Syllabus

OF

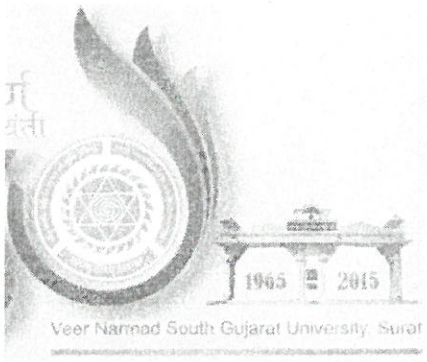
Course Work

for

MASTER OF SCIENCE (M.Sc.)

PHYSICS

Choice Based Credit System (CBCS)



DEPARTMENT OF PHYSICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY,
UDHANA MAGDALLA ROAD,
SURAT -395007. (GUJARAT)

Proposed Structure for M.Sc. Syllabus

Effective from June 2017

SEMESTER- I

M.Sc. (PHYSICS)

Sr. No.	Course Code	Course Title	L	T	Cr.
1	PH-411	Mathematical Methods of Physics	4	1	4
2	PH-412	Classical Mechanics	4	1	4
3	PH-413	Measurement and Statistical Mechanics	4	1	4
4	PH-414	General Electronics	4	1	4
5	PH-415	Practicals	9	1	8
			25	05	24

Faculty Code: **Science** Subject Code: **PH** Level Code: **04**

Name of Program: **M.Sc.** Subject: **PHYSICS**

External Examination Time Duration: **03 Hours**

Name of Exam	Semester	PAPER No.	Course Group	Credit	Internal Marks	External Marks	Total Marks
M.Sc.	1	PH-411	Core	04	30	70	100
		PH-412	Core	04	30	70	100
		PH-413	Core	04	30	70	100
		PH-414	Core	04	30	70	100
		PH-415	Practical	08	60	140	200
			TOTAL	24	180	420	600

DEPARTMENT OF PHYSICS, VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT -395007

M.Sc. Syllabus 2017
M.Sc. (Physics): SEMESTER-I

PH-411: Mathematical Methods of Physics

Unit 1 **Linear spaces**

Vector spaces and subspaces, Linear dependence and independence, Basis and Dimensions, linear operators, linear transformations

Unit 2 **Matrices and eigen values:**

Review of algebraic operations on Matrices, matrix representation, Similarity transformations, Inner product, Orthogonality, Unitary transformations, Eigen values & eigenvectors Diagonalization using Jacobi method

Unit 3 **Ordinary Differential Equations**

Solution in closed form: First order differential equations, Linear equations, Bernoulli's equation, Exact equation, Clairaut's equation

Second order differential equation: Homogeneous and inhomogeneous forms, variation of parameters method, changes of variable.

Power series solution: General consideration, Legendre' equations, Bessel's equation, miscellaneous approximate methods, the W K B method.

Unit 4 **Special functions**

Legendre functions,: Rodrigue's formula, Integral representation, Generating function, recursion relations, orthogonality of Legendre's polynomial, Associated Legendre's polynomial ,it's recursion relations and orthogonality.

Bessel functions: Generating function, recursion relations and orthogonality of Bessel's function, Hermite functions, spherical harmonics, Lagaurre's functions.

Unit 5 **Integral transforms**

Fourier transform, Parseval's theorem, Laplace transforms, Properties of Fourier and Laplaces transforms ,Convolution theorem, other transform pairs, applications of integral transforms.

