 1.110.4), (Rg1.8.8,1.5; Rg 1.87.4, Rg 1.64.9, Rg. 1.36.8).

(6 Lectures)

UNIT-V

UNIVERSE

The Dynamic Universe, Estabilisation and expansion of Universe, Creation and dissolution of universe, Comparison with the theory of oscillatory universe, Nasdiya Sukta (Rig. 10), (Rg. 10.129; 1-7 (Big Bang Theoy); Rg. 10.1.6; Yaju 3-12,14-23,Ath 19.9.80; Rg 1.164.13)

(6 Lectures)

Text Books / Reference Books

1. The Call of Vedas - Abinash Cahndra Bose
2. Cosmology of the Rigvedas (London 1887) - W. Wallis
3. Physics in ancient India - Narayen Gopal Dongre
4. Science in Vedas - Acharya V.N. Shastri
5. The Vedas - Jeanire Miller, Rider & Co., London
6. Vedas: The Source of Ultimate Science, S.R. Verma, Nag Publishers (2005 Ed.)

| M. Sc. I Year | | MPH-C203 | | | Semester-II |
|----------------|--|--|---|--------------------|---------------|
| | | QUANTUM MECHANICS – II | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of three sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of 6 marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Learning Objectives- This is an advanced level course in Quantum mechanics which aims to teach about various approximation methods (including stationary state and time dependent perturbation theory) in physics to calculate the approximate values of energy for various quantum mechanical systems as well as to study various scattering processes. The notions of relativistic quantum mechanics with the establishment of Klein-Gordon (KG) equation and Dirac equation will be discussed in greater length. This course will let students appreciate the beauty of quantum mechanics in the form of the phenomenon like Born approximation and its validity.

UNIT-I

PERTURBATION THEORY -I

Non-degenerate case, First order and second order stationary perturbation theory, Degenerate case, Zeeman effect (without electron spin), First order Stark effect in H-Atom. The Variation method and its application to ground state of He and Vander-Waals interaction. **(12 Lectures)**

UNIT-II

PERTURBATION THEORY -II

WKB approximation, Connection formula for barrier penetration, Application of WKB method to theory of α decay. The time dependent perturbation theory, Transition probability, FG rule, Harmonic perturbation, Adiabatic and sudden approximation. **(12 Lectures)**

UNIT-III

SCATTERING THEORY

Laboratory and C.M. frames, Scattering cross section, Scattering by spherically symmetric potentials (partial wave analysis), Scattering by an attractive potential well, Scattering by a Coulomb field- Rutherford formula, Condition for validity of Born Approximation, Application of Born approximation : (a) Scattering by a square well potential (b) Scattering by a screened Coulomb field. **(12 Lectures)**

UNIT-IV

RELATIVISTIC QUANTUM MECHANICS

The Klein-Gordon equation, Dirac relativistic equation and its covariant form, Dirac equation for particle in E.M. field, Magnetic moment of electron, Existence of electron spin, Spin-orbit coupling, Solution of Dirac's equation for a central field (H-atom), Energy eigen values. **(12 Lectures)**

UNIT-V

SEMICLASSICAL THEORY OF RADIATION

Radiation theory- Interaction of radiation with atom, Electron dipole transition and forbidden transition, Classical radiation field, Asymptotic form of radiated energy, Dipole radiation, Planck distribution formula, Application of radiation theory-selection rule for a single particle. **(12 Lectures)**

Text Books / Reference Books

1. Quantum Mechanics - L. I. Schiff (McGraw-Hill)
2. Quantum mechanics - B. Craseman and J. D. Powell (Addison Wesley)
3. Quantum Mechanics - Mathews and Venkatesan
4. Principles of Quantum Mechanics - I.S. Tyagi (Pearson)
5. Modern Quantum Mechanics - J.J. Sakurai

6. Introduction to Quantum Field Theory, - Paul Roman (John Wiley)
7. Quantum Fields - N.N. Bigollubov & D.V. Shrikov
8. Introduction to Quantum Fiels Theory- Paul Roman

Learning outcomes:

After studying this course successfully, students can calculate the ground state and excited state energies of various real life systems by using Principle, WKB approximation and perturbation methods. Such descriptions are quite useful to explain various energy spectrums in atomic and molecular spectra. They will be knowing about scattering in two different frames and can easily calculate scattering amplitude and scattering cross section for different scattering process which are important in the nuclear and particle physics. For instance, with the understanding of Dirac equation for electrons (or fermions in general), they will be knowing about the presence of antiparticles (or antimatter in general) in our universe.

| Course Outcomes (Cos) | |
|------------------------------|---|
| CO-1: | This is an advanced level course in Quantum mechanics which aims to teach about various approximation methods. |
| CO-2: | The students will also have expertise in physics to calculate the approximate values of energy for various quantum mechanical systems as well as to study various scattering processes. |
| CO-3: | The notions of relativistic quantum mechanics with the establishment of Klein-Gordon (KG) equation and Dirac equation will be discussed in greater length. |
| CO-4: | This course will let students appreciate the beauty of quantum mechanics in the form of the phenomenon like Born approximation and its validity. |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| CO PO Matrix: Quantum Mechanics-II MPH-C203 | | | | | | | | | | | |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C203) | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |

| M. Sc. I Year | | MPH-C204 | | | Semester-II | |
|----------------|--|--|---|--------------------|---------------|--|
| | | ELECTRONIC COMPONENTS & CIRCUITS | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 | |

NOTE: The question paper shall consist of three sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of 6 marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Learning Objective:

This course presents the basic principles of circuit analysis and design, the basic concepts and characteristics of the electronic devices and circuits. It provides information to the students about the electronic components like diodes, transistors etc. in detail. In particular, this course offers the various interesting features associated with a variety of diodes like Zener diode and field effect transistors (FETs). The OP-AMP theory and their circuits as well as oscillators and voltage regulators are also an important part of this course. In total, the course will provide an opportunity to students to practice in the experimental setup, measurement, and analysis of basic electronic devices and circuits along with the knowledge of switching circuit.

UNIT-I

REVIEW

Network & network theorems, Diode circuits-Rectifiers & smoothing circuits, Voltage multipliers, Limiters & clampers, Photodiode and LED, Zener diode, Varactor diode and tunnel diode, Transistor fundamentals, Transistor biasing, CE and CC amplifier and their small signal equivalent circuits. **(12 Lectures)**

UNIT-II

FIELD EFFECT TRANSISTOR (FET) AND FREQUENCY EFFECTS

FET and MOSFET device characteristics, FET biasing, FET amplifier, Lead and lag networks, Miller's theorem, High frequency FET and BJT analysis, Bode frequency response plots, Amplifier frequency response.

(12 Lectures)

UNIT-III

OP-AMP THEORY WITH NEGATIVE FEED BACK

The differential amplifier, DC and AC analysis of a differential amplifier, CMMR, The OP-AMP, OP-AMP DC offset characteristics, Frequency response, Slew rate and power bandwidth, Types of negative feedback: Non-inverting voltage feedback, Effect on input and output impedances, Non-inverting current feedback, Inverting voltage and current feedback, Bandwidth, Closed loop gain and BW.

(12 Lectures)

UNIT-IV

OP-AMP CIRCUITS

Inverting amplifier, Non-inverting amplifier, Summing amplifier, Active filters, Comparators, The Schmitt trigger, Integrator, Differentiator, Waveform conversion, Waveform generator, Current to voltage and voltage to current converters, Low pass, band pass and band reject filters, Brief study of timer 555.

(12 Lectures)

UNIT-V

THE OSCILLATORS, VOLTAGE REGULATORS AND THYRISTORS

The positive feedback and oscillations, Wein bridge oscillator, RC and LC oscillators, The unwanted oscillations and stability, Multivibrators. Zener diode regulators, transistor series voltage regulators, Negative feedback voltage regulators, Transistor shunt voltage regulator, The SCR and its applications, UJT and its applications.

(12 Lectures)

Text Books / Reference Books

1. Solid State Electronics - Ben G. Streetman, PHI
2. Semiconductor Devices-Physics and Technology- S. M .Sze Wiley (1985)
3. Introduction to Semiconductor devices - M.S. Tyagi, John Wiley & Sons

4. Electronic Devices & Circuits- G.K. Mithal
5. Electronic Principles (3/e)- A.P. Malvino, TMH
6. Op-Amps & Linear integrated circuits - Ramakanth A. Gayakwad, PHI, Second Edition, 1991.

