SCHEME OF EXAMINATION

AND

COURSE OF STUDY

CHOICE BASED CREDIT SYSTEM (CBCS)

M. Sc. (PHYSICS)

(w.e.f. 2020-2021)

DEPARTMENT OF PHYSICS
GURUKUL KANGRI VISHWAVIDYALAYA, HARIDWAR

GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR
M.Sc. PHYSICS SYLLABUS (w. e. f. 2020-21)
(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	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)

COURSE OBJECTIVES

1. To produce post graduates who excel in the competencies and values required for leadership to serve a rapidly evolving global community
2. To motivate the students to pursue Ph.D. courses in reputed institutes and to kindle the interest for research in students
3. To acquire placement in educational institutions, engineering, Govt sector, PSU and industrial firms.
4. To endow the students with creative and analytical skills; this will equip them to become entrepreneurs.

COURSE OUTCOME

1. To enhance the student's academic abilities, personal qualities and transferable skills which will give them an opportunity to develop as responsible citizens.
2. To define the basic laws involved in Physics
3. To understand the concepts and significance of the various physical phenomena.
4. To carry out experiments to understand the laws and concepts of Physics.
5. To apply the theories learnt and the skills acquired to solve real time problems.
6. To acquire a wide range of problem solving skills, both analytical and computational and to apply them.

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 syllbus. 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, Recurrsion relations, Orthogonality and generating functions, Associated Legendre polynomials. **(12 Lectures)**

UNIT-IV

INTEGRAL TRANSFORMS

First and second order shifting theorems, Fouriers series, Fourier integral, Fourier transformes (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.*

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 syllbus. 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 equatons 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 planatery 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 oscillaitons, 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 (Canbridge 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.*

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 syllbus. 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, Ehrenfet'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.

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 syllbus. 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- Lagranges interpolation formula, Errors in Lagranges interpolation formula,
Curve fitting - Least square curve fitting, Weighted least square approximation. **(12 Lectures)**

UNIT- III

NUMERCAL DIFFERENTIATION AND INTEGRATION

Numercal 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; Arithmatic, 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.*

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. Febry-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 Febry 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 semicondutor 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 syllbus. 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

Boundry 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- deceptive 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 noncondutors. 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. lassical 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

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 syllbus. 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 syllbus. 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 probaility, 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 symeteric 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 Coloumb field. **(12 Lectures)**

UNIT-IV

RELATIVISTIC QUANTUM MECHANICS

The Klien-Gordon equation, Dirac relativistic equation and its covariant form, Dirac equation for particle in E.M. field, Magnetic moment of electron, Existance 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- Interation 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.

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 syllbus. 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.

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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 filed 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, Varacter diode and tunnel diode, Transistor fundamentals, Transistor biasing, CE and CC amplifier and their small signal equivalanet circuits. **(12 Lectures)**

UNIT-II

FIELD EFFECT TRNASISTER (FET) AND FREQUENCY EFFECTS

FET and MOSFET device chracteristics, 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 differrential amplifier, DC and AC analysis of a differential amplifier, CMMR, The OP-AMP, OP-AMP DC offset characteristics, Freuqncy response, Slew rate and power bandwidth, Types of negative feedback: Non–inverting voltage feed back, Effect on input and output impedences, Non–inverting current feedback, Inverting voltage and current feed back, Band width, 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-ectronic 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.

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

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

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.
7. Experiment shall carry **40 Marks** and **20 Marks** shall be assigned for viva-voce examination. **10** Marks shall be reserved for practical record.
8. No batch for practical class shall consist of more than **20** students.
9. The number of students in a batch allotted to an examiner for practical examination shall not exceed **12-15** students.
10. 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 syllbus. 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

Thermodyanamic 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 disitribution 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, Feyman'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

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 syllbus. 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