Complex integration:

Residue and residue theorem, contour integration

Unit 6 **Probability distributions**

Binomial, poison and Gaussian distribution, properties of distributions

Group theory :an introduction, Subgroup and classes, Group representation ,Applications

Recommended Books

1. J. Mathews and R.L.Walker Mathematical Methods of Physics Benjamin (IBH) (1979)

2. H. Margenau and G.M. Murphy, Mathematics of Physics and Chemistry, East-West Press (1975).

3. P.M. Morse and H. Feshbach, Methods of Theoretical Physics, Vols. 1-2, McGraw Hill-Kogekusha (1953).

4. V.M. Trivedi, Ganitiya, Bhautikshashtra, Vol.3, Univ. Book Production Board, Ahmedabad (1974).

5. D.D. Desai, GAnitiya Bhautikshashtra, Vol.2, Univ. Book Production Board, Ahmedabad, (1978).

6. R.V. Churchill, Complex Variables and Applications, McGraw Hill, (1960).

7. Mathematical Methods - B S Rajput Pragati Prakashan, (1997)

8. Mathematical Methods for Physicists George Arfken, Hans Weber, Frank E. Harris, Academic Press, 7th Edition (2012).

Theory Tutorials
PH – 411: Mathematical Methods of Physics
(Discussion and problem solving/exercise sessions)

1. Applications of series solution method
2. Problems on matrix inversion
3. Problems on Eigen value equation
4. Application of W.K.B. method
5. Problems of method of separation of variables for PDE.
6. Addition theorem of spherical harmonics
7. Problems on Fourier transform
8. Problems on Laplace transform
9. Problems on Gaussian distributions
10. Problems on binomial distributions

In addition to above the tutorial will also consist of solving problems given in the text and reference books.

M. Sc. (Physics): Semester-I

PH-412:- Classical Mechanics

Unit-1 Newtonian Mechanics of Many Particle Systems

Review mainly through examples of Newton's laws of motion; mechanics of system of particles; conservation laws.

Motion in a Non-Inertial Reference Frame:

Rotating coordinate systems; Coriolis force; motion relative to earth; limitations of Newton's programme.

Unit-2 Lagrangian Formulation

Constraints; their classification; generalized coordinates; Calculus of variations; Hamilton's principle; Lagrange's equations of motion; cyclic coordinates; conservation theorems and symmetry properties; Rayleigh dissipation function; Lagrange equation with undetermined multipliers.

Unit-3 Central Force Problem:

Reduction of two body problem to one body problem; equation of motion and first integrals; equivalent one-dimensional problem; classification of orbits; differential equation for the orbit; power law potentials; Bertrand's theorem; Kelper's laws; Scattering in a central force field; Rutherford scattering cross section.

Unit-4 Rigid Body Motion:

Independent coordinates of a rigid body; Orthogonal transformations; transformation matrix; Euler-angles; Euler theorem; angular momentum; kinetic energy; moment of Inertia tensor; principal axis transformation; Euler's and Lagrangian treatment of rigid body motion; force free motion of a symmetrical top; motion of a heavy symmetrical top with one point fixed.

Unit-5 Small Oscillations:

Eigen-value equation and principal axis transformation; normal modes and normal coordinates for small oscillations; examples: Free vibrations of a linear tri-atomic molecule, coupled pendulums, double pendulum.

Hamilton's Equations of Motion:

Legendre transformation and Hamiltonian function; canonical equations of motion; examples; ignorable coordinates and conservation theorems; Cyclic coordinates and Routh's procedure; modified Hamilton's Principle.

Unit-6 **Canonical Transformations:**

I Generators of Canonical transformations, Equations of canonical transformations; examples; the Harmonic oscillator; The integral invariance of Poincaré and Lagrange and Poisson Brackets; Equation of Motion in Poisson bracket; Infinitesimal canonical transformation; constant of motion and symmetry properties; angular momentum Poisson brackets.

Hamilton-Jacobi Theory:

Hamilton-Jacobi equation; Hamilton's principal and characteristic function; examples; separation of variables in Hamilton-Jacobi equation; orbit equation for central force problem; periodicity and action angle variables, frequencies of periodic motion.

Recommended Books

1. H. Goldstein, Classical Mechanics, 3rd ed., Pearson education, 2002 / 2nd ed., Addison Wesley, 1980
2. J.B. Marion and S.T. Thronton, Classical Dynamics of Particles and Systems, 4th ed., Saunders College Publishing, 1995
3. N.C. Rana and P.S. Joag, Classical Mechanics, TMH, 1991.
4. Y. R. Waghmare, Classical Mechanics, PHI, 1990.
5. V. B. Bhatia, Classical Mechanics, Narosa Pub. House, 1997
6. R. G. Takwale and P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill, 1990
7. M. R. Spiegel, Theory & Problems of Theoretical Mechanics, Schaum's Outline Series.