Learning outcomes:

After the completion of the course, students will be able to get an expertise necessary to work with an electronic industry. With the knowledge to work with various circuits and devices like an opto-electronic device, students are get familiar with the process like the conversion of energy and light to electrical energy/signals. The study of semiconductor devices in diverse context makes the base of student in the electronic field. Moreover, the study of Zener diode tells a student that how it acts as a voltage regulator and how to control the voltage. By the end of this course, the students should have fully acquired reasonable proficiency in the analysis and design of basic electronic circuits.

| Course Outcomes (Cos) | |
|------------------------------|--|
| CO-1: | Presents the basic principles of circuit analysis and design, the basic concepts and characteristics of the electronic devices and circuits. |
| CO-2: | Provides information to the students about the electronic components like diodes, transistors etc. in detail |
| CO-3: | Various interesting features associated with a variety of diodes like Zener diode and field effect transistors (FETs). The OP-AMP theory and their circuits as well as oscillators and voltage regulators are also an important part of this course. |
| CO-4: | The course provides an opportunity to students to practice in the experimental setup, measurement, and analysis of basic electronic devices and circuits along with the knowledge of switching circuit. |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| CO PO Matrix: Electronic Components & Circuits MPH-C204 | | | | | | | | | | | |
|--|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C204) | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |

| M. Sc. I Year | | MPH-C251 | | Semester-II | |
|----------------|--|--|---|--------------------|---------------|
| | | Lab Course (ELECTRONIC CIRCUITS) | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 |

LIST OF EXPERIMENTS

- Design and study of a CE transistor amplifier and study its frequency response, Input and output impedance
- Design and study of a CC transistor amplifier and estimate its input, output impedances and frequency response.
- Design and study of Network Theorems.
- Design a two stage RC coupled BJT amplifier with and without feedback and study frequency response for two different gains
- Design and study of junction diode limiter & clamper
- Study of FET characteristics, Load line, Calculation of I_{DSS} and pinch off voltage
- Study of MOSFET characteristics, Load line, Calculation of I_{DSS} and pinch off voltage
- Design and study of FET & MOSFET amplifier
- Study and construction of a Push-Pull amplifier
- Study and draw V-I characteristics of SCR, its design and application circuit using SCR
- Design and study of UJT relaxation oscillator. To study wave form generation and storage oscilloscope
- Study of real OP-AMP; The maximum slew rate, Input offsets, Frequency compensation
- Design and study of OP-AMP as inverting, Non-inverting and summing amplifier
- Design and study of OP-AMP as subtracter, integrator and differentiator
- Design and study of OP-AMP as Schmitt trigger and measure its hysteresis characteristics
- Design and study of astable, monostable and bistable multivibrator using OP-AMP
- Design and study of phase shift oscillator using OP-AMP
- Design and study of a Wein bridge oscillator using OP-AMP
- Study of IC timer 555 as; (a) Astable multivibrator (b) A monostable multivibrator (c) Time delay
- Design and study of high pass, low pass, band pass and band reject filters using OP-AMP
- Design and test a Logarithmic amplifier
- Study of function generator using OP-AMP
- Study of an instrumentation amplifier using OP-AMP

- Note:**
- Students are required to perform atleast **ten** experiments from the above list.
 - In practical examination the student shall be required to perform **one** experiment from the list.
 - Experiment shall carry **40 Marks** and **20 Marks** shall be assigned for viva-voce examination. **10** Marks shall be reserved for practical record.
 - No batch for practical class shall consist of more than **20** students.
 - The number of students in a batch allotted to an examiner for practical examination shall not exceed **12-15** students.
 - Addition/deletion in the above list of **some experiments of similar nature** may be made in accordance with the facilities available with the approval of **H.O.D.**

| M. Sc. II Year | | MPH-C301 | | Semester-II | |
|-----------------------|--|--|---|--------------------|---------------|
| STATISTICAL MECHANICS | | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of three sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of 6 marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

BASIC PRINCIPLES OF STATISTICAL MECHANICS

Thermodynamic potentials, Thermodynamic equilibria, Nernst's heat theorem, Chemical potential, Phase space, Ensembles, Density distribution of phase space, Liouville's theorem, Microstate and macrostates, Thermodynamical probability, Most probable distribution, Maxwell-Boltzmann distribution law, Law of equipartition of energy.

(12 Lectures)

UNIT-II

METHODS OF ENSEMBLES

Microcanonical ensemble- Perfect gas in microcanonical ensemble, Entropy, Gibbs Paradox, Partition function and its correlation with thermodynamic quantities, Canonical Ensemble- Thermodynamic function and partition functions, Grand canonical ensemble- Thermodynamic function and partition functions, Theory of imperfect gases, Equation of state and virial co-efficients.

(12 Lectures)

UNIT-III

THEORY OF IDEAL GAS

The ideal quantum gas, Bose-Einstein statistics, Fermi-Dirac statistics and Maxwell-Boltzmann statistics, Evaluation of constants α and β and their thermodynamic interpretation, Black body radiation and Planck's radiation, Grand canonical ensemble and the quantum statistics.

(12 Lectures)

UNIT-IV

IDEAL B/E GAS

Energy and pressure of a gas, Gas degeneracy, Bose-Einstein condensation, Thermal properties of B/E gas, Liquid He, Landau's theory of liquid He-II, Feynman's theory of liquid He-II.

(12 Lectures)

UNIT-V

IDEAL FERMI GAS

Energy and pressure of a gas, Weakly degenerate and strongly degenerate, Thermodynamic functions of degenerate F/D gas, Electron gas, Pauli theory of paramagnetism and Landau diamagnetism, White Dwarfs, Neutron stars.

(12 Lectures)

Text Books / Reference Books

1. Statistical Mechanics – R. K. Pathria
2. Statistical Mechanics – K. Huang
3. Statistical Physics - E.S. R. Gopal
4. Theoretical Chemistry - Glasstone
5. Statistical Mechanics - S.K. Sinha
6. Statistical and Thermal Physics- F. Reif
7. Statistical Mechanics - Landau & Lifshitz
8. Introduction to Statistical Physics – Pointon

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

| | |
|------------|--|
| CO1 | Gain knowledge and become familiar with various thermodynamics processes. |
| CO2 | Correlate how the concept of ensembles formalism forms the basis of statistical mechanics |
| CO3 | Understand the concepts of Maxwell-Boltzmann statistics, Bose Einstein statistics, Fermi Dirac statistics and realize the classical and quantum statistics which describes the state of a system made of microscopic particles |
| CO4 | Realize the applications of statistical mechanics by studying specific examples like Bose Einstein Condensation, Black body radiation, Liquid Helium and its properties |
| CO5 | Value of the phase transitions and extend these ideas to quantum world. To understand phase transition arising in Ising model |

Course Articulation Matrix**Mapping of Course Outcomes (COs) With Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)**

| CO PO Matrix :Statistical Mechanics MPH-C301 | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C301) | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |

| M. Sc. II Year | | MPH-C302 | | | Semester-III | |
|----------------|--|--|---|--------------------|---------------|--|
| | | ATOMIC & MOLECULAR PHYSICS | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 | |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

SPECTRA OF ALKALI & ALKALINE ELEMENTS AND X-RAY SPECTRA

Review of Solution of Schrodinger's equation for Coulomb field and Hydrogen atom. Quantum states of an electron atoms, Pauli's exclusion principle, Different series in alkali spectra, Term values and quantum defect, Ritz combination principle, Penetrating and non-penetrating orbits, Energy state of Helium atom, Spectra of Helium and Mercury, Characteristics of X-ray spectra, Fine structure of X-ray levels, Auger effect.

UNIT II

COUPLING SCHEMES, COMPLEX SPECTRA AND RESONANCE SPECTROSCOPY

Spin-Orbit coupling, Lamb shift and Rutherford experiment, LS and JJ coupling schemes, Term values in equivalent and non-equivalent electron systems, Energy level diagrams and selection rules in complex spectra, Regularities in complex spectra, Fine and Hyperfine structure of spectral lines, normal Zeeman effect, Paschen-Back effect and Stark effect. Normal and specific mass shifts, Anomalous Zeeman effect, Applications of Resonance Spectroscopy: ESR and NMR.

UNIT III

MOLECULAR STRUCTURE AND ROTATION -VIBRATION SPECTRA

Born and Oppenheimer separation for diatomic molecules, rotation, vibration and electronic structure of diatomic molecules. Molecular orbital method, Hydrogen molecular ion, Rotational spectra of diatomic molecule as a rigid and non-rigid rotator, Vibrational spectra of a diatomic molecule as a harmonic and anharmonic oscillator, Selection Rules, Isotope effects in vibrational spectra.