Quantum states of an electron atoms, Atomic orbitals, Pauli's principle, Different series in alkali spectra, Term values and quantum defect, Ritz combination principle, Penetrating and non-penetrating orbits, Spin orbit interaction, Spectra of alkali and alkaline elements, Energy state of helium atom, Spectra of helium and mercury, Characteristics of X-ray spectra, Fine structure of X-ray levels, Spin relativity doublets, Flourescence yield and Auger effect. **(12 Lectures)**

UNIT-II

COMPLEX SPECTRA

Hamiltonian of complex spectra atom, L-S and J-J coupling, Term values in equivalent and non-equivalent electron systems, Hunde's rule, Lande interval rule, Energy level diagrams and selection rules in complex spectra, Regularities in complex spectra, Fine and Hyperfine structure of spectral lines, Zeeman effect, Paschan -Back effect and Stark effect. **(12 Lectures)**

UNIT-III

MOLECULAR BINDING AND ROTATION -VIBRATION SPECTRA

Molecular orbital method, The hydrogen melecule ion, Van der-Waals forces for H-atom, Born and Oppenheimer approximation, Rotational spectra of linear and diatomic molecules, Vibrating diatomic molecule, Molecule as anharmonic oscillator, Fine structure of vibration-rotation bands, Vibrational spectra of YX_2 type molecules, Isotope effects in vibrational bands. **(12 Lectures)**

UNIT-IV

ELECTRONIC AND RAMAN SPECTRA

Frank-Condon principle, Vibrational coarse structure, Rotational fine structure of electronic vibration transition, Raman spectra : Classical and quantum theory of Raman effect, Rotational Raman effect , Structure determination from Raman and IR spectroscopy. **(12 Lectures)**

UNIT-V

LASERS

Spontaneous and stimulated emission, Temporal and spatial coherences, Pumping process, Types of Laser:Solid state Laser (Ruby), Gas Lasers (Helium-Neon and Carbon dioxide) and Semiconductor laser (Ga-As), Population inversion, Properties of Laser beams, Laser Applications : Distance measurement, Laser interferometery, Holography. **(12 Lectures)**

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

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 syllbus. 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 arithmatic, 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 SEMICONDUTOR MEMORIES

A/D converters: Successive approximation A/D converters, Voltage to time A/D converter, Voltage to frequancy 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 with8085/8086 by Ramesh S. Gaonkar, Wiley-Eastern Ltd., 1987
4. Microprocesor and Interfacing ,Programmkimg and Hardware -Douglas V. Hall, second edition, Mcgraw Hill International Edition,1992.

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 syllbus. 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 impedence, 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 Commuincation system - Roden H.S., PHI
5. Analog and Digital Communication - Chakraborty, Dhanpat Rai
6. Advanced Electronics Communication Systems- Wayne Tomasi, PHI. Edn.

<table>
<tr><td colspan="2">M. Sc. II Year</td><td colspan="3">MPH-E305</td><td>Semester-III</td></tr>
<tr><td colspan="2">ELECTIVE PAPER- I</td><td colspan="3">FUNDAMENTAL ATMOSPHERIC PHYSICS</td><td></td></tr>
<tr><td>Total Lectures</td><td>Time Allotted for End Semester Examination</td><td>Marks Allotted for Continuous Assessment</td><td>Marks Allotted for End Semester Examination (ESE)</td><td>Maximum Marks (MM)</td><td>Total Credits</td></tr>
<tr><td>60</td><td>3 Hrs</td><td>30</td><td>70</td><td>100</td><td>04</td></tr>
</table>

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 syllbus. 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 warning 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 ULTRAVVIOLET 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 ultraciolet radiation: Action spectra and damage, Absorption by DNA and proteins;(Ozone in troposphere, Montrcal 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 syllbus. 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 adiabaic 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, collission-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 PressN.Yf. (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 indusreial)
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 EXPERIMETS

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 atmospherics
9. Effect of electrostatic field on mice and rates
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 syllbus. 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 NUCLEAR REACTIONS

Nucleon: nucleon interaction, Exchange forces and tensor forces, Meson theory of nuclear forces, Nucleon-nucleon scattering, Effective range theory- Spin dependence of nuclear forces, Charge independence and charge symmetry of nuclear forces, Iosospin formalism ,Yukawa interaction.