Theory Tutorials (PH-412)

(These are mainly problem solving sessions. Concepts and other relevant aspects of theory course can also be discussed)

1. Solution of Mechanical problems with free body diagrams and use of Newton's laws; and conservation laws.
2. Examples of effect of Coriolis force and Foucault pendulum.
3. Examples of systems with different degrees of freedom; constraints.
4. Examples of Hamilton's principle
5. Examples of Lagragian formulation.
6. Motion of bodies under central forces which are not inverse-square.
7. Hard sphere scattering; problem on scattering.
8. Symmetric top using Euler's equations; moments of symmetric rigid bodies about their axis of symmetry.
9. Examples of small oscillations; normal modes.
10. Examples of Hamiltonian formulation.
11. Examples of canonical transformations.
12. Poisson bracket involving angular momentum.
13. Examples of Hamilton-Jacobi equations
14. Examples using action – angle variables and determination of frequencies.

M.Sc. Physics Semester-I

PH-413:- Measurement and Statistical Mechanics

Unit-1 Measurement System

Measurement, Definition of basic Terms, Calibration, The Generalized Measurement Systems, Static Characteristics - Some basic statistics, Static Sensitivity, Linearity, Threshold, Noise Floor, Resolution, Hystersis Scale Readability, spam, Dynamic Characteristics. Generalized Mathematical Model of Measurement System.

Unit-2 Transducers

Transducers, The Variable-Resistance Transducer, The Differential Transformer (LVDT), Capacitive Transducer, Piezoelectric Transducer, Photoconductive Transducer, Photovoltaic Transducer, Ionization Transducers, Hall-Effect Transducer, Digital Displacement Transducers, Problems.

Unit-3 Measurements of Different Physical quentity

Mechanical Pressure Measurement Devices, Low Pressure measurement, Ionization Gages, Dimensional Measurement, Force Measurement. Measurement of Viscosity, Humidity Measurement, pH Measurement, Detection of Nuclear radiation, Neutron Detection, Air Pollution standards.

Unit-4 Quantum Statistical Mechanics

The density matrix, quantum statistics of micro-canonical, canonical and grand canonical ensembles and their partition functions, system of indistinguishable particles, an ideal gas in a quantum mechanical micro-canonical, canonical and grand canonical ensemble, statistics of occupation numbers

Unit-5 Ideal Bose and Fermi systems

Thermodynamic behaviour of an ideal Bose gas, thermodynamics of blackbody radiation, elementary excitations of liquid He-II, Thermodynamic behaviour of ideal Fermi system,
Pauli para-magnetism

Unit-6 Interacting systems and phase transition

Cluster expansion of a classical gas, Mayer's cluster expansion, virial expansion of equation of state, evaluation of virial coefficients, cluster expansion of quantum mechanical system, gas of non-interacting particles, dynamical model of phase transitions, Ising model in zeroeth and first order approximation

Reference Books:

1. Measurement Systems - Application and Design.
   Earnest O. Doebein, Tata McGraw Hill Publication (5th Edition) (2004)
2. Experimental Methods for Engineers J.P. Homan.
   Tata McGraw Hill Publication (7th Edition) (2004)
3. Statistical Mechanics by R. K. Pathria and Baele, Academic Press, 3rd Ed.
4. Thermodynamics and Statistical Mechanics, Greiner, Neise and Stocker, Springer 199
   5.
5. Introduction to Statistical Physics, Kerson Huang (H), Taylor and Francis 2001.
6. Statistical Mechanics by Franz Schwabl, Springer 2010, 2nd Ed.