UNIT IV

ELECTRONIC AND RAMAN SPECTRA

Electronic spectra of diatomic molecules, Frank-Condon principle, Vibrational coarse structure, Rotational fine structure of electronic-vibration transition, Raman spectra: Classical and quantum explanation of Raman Effect, Vibrational and rotational Raman spectra of diatomic molecules. Structure determination of molecules by Raman spectroscopy.

UNIT V

LASERS

Requisites for producing laser light, Multilevel rate equations and saturation, Rabi frequency, Laser pumping and population inversion, Solid state Laser (Ruby), Gas Lasers (Helium-Neon and Carbon dioxide), Semiconductor laser (GaAs), Free electron Laser, Nonlinear phenomenon, Harmonic generation, Laser accelerator, Laser Applications : Distance measurement, Laser interferometry, Holography.

Text Books / Reference Books

1. Introduction to Atomic spectra- H.E. White
2. Fundamentals of molecular spectroscopy - C. B.Banwell
3. Molecular spectroscopy - J.M. Brown
4. Introduction to Molecular Spectroscopy - G.M. Barrow
5. Spectra of atoms and Molecules- Jeanne L. McWale
6. Lasers- B.B. Laud
7. Principles of Lasers- O. Svelto

COS

CO-1 To develop basic concepts and principles of atomic spectroscopy.

It is intended that a student will be able to learn completely about the atoms and molecules.

CO-2 To impart knowledge of different coupling scheme, selection rules and different atomic field effects. This course will make students able to know the principles of atomic spectroscopy and molecular spectroscopy.

CO-3 To enhance the understanding of essential theory of molecular spectroscopy. It will also provide them a deep understanding of Raman Spectroscopy.

CO-4 the students will also be able to understand the physics of LASERS.

Course Articulation Matrix Mapping of Course Outcomes (COs) With Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

| CO PO Matrix: Atomic And Molecular Physics MPH-C302 | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C302) | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |

| | | | | | |
|--------------------------|--|---|---|--------------------|---------------------|
| M. Sc. II Year | | MPH-E303 | | | Semester-III |
| ELECTIVE PAPER- I | | DIGITAL ELECTRONICS & MICROPROCESSOR | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

NUMBER SYSTEM AND LOGIC CIRCUITS

Number systems - Decimal, Binary, Octal, Hexa decimal and their interconversions, The ASCII code, EXCESS-3 code, Gray code and BCD code, Binary addition and subtraction, 2's complements arithmetic, Half adder and full adder, Binary multiplication and division, Transistor as a switch, OR, AND, NOT and NAND logic gates, Boolean algebra: Boolean laws and theorem, Demorgan's theorem, Logic families : RTL, DTL, TTL, ECL, Sum of product and product of sum methods, K-Map; pairs, quads and octets, K-map simplification, Min-term and max- term analysis. **(12 Lectures)**

UNIT-II

DATA PROCESSING CIRCUITS AND FLIP FLOP

Multiplexer and demultiplexer, Decoder, BCD to decimal decoders, Encoders, Parity generators, Checker, Seven segment display, RS, JK, M/S JK, T & D clocked and edge triggered flip-flop and their timing diagrams. **(12 Lectures)**

UNIT-III

REGISTERS AND COUNTERS

Buffer register, Shift register, Controlled shift register, Ripple counter, Frequency counters, Ring counters, Up and down counters, Electronic counters : Counting unit, Gate generator, Universal counter and its modes of operation. **(12 Lectures)**

UNIT-IV

D/A & A/D CONVERSION AND SEMICONDUCTOR MEMORIES

A/D converters: Successive approximation A/D converters, Voltage to time A/D converter, Voltage to frequency A/D converters and dual-slope integrator A/D converters, D/A conversion techniques, Digital voltmeter, Accuracy and consideration, Memory addressing, ROMS, RAMS, DRAMS. **(12 Lectures)**

UNIT-V

8085 MICROPROCESSOR: ARCHITECTURE & OPERATIONS

Microprocessor architecture and its operations, Memory, Input/output (I/O), The 8085 MPU, Instructions classification, instruction format, How to write and execute a simple programme, Instruction timings and operation status, Data transfer (copy) Instructions, Arithmetic operations, Logic operations, Branch operations, Writing assembly language programs, Debugging a program. **(12 Lectures)**

Text Books / Reference Books

1. Digital Principles and Application- A.P. Malvino and Donald P. Leach , TMH, New Delhi
2. Digital Design - M. Morris Mano, PHI, 1998
3. Microprocessor Architecture, Programming and Applications with 8085/8086 by Ramesh S. Gaonkar, Wiley-Eastern Ltd., 1987
4. Microprocessor and Interfacing , Programmking and Hardware -Douglas V. Hall, second edition, Mcgraw Hill International Edition, 1992.

| Course Outcomes (Cos) | |
|------------------------------|--|
| CO-1: | Understanding basic knowledge of Boolean algebra. define basic logical circuits, , minimization methods, methods for writing Boolean functions, combinational and sequential circuits, flip-flops, register, counter, A/D, D/A, digital automaton, programmable structures |
| CO-2: | Describe operation methods of combinational and sequential circuits, similarities and differences of writing the Boolean functions and minimizations |
| CO-3: | Synthesis of appropriate combinational and sequential logic circuits |
| CO-4: | To understand the working of a microprocessor/controller. To learn to program a processor using assembly language. Describe the architectures of 8085 microprocessors. |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO 1 | PSO2 | PSO3 | PSO4 |
|----------------------------------|-----|----------|----------|-----|-----|----------|----------|----------|----------|----------|----------|
| CO1 | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |
| CO2 | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |
| CO3 | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |
| CO4 | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |
| Average CO (MPH-E303) | - | 3 | 1 | - | - | 2 | 3 | 3 | 1 | 2 | 3 |

| | | | | | | |
|---------------------------|--|--|---|--------------------|---------------------|--|
| M. Sc. II Year | | MPH-E304 | | | Semester-III | |
| ELECTIVE PAPER- II | | COMMUNICATION ELECTRONICS-I | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 | |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

AMPLITUDE MODULATION

Communication systems, Modulation, Bandwidth requirements, Noise: External noise, Internal noise, Noise calculation, Noise figure, Amplitude modulation: Theory, Generation of AM, Basic requirement, Modulated transistor amplifiers, Single side band (SSB) techniques: Evolution of SSB, Suppression of carrier and unwanted side band, Demodulation: Envelop detection, Product detector. **(12 Lectures)**

UNIT-II

ANGLE MODULATION

Theory of frequency and phase modulation- Mathematical representation of FM, Frequency spectrum of FM wave, Phase modulation, Intersystem comparisons, Noise and frequency modulation- Effects of noise on carrier, Pre-emphasis de-emphasis, Comparison of wide band and narrow band FM, Stereo Phonic FM multiplex system, Generation of FM- FM methods, Direct methods, AFC. **(12 Lectures)**

UNIT-III

TRANSMISSION LINES, RADIATION AND PROPAGATION

Fundamentals of transmission lines, Characteristics impedance, Losses, Standing waves, Reactance properties of transmission lines, The Smith chart and its applications, Ground (surface) waves, Sky wave propagation- The ionosphere, Space waves, Tropospheric scatter propagation, Extraterrestrial communications. **(12 Lectures)**

UNIT-IV

ANTENNAS

The elementary doublet, Wire radiator in space, Antenna gain and effective radiated power, Antenna resistance, Bandwidth, Beamwidth and polarisation, Ungrounded antennas, Grounded antennas, Grounding systems, Effects of antenna height, Antenna coupling at medium frequency, Directional antennas- dipole arrays, Folded dipole and applications, The Yagi antenna. **(12 Lectures)**

UNIT-V

RADIO RECEIVERS

Receiver types- TRF receiver, Superhetrodyne receiver, AM receiver- RF section and characteristic, Frequency changing and tracking, intermediate frequency and IF amplifiers, AGC, Extension of superhetrodyne principle, FM receivers- comparison with AM receiver, Amplitude limiting, Basic FM demodulators. **(12 Lectures)**

Text Books / Reference Books

1. Principles of communication systems - Taub and Schilling, TMH, 1994
2. Electronic Communication System - G. Keneddy
3. Communication systems, Third Edition -Simon Haykin, John Wiley & Sons ,Inc. 1994
4. Digital and Commuication system - Roden H.S., PHI
5. Analog and Digital Communication - Chakraborty, Dhanpat Rai
6. Advanced Electronics Communication Systems- Wayne Tomasi, PHI. Edn.

| Course Outcomes (Cos) | |
|------------------------------|---|
| CO-1: | Appraise about AM, DSB/SSB modulation. |
| CO-2: | Interpret frequency modulation and modulation factor. |
| CO-3: | Determine the characteristics of long transmission line, Antenna. |
| CO-4: | Determine the characteristics of AM and F.M. radio receiver. |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| CO-PO Matrix: Electronics and Communication Lab MPH-E352 | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO 4 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 |
| Average CO (MPH-E352) | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 |

| M. Sc. II Year | | MPH-E305 | | | Semester-III | |
|--------------------------|--|--|---|--------------------|---------------------|--|
| ELECTIVE PAPER- I | | FUNDAMENTAL ATMOSPHERIC PHYSICS | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 | |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

STRUCTURE & ELEMENTARY DYNAMICS OF ATMOSPHERE

Thermal structure of atmosphere, Composition of atmosphere, Hydrostatic equation and lapse rate, Ambient lapse rate and vertical mixing, Cloud formation and precipitation, General circulation, Forces driving horizontal motion, Geostrophic flow, Vertical wind shear, Horizontal wind shear-weather fronts, Tropical cyclone & hurricanes.