Direct and compound nuclear reaction mechanisms, Cross sections in terms of partial wave amplitudes, Compound nucleus, Scattering matrix, Reciprocity theorem, Breit-Wigner formula. **(12 Lectures)**

UNIT-II

NUCLEAR MODELS

Liquid drop model, Bohr-Wheeler theory of fission, Experimental evidence for shell effects, Shell model, Spin-orbit coupling, Magic numbers, Angular momenta and parities of nuclear ground states, Qualitaive discussion and estimates of transition rates, Magnetic moments and Schmidt lines, Collective model.

(12 Lectures)

UNIT-III

NUCLEAR DECAY

Alpha decay, Beta-decay, Fermi theory of beta decay, Shape of the beta spectrum, Total decay rate, Angular momentum and parity selection rules, Comparative half lives, Allowed and forbidden transitions, Selection rules, Parity violation, Two component theory of neutrino decay, Multipole transitions in nuclei : Angular momentum and parity, Selection rules, Internal conversion, Nuclear isomerism. **(12 Lectures)**

UNIT-IV

ELEMENTARY PARTICLES

Types of interaction between elementary particles, Hadrons and leptons, Symmetry and conservation laws, Elementary ideas of CP and CPT invariance, Classification of hadrons, Lie algebra, SU(2), SU(3) multiplets, Quark Model, Gell-Mann, Okubo mass formula for octet and decuplet hadrons, Charm, Bottom and top quarks. **(12 Lectures)**

UNIT-V

NUCLEAR INSTRUMENTATION

Ionization chamber, Geiger-Muller counter, Scintillation counter, Semiconductor detecctor, Bubble chamber, Spark chamber, Nuclear Emulsions, Cerenkov Counters, Van De Graff accelerator, Cyclotron, Phase stability principle, Synchrotrons, Colliding beam, Betatron, Basic introduction to large hadron collider (LHC).

(12 Lectures)

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 Experiemntal 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, 1975
8. Introduction to high energy Physics - P.H.Perkins, Addison-wesley, London, 1982
9. Quarks, Leptons - F. Halzen and A.D. Martin, John Wiley & sons, N York
10. Modern Elementary Particle Physics- G. Kare, Edition Wiseley

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 syllbus. 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 dimentional 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 semicondutor 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 impurites, 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 resonannce, Resonance, Flourescence, 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. Cryatallography for Solid State Physics- Verma & Srivastava
4. Introduction to Solids - Azaroff
5. Elementary Solid State Physics - Omar
6. Solid State Physics : Aschroft & Mermin
7. Principle of Condensed Matter Physics - Chaikim & Lubensky
8. Introduction to Solid State Physics-Paterson

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 syllbus. 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 freuquency shft keying (BFSK).

(12 Lectures)

UNIT-IV

MICROWAVE COMMUNICATION

Principle of velocity modulation, Reflex klystron and magnertron, 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 repeitition frequency, Antenna parameters, Radar transmitters and receivers.

Satellite communcations: 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 Commuincation 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	ELECTRCAL 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 syllbus. 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 stratospherie to the troposphere, Troposphric 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

WHETHER PREDICTION

Forecasting, Post processing, Refinements, Forecast quqlity; 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-Ronaid B. Stul,Brocks/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. Seinfield 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 EXPERIMETS

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 mircowave 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 (SO_2,CO_2,NO,O_3)
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 syllbus. 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 Verlog.
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.

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 syllbus. 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, Instrumention 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 syllbus. 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 syllbus. 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 DISSERTATION	Semester-IV
Report		**100**
Viva-voce/Presentation		**50**
Seminar (Internal)*		**30**
Diary (Periodic ssessment)**		**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 10^{th} May.

The student shall be required to maintain a diary showing the progress report of the dissertation, which will be submited 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 .