Theory Tutorials (PH-413)

1. Concept of Measurement
2. Errors
3. Uncertainty Analysis
4. Chi-square Test
5. Statistics of occupation number calculation of thermo dynamical quantities
6. Blackbody radiation and photon statistics
7. Evaluation of second virial coefficients.
8. Fluctuations of thermo dynamical variables

M.Sc.- (Physics)- Semester - I
PH-414 : General Electronics

Unit-1 **Network analysis**

Review of Thevenion, Norton and Superposition theorems, Mesh and Node circuit analysis, T-Network analysis, π-Network analysis, conversions between T-Network section and π-Network section, Bridged-T network, Matrices method, Determinants method

Unit-2 **Bipolar Junction Transistor**

DC Model, BJT as Switch, BJT as an Amplifier, BJT Small-Signal Model, Frequency response of an amplifier, Low frequency response, High frequency response, Bandwidth, Step response of an amplifier.

Unit-3 **Operational Amplifier:**

Basic operational amplifier, Operational amplifier with negative feedback, Voltage series feedback amplifier: close loop voltage gain, input resistance, output resistance, voltage follower. Voltage shunt feedback amplifier: close loop voltage gain, input resistance, output resistance, Inverter. Application of operational amplifier: Summing, Scaling and Averaging amplifier, Integrator and Differentiator circuit. Active filters: First order Low pass, High pass, and Band pass filters.

Unit-4 **Oscillators and Generators:**

Oscillators, Phase shift oscillator, Wien-Bridge oscillator, Basic Comparator, Comparator characteristic, Square wave generator, Triangular wave generator, Saw tooth wave generator, Voltage regulators.

Unit-5 **Combinational digital circuit design:**

Standard Gate Assemblies, Arithmetic Functions, Digital Comparator, Parity Checker-Generator, Multiplexer, De-multiplexer, Encoder, Decoder, Digital to Analog Converter, Analog to Digital Converter Tri-State buffer, Read Only Memory (ROM), ROM applications.

Unit-6 **Sequential digital circuit design:**

The clocked S-R flip-flop, D flip-flop, J-K flip-flop T flip-flop and M-S flip-flop, Shift Registers, A-stable Multivibrator, Bi-stable Multivibrator, Mono-stable Multivibrator, Counters, Applications of counters, 7-Segment display, Alpha-Numeric display, Multiplexed display system.

Recommended Books

1. J.D. Ryder, Electronic Fundamentals and Applications Prentice Hall of India, (1981).
2. A Mottershed, Electron Devices and Circuits Prentice Hall of India, (1981).
3. J. Millmann and A grabel, Microelectronics, Mc Graw Hill, (1987).
4. A.S. Sedra and R.C. Smith, Microelectronics Circuits Oxford Press (1996).
5. R.A. Gaikwad, Op. Amps and linear Integrated circuits, Prentice Hall of India.

Theory Tutorials (PH-414)

1. Transistors, h-parameters
2. Feedback Amplifiers
3. Applications of Timer IC 555
4. Digital system designing
5. Electronic Instruments C.R.O., A.F.O., Multimeters, DMM, VTVM

M.Sc.- (Physics)- Semester - I
PH-415: Practicals

1. Numerical Analysis-I
2. Numerical Analysis-II
3. Computer Experiment –I
4. Normal Mode
5. Fourier Analysis
6. e/m Helical Method
7. Hall Effect
8. Ultrasonic Interferometer
9. Transducers-I
10. Measurement of Wavelength of Laser by diffraction Method.
11. Measurement of Electrical Conductivity of Graphite.
12. Measurement of Energy Band Gap of a Semiconductor.
13. Characteristics of DIAC, TRIAC
14. Study of Inter conversion of 'π' and 'Ţ' Network
15. To design, build & Test relaxation Oscillator using UJT.
16. To design, build & Test Inverting and non-inverting Amplifier using Operational Amplifiers.
17. To design, build & Test combinational Logic circuit using only NAND/ NOR Gates.
18. To design, build & Test 04- bit Up/Down counter using IC 7493.

Syllabus

OF

Course Work
for

MASTER OF SCIENCE (M.Sc.)
PHYSICS

Choice Based Credit System (CBCS)

DEPARTMENT OF PHYSICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY,
UDHANA MAGDALLA ROAD,
SURAT -395007. (GUJARAT)