(12 Lectures)

UNIT-II

SOLAR AND TERRESTRIAL RADIATION

Physics of radiation, Interaction of light with matter, Rayleigh- and Mie- scattering, Laws of radiation (Kirchoffs law, Planck's law, Beer's law, Wien's displacement law, etc.), Solar and terrestrial spectra, UV radiation, Ozone depletion problem, IR absorption, Energy balance of the earth atmosphere system.

(12 Lectures)

UNIT-III

THE GLOBAL CLIMATE

Solar spectrum, Radiation balance and temperature of Earth's surface, Global warming and radiative forcing, Feedback effects, Role of carbon di oxide, Climate variations, Impact of global climate change, Climate change in international politics.

(12 Lectures)

UNIT- IV

SOLAR ULTRAVIOLET RADIATION & LIFE

Solar ultraviolet spectrum, The ozone filter: Chapman reactions, Reaction rates; Ozone depletion: Thinning of ozone layer and ozone holes, Chlorine cycle. Destruction of ozone by NO_x and HO_x reactions, The antarctic ozone hole: Biological impacts of ultraviolet radiation: Action spectra and damage, Absorption by DNA and proteins;(Ozone in troposphere, Montreal Protocol.

(12 Lectures)

UNIT-V

ATMOSPHERIC MEASUREMENT TECHNIQUES

Ground based measurements of temperature, Pressure and humidity, Air-born measurement of above parameters, Measurement of air, water and noise pollutions, Measurement of precipitation, Measurement of cloud parameters using Radar.

(12 Lectures)

Text Books / Reference Books

1. Physics of the Environmental - A.W. Brinkman, Imperial college Press.
2. Atmospheric Science: John M.Wallace & Peter V. Hobbs, Academic Press(2006)

| M. Sc. II Year | | MPH-E306 | | | Semester-III |
|--------------------|--|--|---|--------------------|---------------|
| ELECTIVE PAPER- II | | ADVANCED ATMOSPHERIC PHYSICS | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

ATMOSPHERIC THERMODYNAMICS I

Gas laws: Virtual temperature, Hydrostatic equation: Geopotential, Scale height, Constant pressure surfaces, Reduction of pressure to sea level, First law of thermodynamics: Joule's law, Specific heats & enthalpy, Adiabatic processes: Air parcel & dry adiabatic lapse rate, Potential temperature, Thermodynamic diagrams, (12 Lectures)

UNIT-II

ATMOSPHERIC THERMODYNAMICS II

Water vapour in air: Moisture parameters, Pseudoadiabatic processes & saturated adiabatic lapse rate, Equivalent and wet bulb potential temperatures, Normand's rule, Ascent decent effect, Static stability : Unsaturated & saturated air, Conditional & convective stability, Second law of thermodynamics: Carnot cycle, entropy, Clausius - Clapeyron equation. (12 Lectures)

UNIT-III

CLOUD MICROPHYSICS I- WARM CLOUD

Theory of nucleation of water vapour & cloud condensation nuclei, Microstructure of warm clouds, Cloud liquid water content & entrainment, Growth of cloud droplets in warm clouds: by condensation, by collection, collision-coalescence, (12 Lectures)

UNIT-IV

CLOUD MICROPHYSICS II- COLD CLOUD

Microphysics of cold clouds: Nucleation, Growth & concentration of ice particles, Formation of precipitation in cold clouds, Artificial modification of clouds & precipitation: Modification of warm & cold clouds, Inadvertent modification. (12 Lectures)

UNIT-V

ATMOSPHERIC DYNAMICS

Kinematics of large scale horizontal flow: Elementary properties, Vorticity & divergence, Deformations, streamlines & trajectories, Dynamics of horizontal flow: Apparent & real forces, Equation of motion, Geostrophic & thermal wind, Vertical motion & planetary rotation, Vorticity conservation, Potential vorticity, Primitive equations: Vertical coordinate, Hydrostatic balance, Energy equation, Vertical motion field, Solution & application of primitive equations. (12 Lectures)

Text Books / Reference Books

1. Atmospheric Science - John M. Wallace & Peter V. Hobbs, Academic Press (2006)
2. Dynamic Meteorology - Holton, J.R., 3rd edition, Academic Press N.Y. (1992).
3. Numerical Weather Prediction - G.J. Haltiner and R.T. Villians, John Wiley and Sons, 1980

| M. Sc. II Year | | MPH-E351 | | Semester-III | |
|----------------|--|--|---|--------------------|---------------|
| | | Lab Course (DIGITAL ELECTRONICS & MICROPROCESSOR LAB) | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 |

LIST OF EXPERIMENTS

1. Construction and study of logic gates using diode and transistors
2. Study of pin connection, power supply requirement and truth tables of various digital IC's
3. Design and study of control combinational logic network
4. Design and study of different shift registers using IC's
5. Design and study of multiplexer for different modes using IC's
6. Design and study of demultiplexer for different modes
7. Design and study of decoders
8. Design and study of encoders
9. Design and study of different counter modes
10. Design and study of RS, D, JK and T flip-flops
11. Design and study of A/D converter
12. Design and study of D/A converter
13. Study of ITL 742121 as monostable Schmitt trigger
14. Design and study of decode and display circuit using 7448 and FND 507 or other LED
15. Study of basic instructions and programming for simple application of 8085 Microprocessor
16. Study of interfacing of 8251, 8255, 8253, 8257 etc.
17. Study of addition, subtraction, multiplication & division using 8085/8086
18. Study of motor speed control, temperature control using 8085/8086
19. Design and study of active filters
20. Study of an experiment using various types of memory elements

Note:

1. Students are required to perform **ten** experiments from the list.
2. In practical examination the student shall be required to perform **one** experiment.
3. Addition or deletion in the above lists may be made in accordance with the facilities available with the approval of H.O.D. Physics.

| M. Sc. II Year | | MPH-E352 | | | Semester-III | |
|----------------|--|--|---|--------------------|---------------|--|
| | | Lab Course (COMMUNICATION ELECTRONICS LAB) | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 | |

LIST OF EXPERIMENTS

1. Study of amplitude modulation & demodulation
2. Study of SSB modulation & demodulation
3. Study of frequency modulation & demodulation
4. Study of AGC and AVC
5. Study of simple radio receiver circuits using IC
6. Study of the characteristics of a superhetrodyne broadcast radio receiver
7. Study of FM receivers
8. Study of the sweep generator using SCR and UJT
9. Determination of antenna constants
10. Study of half wave antenna
11. Study of Marconi antenna
12. An elementary study of antenna array
13. Study of Yagi antenna
14. An elementary study of broadcast transmitter
15. An elementary study of coaxial and parallel transmission lines
16. Ionospheric study (i) critical frequency (ii) virtual height (iii) signal strength

- Note:**
1. Students are required to perform **ten** experiments from the list.
 2. In practical examination the student shall be required to perform **one** experiment.
 3. Addition or deletion in the above lists may be made in accordance with the facilities available with the approval of H.O.D. Physics.

| | | | | | |
|---------------------------|--|---|---|---------------------|---------------|
| M. Sc. II Year | | MPH-E353 | | Semester-III | |
| | | Lab Course (ATMOSPHERIC PHYSICS-I LAB) | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 |

1. Measurement of solar radiations (Solarimeter)
2. Wind direction and speed measurement
3. Measurement of rainfall
4. Measurement of aerosols
5. Numerical weather modelling
6. Wind fabric diagram
7. Measurement of humidity
8. Measurement of atmospheric attenuation of laser radiation
9. Measurement of particulate matter(Man made or industrial)
10. Measurement of ozone in atmosphere

Note:

1. In practical examination the student shall be required to perform **One** experiment.
2. Addition or deletion in the above lists may be made in accordance with the facilities available with the approval of H.O.D. Physics

| M. Sc. II Year | | MPH-E354 | | Semester-III | |
|-----------------------|--|---|---|---------------------|---------------|
| | | Lab Course (GENERAL ATMOSPHERIC LAB) | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 |

LIST OF EXPERIMENTS

1. Laboratory simulation of cloud formation and to study the effect of aerosols, ions, electric field on it
2. Simulation of atmospheric electric field
3. Measurement of atmospheric electrostatic field
4. Measurement of lightning radiation at VLF
5. Measurement of lightning radiation at HF
6. Experiments on lightning protector
7. Analysis of rain water using UV spectrophotometer
8. Measurement of parallel and perpendicular components of atmospheric fields
9. Effect of electrostatic field on mice and rats
10. Effect of pollution on some animals (rats etc.)

Note:

1. In practical examination the student shall be required to perform **one** experiment.
2. Addition or deletion in the above lists may be made in accordance with the facilities available with the approval of H.O.D. Physics

| M. Sc. II Year | | MPH-C401 | | Semester-IV | |
|----------------|--|--|---|--------------------|---------------|
| | | PHYSICS OF NUCLEI & PARTICLES | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

NUCLEAR INTERACTION AND REACTIONS

General properties of nuclei, magnetic dipole moment, electric quadrupole moment and nuclear shape, charge independence and spin dependence of nuclear forces, Exchange nature of nuclear forces and their types, elementary discussion on Yukawa's theory, Deuteron ground state, excited states, two nucleon scattering, n-p scattering, partial wave analysis, phase-shift, scattering length, p-p scattering (qualitative discussion only), Direct and compound nuclear-reactions, resonance reactions, Breit-Wigner one-level formula, Reciprocity theorem.

UNIT-II

NUCLEAR MODELS

Liquid drop model and Bohr-Wheeler theory of fission, Shell model, Magic numbers, Doubly Magic Nuclei, Experimental evidences for Shell Model. Merits/Demerits of Liquid drop model and shell model, Nilsson model, Collective model, Physical concepts of the unified model.

UNIT-III

NUCLEAR DECAY

Alpha decay, Gamow Theory of Alpha decay, Beta-decay, Shape of the beta spectrum, Fermi theory of beta decay, Kurie plots, Fermi and Gamow-Teller transitions, Parity violation in beta decay, Detection and properties of neutrino, Two component theory of neutrino decay, Internal conversion, Nuclear isomerism.

UNIT-IV

ELEMENTARY INTERACTIONS AND PARTICLES

Basic interactions in nature and their mediating quanta, Elementary particles, Quantum numbers and conservation laws, Isospin and its conservation, Strangeness and associated production of strange particles, Gell-Mann Nishijima scheme, Elementary ideas of SU(2) and SU(3) symmetry groups and hadron classification, Properties of Quarks and their classifications, Colour of Quarks, Electroweak interaction (W and Z bosons), Introduction to the Standard Model.

UNIT-V

DETECTORS AND ACCELERATORS

Outline of interaction of charged particles and of Gamma-rays with matter, Ionization chamber, Geiger-Muller counter, Scintillation counter, Semiconductor detector, Bubble chamber, Spark chamber, Cerenkov Counters, Van De Graff accelerator, Cyclotron, Synchrotrons, Betatron, Colliding beam accelerator, Introduction of Modern Colliders (LHC and RHIC).

Text Books / Reference Books

1. Nuclear Physics - I. Kalplan, Narosa, Madras
2. Atomic nucleus - R. D. Evans, McGraw Hill, N York
3. Concepts of Nuclear Physics - B.L. Cohen, MGH, Bombay, 1971
4. Nuclear Physics - R.R. Roy and B.P. Nigam, Wiley- Eastern Ltd., 1983
5. Introduction to Experimental Nuclear Physics - R.M. Singru, John Wiley & Sons
6. Atomic and Nuclear Physics vol.2 - Ghoshal,
7. Introduction to nuclearPhysics- H.A. Enge, Addison -wesley

| |
|--|
| Course Outcomes: At the end of the course, the student will be able to: |
| Co-1 Describe various types of nuclear interactions and reactions and their properties. |
| CO-2 Compare various nuclear models and properties of the nucleus. Understand about nuclear forces and their dependence on various parameters. |
| CO-3 Conceptualize different nuclear detectors and their application. |
| CO-4 Classification of elementary particles and also their decay modes. Study of nuclear detectors and accelerators |
| |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| CO PO Matrix: Physics of Nuclei and Particles MPH-E 401 | | | | | | | | | | | |
|--|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO 1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-E352) | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |

| M. Sc. II Year | | MPH-C402 | | | Semester-IV | |
|----------------------------|--|--|---|--------------------|--------------------|--|
| SOLID STATE PHYSICS | | | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 | |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

CRYSTAL STRUCTURE AND LATTICE VIBRATIONS

Introduction to crystal structure, Ionic bonding, Evaluation of Madelung constant, Covalent crystals, Exchange energy calculation, Molecular bonding and Vander-Waals interaction. Vibration of one dimensional solid, The linear diatomic lattice, Acoustic and optical modes of vibrations, Phonon, Momentum of phonon, Einstein & Debye models and T^3 Law. **(12 Lectures)**

UNIT-II

DEFECTS IN CRYSTALS AND FREE ELECTRON THEORY

Point defects, Line defects and planer faults, The role of dislocations in plastic deformation and crystal growth, X-ray and electron microscopy techniques for observation of imperfections in crystals. Energy levels and density of orbits (in one dimension), Fermi-Dirac distribution, Free electron gas in three dimension, Electrical conductivity and effect of impurities, Thermal conductivity of free electron gas, Wiedemann -Franz law. **(12 Lectures)**

UNIT-III

ENERGY BANDS IN SOLIDS AND SEMICONDUCTOR THEORY

Wave function in a periodic lattice and Bloch theorem, Kroning Penny model, The nearly free electron approximation, The tight binding approximations, Number of orbitals in a band, Classifying material as semiconductor and band gap, Intrinsic and extrinsic semiconductor, Mobility, Drift velocity and conductivity of intrinsic semiconductors, Carrier concentration in semiconductors, Impurity semiconductors and thermal ionization of impurities, Impurity states and band model. **(12 Lectures)**

UNIT-IV

TRANSPORT PROPERTIES AND MAGNETIC RESONANCE

Boltzmann transport equation, Sommerfeld theory of electrical conductivity, Relaxation time, Hall effect, Experimental determination of Hall coefficient, Residual resistivity, Temperature dependent resistivity, Principle of magnetic resonance, Nuclear magnetic resonance, Electron spin resonance, Resonance, Fluorescence, Theory of Mössbauer effect, Isomer shift, Quadrupole interaction, magnetic hyperfine interaction. **(12 Lectures)**

UNIT-V

SUPERCONDUCTIVITY AND FERROMAGNETISM

The BCS theory, Transition temperature, Meissner effect, Critical field, Type I and type II superconducting materials, Cooper pairs, Joesphson tunneling, Superconductivity at high temperatures (elementary). Weiss theory of ferromagnetism, Heisenberg model and molecular field theory, Spin waves and magnons, Curie-Weiss law for susceptibility. **(12 Lectures)**

Text Books /Reference Books

1. Solid State Physics – C.Kittel
2. Solid State Physics - A.J. Dekker
3. Crytallography for Solid State Physics- Verma & Srivastava
4. Introduction to Solids - Azaroff
5. Elementary Solid State Physics - Omar
6. Solid State Physics : Ashcroft & Mermin

7. Principle of Condensed Matter Physics - Chaikim & Lubensky
8. Introduction to Solid State Physics-Paterson

| Course Outcomes (Cos) | |
|------------------------------|---|
| CO-1: | Understand different types of crystal structures in terms of the crystal lattice and the basis of constituent atoms. |
| CO-2: | Understand the theory of X-ray diffraction in the reciprocal lattice (k-space) formalism. Apply the theory of lattice vibrations (phonons) to determine thermal properties of solids. |
| CO-3: | Study the problem of electrons in a periodic potential, examine its consequence on the band-structure of the solids. |
| CO-4: | Elaborate superconductivity, Type-I and Type-II superconductors, Thermodynamics of Superconducting transition and build the concepts of Critical fields and Critical currents. |

Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)

| CO-PO Matrix: Solid State Physics MPH-C402 | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO 1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-C402) | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |

| M. Sc. II Year | | MPH-E403 | | | Semester-IV | |
|---------------------------|--|--|---|--------------------|--------------------|--|
| ELECTIVE PAPER III | | COMMUNICATION ELECTRONICS-II | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 | |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

SIGNAL ANALYSIS & SAMPLING

System and signals, Signal representation using Fourier series, Signal representation using Fourier transform, Power spectral density. Sampling theorem- Low Pass and Band Pass signals, PAM, Channel BW for a PAM signal, Natural sampling, Flat-top sampling, Signal recovery through Holding, Quantization of signals, Quantisation error.

(12 Lectures)

UNIT-II

PULSE MODULATION SYSTEMS

PCM, Differential PCM, Delta modulation, Adaptive delta modulation, Noise in pulse code and delta modulation Systems: Calculation of quantization noise, Output signal power, Output signal-to-noise ratio in PCM.

(12 Lectures)

UNIT-III

DIGITAL MODULATION TECHNIQUES

Binary phase shift keying (BPSK), Differential phase shift keying (DPSK), Quadrature phase shift keying (QPSK), Binary frequency shift keying (BFSK).

(12 Lectures)

UNIT-IV

MICROWAVE COMMUNICATION

Principle of velocity modulation, Reflex klystron and magnetron, Advantages and disadvantages of microwave transmission, Loss in free space, Propagation of microwaves, Atmospheric effects on propagation, Fresnel zone problem, Ground reflection.

(12 Lectures)

UNIT-V

RADAR SYSTEMS AND SATELLITE COMMUNICATION

Radar block diagram and operation, Radar range equation, Minimum detectable signal, Receiver noise, Radar cross-section, Pulse repetition frequency, Antenna parameters, Radar transmitters and receivers. Satellite communications: Orbital and geostationary satellites, Orbital patterns, Look angles, Orbital spacings, Satellite systems, Link modules.

(12 Lectures)

Text Books / Reference Books

1. Principles of communication systems, 2/e - Taub and Schilling, TMH
2. Digital and Communication system - Roden H.S., PHI
3. Analog and Digital Communication - Chakraborty, Dhanpat Rai
4. Advanced Electronics Communication Systems - Wayne Tomasi., PhI. Edn.
5. Digital and Analog Communication System- K. San Shanmugam, John Wile & Sons
6. Microwaves- K.L. Gupta, Wiley Eastern Ltd., New Delhi
7. Satellite communication - D.C. Agrawal

| M. Sc. II Year | | MPH-E404 | | | Semester-IV | |
|--------------------|--|--|---|--------------------|---------------|--|
| ELECTIVE PAPER III | | ELECTRICAL ATMOSPHERE & MODELING | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 4 Hrs | 30 | 70 | 100 | 04 | |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

ATMOSPHERIC ELECTRICITY

Fair-weather atmospheric electric fields and currents, Mechanisms of cloud electrification: precipitation powdered & connective mechanisms, electrochemical charge separation, charge structure of the clouds, thundercloud electric fields. **(12 Lectures)**

UNIT-II

PHYSICS OF LIGHTNING

Lightning initiation in a thundercloud, Cloud to ground and intra-cloud lightning, Positive lightning, Lightning super bolts, Lightning fields: electric & magnetic fields, Radiations from lightning, Application of the lightning electric field measurements. Lightning sprites. **(12 Lectures)**

UNIT-III

ATMOSPHERIC OZONE

Ozone and the Dobson unit, Temporal and spatial variation of ozone Umkehr effect, Stratospheric ozone, Ozone flux from stratosphere to the troposphere, Tropospheric ozone, Chapman mechanism, Ozone depletion on ozone Hole, Polar stratospheric clouds and Role of ozone. **(12 Lectures)**

UNIT-IV

NUMERICAL METHODS

Solution to atmospheric equations: Approximate solutions, Parameterizations & models. Grid points. Finite difference equations, Numerical stability: Numerical forecast process: Balanced mass & flow fields, Data assimilation & analysis. **(12 Lectures)**

UNIT-V

WEATHER PREDICTION

Forecasting, Post processing, Refinements, Forecast quality; accuracy & verification, Elementary non linear dynamics & chaos: Predictability, Lorentz strange attractor. Ensemble forecaster. **(12 Lectures)**

Text Books / Reference Books

1. Atmospheric Science: John M. Wallace & Peter V. Hobbs, Academic Press(2006)
2. Meteorology for Scientists and Engineers-Ronald B. Stull, Brooks/Cole Cengage Learning(1995)
3. 4. Dynamic Meteorology: Holton, J.R, 3rd edition Academic Press N.Y.(1992)
5. The Physics of Monsoons_ R.N.keshavamurthy and m.Shanker Rao, Allied publishers, 1992.
6. Numerical weather prediction_ G.J.Haltiner and R.T.Villians John wiley and sons 1980.
7. Atmospheric chemistry and Physics-J.H. Seinfeld and spynes N. Pandis, wiley and sons,2006

| M. Sc. II Year | | MPH-E451 | | | Semester-IV | |
|----------------|--|---|---|--------------------|---------------|--|
| | | Lab Course (ADVANCED COMMUNICATION ELECTRONICS LAB) | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 | |

LIST OF EXPERIMENTS

1. To study pulse amplitude modulation/demodulation
2. To study pulse position /pulse width modulation /demodulation
3. To study phase modulation
4. To study FSK modulation/ demodulation using timer/PLL
5. To study microwave characteristics and measurement
6. To study solid state microwave oscillator
7. To study PLL circuits and applications
8. To study fibre optics communication
9. To study trouble shooting using signal analyzer
10. To study assembler language programming on PC
11. To study experiments based on computer aided design
12. To study PCM-PDM
13. To study TDM-PAM
14. To study sampling and reconstruction
15. To study PSK, QSK modulation techniques
16. To study PAM wave form
17. To study delta modulation, adaptive delta modulation
18. To study sigma modulation and demodulation techniques
19. To study microwave communication systems
20. To study microwave antennas

- Note:**
1. Students are required to perform **ten** experiments from the list.
 2. In practical examination the student shall be required to perform **one** experiment.
 3. Addition or deletion in the above lists may be made in accordance with the facilities available with the approval of H.O.D. Physics.

| | | | | | |
|---------------------------|--|--|---|--------------------|---------------|
| M. Sc. II Year | | MPH-E452 | | Semester-IV | |
| | | Lab Course (ADVANCED ATMOSPHERIC PHYSICS LAB) | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 120 | 4 Hrs | 30 | 70 | 100 | 04 |

1. Measurement of gaseous pollutant (SO₂,CO₂,NO,O₃)
2. Measurement of solar UV radiation
3. To study biological effect of ELF fields (on animals)
4. To study biological effect of strong magnetic fields(on animals)
5. To study monitoring of noise pollution
6. To study on water pollution
7. To study on soil pollution

Note:

1. In practical examination the student shall be required to perform **one** experiment.
2. Addition or deletion in the above lists may be made in accordance with the facilities available with the approval of H.O.D. Physics

| M. Sc. II Year | | MPH-E411 | | | Semester-IV |
|---------------------|--|--|---|--------------------|---------------|
| ELCETIVE PAPER IV/V | | PHYSICS OF NANO MATERIALS | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Nanostructures & Structural Characterization : History – background – nanoscale in one dimension, two dimensions, three dimensions – Synthesis of oxide nanoparticles (Sol-gel processing), metallic nanoparticles: semiconductor nanoparticles, fabrication of core – shell nanostructures – aerosol synthesis – gas phase synthesis of nanoparticles – Structural characterization – X-ray diffraction – STM, Atomic force microscopy, properties of nano materials.

UNIT II

Carbon Nanotubes : Carbon allotropes – types of carbon nanotubes – graphene sheet to single walled carbon nanotubes – electronic structure of carbon nanotubes – synthesis of carbon nanotubes: electric arc discharge method – laser method – electrolysis – pyrolysis of hydrocarbons – Fluidised bed CVD method – solar production of CNT – purification methods – properties – filling of CNT – fullerene – purification – properties – application of CNT .

UNIT III

Quantum Heterostructures: Introduction – heterostructure – growth of heterostructure: molecular beam epitaxy – metal organic chemical vapour deposition – heterojunction band alignment – quantum well – superlattice – low dimensional system – doped heterostructures: modulation doping – quantum wells in heterostructures – effective mass theory in heterostructures – application of effective mass theory in quantum wells in heterostructures – optical confinement – application of heterostructures.

UNIT IV

Quantum wires & Quantum dots: Introduction – size effects - preparation of quantum nanostructures – Fermi gas and density of states – calculation of density of states – infrared detector – quantum well lasers – quantum cascade laser – nanowires – production, structure and uses of nanowires – quantum dots: fabrication techniques – electronic properties - application of quantum dots: information storage – infrared photodetector – laser.

UNIT V

Magneto Electronics and Applications of Nano Technology:

Magnetism in nanocrystals – Nanocrystalline soft magnetic materials – Columb blockade – single electron transistor – quantum cellular automata – fabrication – Spintronics – giant magnetoresistance – Quantum Hall effect – Quantum spin Hall effect – fractional quantum Hall effect – application of nanotechnology – medical application of molecular nanotechnology.

BOOKS FOR REFERENCE

1. Optical Properties of Semiconductor Quantum Dots, U. Woggon Springer Verlag.
2. Nanophysics edited by Dr. Sr. Gerardin Jayam.
3. Transport in Semiconductor nanostructure, D. Ferry and S. Goodnick, Cambridge University Press, 1997.
4. Nanotechnology in Carbon Materials, M. S. Dresselhaus and R. Salio .
5. Advanced Magnetic nanostructures, K. P. Awasthi, Cyber Tech Publications, 2008.
6. Introduction to Nanotechnology , Charles P. Poole Jr, Frank.J.Owens, Wiley India Pvt. Ltd, 2008.

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

| | |
|-------------|--|
| CO 1 | Acquire an insight into the synthesis of nano materials.. Acquire knowledge of basic approaches Synthesis of oxide nanoparticles etc. |
| CO 2 | Demonstrate the stages of thin film formation and can outline the conditions for the formation of amorphous, crystalline and epitaxial films. |
| CO 3 | Understand the construction, types, physical and chemical properties of nanotubes. |
| CO 4 | Assimilate the principle, construction and working knowledge of spectroscopic techniques like X-ray diffraction – STM, Atomic force microscopy, properties of nano materials |

**Course Articulation Matrix
Mapping of Course Outcomes (COs) With Programme Outcomes (POs)
and Programme Specific Outcomes (PSOs)**

| CO-PO Matrix: Solid State Physics MPH-E 411 | | | | | | | | | | | |
|--|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO 1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| CO 4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |
| Average CO (MPH-E411) | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 |

| M. Sc. II Year | | MPH-E412 | | | Semester-IV | |
|---------------------|--|--|---|--------------------|---------------|--|
| ELCETIVE PAPER IV/V | | ELECTRONIC DEVICES | | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits | |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 | |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Transistors: JFET, BJT, MOSFET and MESFET– Structure – Working – Derivations of the equations for I-V characteristics under different conditions – High Frequency limits.

UNIT II

Photonic Devices: Eradicative and non radiative transitions – Optical absorption- Bulk and thin film – Phtotoconductive devices(LDR) – diode photodetectors – solar cell – (open circuit voltage and short circuit current, fill factor) – LED (high frequency limit – effect of surface and indirect combination current, operation of LED) – diode lasers (conditions for population inversion in active region, line confinement factor) – Optical gain and threshold current for lasing – Fabry-Perrot cavity length for lasing and the separation

UNIT III

Memory Devices: Static and Dynamic random access memories SRAM and DRAM – CMOS and NMOS – non-volatile – NMOS – magnetic – optical and ferroelectric memories – charge coupled (CCD)

UNIT IV

Other Electronic Devices : Electro-optic – Magneto-optic and Acousto– Optic effects – Material properties related to get these effects – Important Ferro electric, Liquid Crystal and Polymeric materials of these devices – Piezoelectric – Electrostrictive and Magnetostrictive Effets - Important material exhibiting these properties and their applications in sensors and actuator devices. Acoustic Delay lines – piezoelectric resonators and filters – High frequency piezoelectric devices– Surface acoustic wave devices

UNIT V

Microwave Devices: Tunnel diode – Transfer electron devices (Gunn diode) – Avalanche transit time devices – Impatt diodes – parametric devices.

BOOKS FOR STUDY

- 1 . Semiconductor Devices- Physics and Technology, S.M. Sze, John Wiley & Sons, 1985
- 2 . Introduction to Semiconductors Devices, M.S. Tyagi, John Wiley & Sons, 1991
- 3 . Measurment, Instrumentation and Experiment Design in Physics and Engineering, M. Sayer and A. Mansingh, Prentice Hall, India, 2000.
- 4 . Optical Electronics, Ajoy Ghatak and K. Thyagarajan, Cambridge Univ. Press,1989

| | | | | | |
|----------------------------|--|--|---|--------------------|--------------------|
| M. Sc. II Year | | MPH-E413 | | | Semester-IV |
| ELCETIVE PAPER IV/V | | RENEWABLE ENERGY SOURCES | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Introduction : Primary and Secondary energy– commercial and non – commercial energy – renewable and non– renewable energy resources and their importance – world energy use– reserves of energy resources – energy cycle of earth – Indian energy scenario – Long term energy scenario for India – environmental aspects of utilization.

UNIT II

Solar Energy: Introduction– extra terrestrial solar radiation– radiation at ground level – collectors – solar cells – application of solar energy – Biomass energy – biomass conversion – bio gas production – ethanol production – pyrolysis and gasification – direct combustion – applications.

UNIT III

Wind Energy: Introduction – basic theory – types of turbines – applications
Geothermal energy – Introduction – geothermal resources types – resource base– application for heating and electricity generation– **Tidal energy –** Introduction – origin of tides – power generation scheme – **Wave energy –** Introduction – basic theory – wave power devices.

UNIT IV

Other Renewable Energy Sources: Introduction – open and closed OTEC cycles – biophotolysis – ocean currents – Hydropower – introduction – basic concept– site selection – types of turbine – small scale hydropower– Magneto hydrodynamics (MHD), Thermoelectric and Thermionic energy resources – basic principles – power generation – Nuclear energy – basic principle – power generation (basic ideas only).

UNIT V

Chemical Energy Sources: Introduction – Fuel cells–design and principle– classification – types–advantages and disadvantages – applications – Batteries– introduction – theory– different types of batteries arrangements – classification of batteries – advantages of batteries for bulk storage – Hydrogen energy – production– electrolysis – thermochemical methods – solar energy method – hydrogen storage.

BOOKS FOR REFERENCE

1. Solar Energies of Thermal Processes, A.Duffie and W.A.Beckmann, John-Wiley,1980.
2. Principle of Solar Engineering, F.Kreith and J.F.Kreider, McGraw-Hill,1978
3. Alternate Energy Sources, T.N. Veziroglu, Vol.5 and 6, McGraw –Hill,1978.
4. Solar Energy -Principles of Thermal Collection and Storage, *S P Sukhatme* and J K Nayak, Tata Mc Graw Hill.Tata, 2008
5. Non-Conventional Energy Sources, G.D. Rai, Khanna publishers, New Delhi,1984

| | | | | | |
|----------------------------|--|--|---|--------------------|--------------------|
| M. Sc. II Year | | MPH-E414 | | | Semester-IV |
| ELCETIVE PAPER IV/V | | OPTOELECTRONICS AND LASERS | | | |
| Total Lectures | Time Allotted for End Semester Examination | Marks Allotted for Continuous Assessment | Marks Allotted for End Semester Examination (ESE) | Maximum Marks (MM) | Total Credits |
| 60 | 3 Hrs | 30 | 70 | 100 | 04 |

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Light wave fundamentals: Electromagnetic waves -dispersion – pulse distortion – and information rate – polarisation- resonant cavities at plane boundary – critical angle – reflections.

UNIT II

Integrated wave guides: Dielectric slab guide – modes in the symmetric slab guide – modes in the asymmetric slab wave guide – coupling to the wave guide- integrated optical network.

UNIT III

Optic fiber wave guides : Step index fiber – graded index fibre – attenuation in fibers – modes in step index fiber – modes in graded index fibre pulse distortion and information rate in optic fibers – construction of optical fibers.

UNIT IV

Lasers : Emission and absorption of radiation- Einstein relations – absorption of radiation- population inversion – threshold conditions – laser losses - line shape functions – population inversion and pumping threshold conditions - Laser modes – Axial modes -Transverse modes- classes of laser - doped insulator laser - semiconductor laser - gas lasers - liquid gas lasers- single mode operation- frequency stabilization - mode locking - active mode-passive mode locking- Q-switching methods

UNIT V

Holography: Wavefront reconstruction – linearity of holographic process – image formation of holographic process – Gabor hologram – limitations – Recording the hologram – minimum reference angle – holography of three dimensions – practical problems in holography – types of holograms- Fresnel - Fraunhofer – transmission- reflection – rainbow multiplex- embossed and thick holograms - application of holography – holography interferometry – holography computer memories.

BOOKS FOR STUDY

1. Fiber Optic Communications, Joseph C. Palais, Prentice Hall Publications. IV Edition (Unit 1-3)
2. Optoelectronics, J. Wilson and J.F.B.Hawkes, Prentice Hall Publications,1989 (Unit 4)
3. Introduction to Fourier Optics, Joseph W.Goodman, McGraw Hill, Person Education II Edition, 1996. (Unit 5)

BOOKS FOR REFERENCE

1. Photonics Optical Electronics in Modern Communications, Amnon Yariv and Pochi Yeh, Oxford University Press, VI Edition, 2006
2. Optical Fibers and Fiber Optic Communication Systems, Subir Kumar Sarkar, S. Chand & Co

3. Introduction to Fiber Optics, *Ajoy Ghatak* and *K. Thyagarajan*, Tata McGraw Hill

| M. Sc. II Year | MPH-E460 | Semester-IV |
|-------------------------------|---------------------|--------------------|
| | DISSERTATION | |
| Report | | 100 |
| Viva-voce/Presentation | | 50 |
| Seminar (Internal)* | | 30 |
| Diary (Periodic sssessment)** | | 20 |
| TOTAL | | 200 |

The student is required to undergo a dissertation in the IV Semester. The course will be based on preliminary research oriented topics both in theory and experiment. The teacher who will act as supervisor for the dissertation will float topic of the dissertation and any one of them will be allotted to the student.

Supervisor for each student and topic of the dissertation shall be notified at the end of II Semester and the student will carry the work throughout the III and IV Semesters (second year). A departmental committee will approve the subject/topic of dissertation. The dissertation shall have to be submitted at the end of IV semester up to 10th May.

The student shall be required to maintain a diary showing the progress report of the dissertation, which will be submitted by him for examination and evaluation. The diary should be countersigned by the supervisor periodically.

The candidate can perform his dissertation work either at GKV Haridwar or at any other Organization/Industry approved by H.O.D. Physics. A person of the concerned Organization/Industry not below the rank of Assistant Professor can act as co-supervisor on the recommendation of Head /Manager of that Institution and approved by the departmental committee .

Course Outcomes (CO)

CO1 Identify the research problem by being aware to the current scientific issues.

CO 2 Develop ethics and skills regarding research methodology and techniques.

CO 3 Describe the results and findings and address the issues related to local/ national/ global challenges.

Course Articulation Matrix

Mapping of Course Outcomes (COs) With Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

| CO PO Matrix: Project (Dissertation) MPH-E460 | | | | | | | | | | | |
|--|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Average CO (MPH-E460) | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

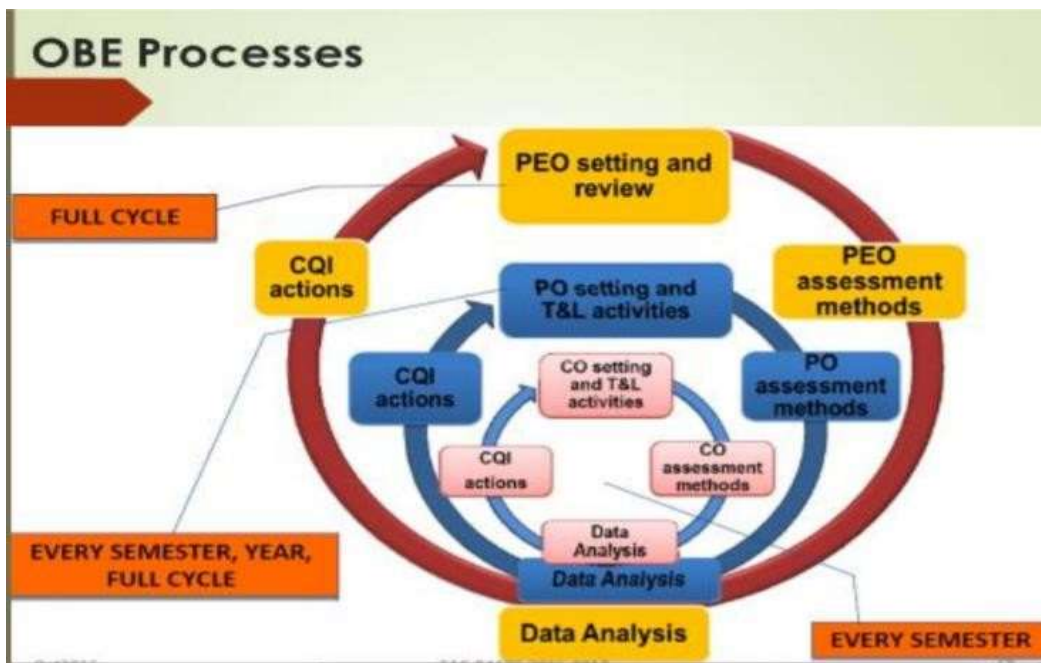
APPENDIX A

Outcome Based Education (OBE)

Outcome-based education means starting with a clear picture of what is important for students to be able to do, then organizing the curriculum, instruction and assessment to make sure that this learning ultimately happens

OBE means clearly focusing and organizing an educational system around what is essential for all students to be able to do successfully at the end of their learning experiences.

Students need to achieve by gaining Knowledge, Skill and Ability. For this to happen it is necessary to organize the curriculum, instruction, and assessment and make sure the learning ultimately happens.



APPENDIX B

Graduate Attributes

Graduate Attributes are the qualities, skills and understandings that the students should develop during their time with the Institution. These generic graduate attributes outline the overarching capabilities that will be developed by students. These qualities are intended to equip graduates to be global citizens, and effective members of society.

Intellectual rigour: a commitment to excellence in all scholarly and intellectual activities, including critical judgement.

Knowledge of the discipline: command of a discipline to enable a smooth transition and contribution to professional and community settings.

Communication and social skills: the ability to communicate and collaborate with individuals, and within teams, in professional and community settings.

Lifelong learning: the ability to be responsive to change, to be inquiring and reflective in practice, through information literacy and autonomous, self-managed learning.

Ethical practice: a commitment to sustainability and high ethical standards in social and professional practices.

Creativity: an ability to develop creative and effective responses to intellectual, professional and social challenges.

Cultural competence: an ability to engage with diverse cultural and Indigenous perspectives in both global and local settings.

APPENDIX C

Bloom's Taxonomy

REMEMBERING: recall of information

arrange; cite; collect; define; describe; duplicate; enumerate; find; identify; locate; memorize; record; recognize; match; relate; select; name; label; list; order; quote; recall; repeat; reproduce; select; show; state

UNDERSTANDING: demonstration of comprehension

associate; classify; compare; contrast; convert; describe; estimate; explain; extend; generalize; give examples; identify; interpret; justify; locate; outline; paraphrase; predict; recognize; report; restate; review; select; summarize; trace; translate

APPLYING: applying knowledge in a new context

apply; calculate; chart; choose; classify; complete; compute; construct; contribute; develop; discover; dramatize; employ; experiment; extend; illustrate; implement; instruct; interpret; modify; operate; participate; practice; predict; show; solve; teach; text; use

ANALYZING: supporting assertions through the use of evidence and arguments identifying causes and patterns

advertise; analyze; break down; categorize; classify; collect; compare; connect; contrast; correlate; criticize; diagram; differentiate; distinguish; divide; establish; explain; identify; illustrate; infer; investigate; order; outline; prioritize; question; select; separate; verify

EVALUATING: coming to a judgement on the value of information or the validity of arguments

appraise; argue; assess; choose; conclude; convince; criticize; critique; debate; decide; defend; determine; discriminate; evaluate; grade; integrate; interpret; judge; justify; predict; prioritize; rate; recommend; reframe; score; select; support; value

CREATING: combining or grouping knowledge to come to new conclusions

adapt; anticipate; arrange; assemble; collect; combine; compile; construct; decide; design; develop; facilitate; formulate; generate; generalize; imagine; incorporate; individualize; integrate; invent; modify; negotiate; organize; plan; propose; rearrange; reconstruct; reorganize; revise; select; structure; substitute; validate

[Verbs correlating to Bloom's Taxonomy drawn from <http://www.coun.uvic.ca/learn/program/hndouts/bloom.html>]