

**VEER NARMAD SOUTH GUJARAT UNIVERSITY,  
DEPARTMENT OF PHYSICS  
SURAT- 395 007 (GUJARAT)  
Revised Syllabus (Effective from June-2010)**

**M.Sc. (PHYSICS)  
Structure for Semester I**

**FIRST SEMESTER:**

Course No.	Title	Theory / Lab. Hours per week			External Exam. Marks	Internal Marks	Total Marks
		Theory	Tutorial	Total Hours			
PH-411	Mathematical & Computational Physics	04	01	05	70	30	100
PH-412	Classical Mechanics	04	01	05	70	30	100
PH-413	Measurement & Experimental Planning	04	01	05	70	30	100
PH-414	General Electronics	04	01	05	70	30	100
PH-415	Practicals	09	01	10	140	60	200

**Practicals :** 14 to 16 Practicals in each semester will be given in the Laboratory Work.

**DISTRIBUTION OF INTERNAL MARKS:**

For each Theory Papers :	Weight age of Marks
1. One Unit Test per Semester	15
2. One Tutorial Test per Paper Per Semester	10
3. One Assignment per Paper Per semester	05
Total	30

For each Practical Course :	Weight age of Marks
1. One Practical Test per Semester	30
2. Assessment of Journal Per Semester	10
3. Viva Voce Examination Per Semester	20
Total	60

## M.Sc. (Physics) : Semester - I

### PH-411 : Mathematical Methods in Physics

#### Unit - 1 :

##### Ordinary Differential Equations:

Solution in closed form, power series solution, miscellaneous approximate methods, the W K B method.

#### Unit - 2 :

##### Integral Transforms:

Fourier transforms, Laplace transforms, other transform pairs, applications of integral transforms.

#### Unit - 3 :

##### Special Functions:

Legendre functions, Bessel functions, hypergeometric functions, confluent hypergeometric functions. Hermite functions, spherical harmonics, Laguerre's functions.

#### Unit - 4 :

##### Partial Differential Equations:

Examples, general discussion, separation of variables, integral transform method.

##### Evaluation of Integrals:

Review of residue theorem, contour integration and evaluation of definite integrals, conformal mapping.

#### Unit - 5 :

##### Numerical Methods:

Finite differences, difference tables, interpolation, roots of equations.

##### Probability Distributions:

Binomial, poisson and Gaussian distribution, properties of distributions, fitting of experimental data.

#### Unit - 6 :

##### Group Theory:

Introduction to groups and group representations, definitions, sub-group and classes, group representation, characters, physical applications, infinite groups, SU(2), SU(3).

### **Recommended Books**

1. J. Mathew & 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 Physics, B.S. Rajput Pragati Prakashan, 1997.

### **Theory Tutorials (PH-411)**

(These are problem solving and discussion sessions. Concepts in theory and related aspects can be discussed).

1. Applications of series solution method
2. Application of W.K.B. method
3. Problems of method of separation of variables for PDE.
4. Problems of hypergeometric and confluent hypergeometric functions.
5. Addition theorem of spherical harmonics
6. Residue theorem applications
7. Contour integration
8. Evaluation of definite integrals using contour integration.
9. Problems on numerical methods
10. Problems on distributions
11. Constructing character tables
12. Representation theory of groups
13. SU (2), SU (3) – applications

**M. Sc. (Physics) : Semester-I**  
**PH-412 : Classical Mechanics**

**Unit - 1 :**

**Newtonian Mechanics of One and 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; equivalence of Lagrange's and Newton's equations; cyclic coordinates; conservation theorems and symmetry properties; Velocity dependent potential of electromagnetic field and the Rayleigh dissipation function; Lagrange undetermined multipliers; simple examples of Lagrange formulation.

**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.

**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 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;

### **Hamilton's Equations of Motion:**

Legendre transformation and Hamiltonian function; canonical equations of motion; examples; ignorable coordinates; Routh's procedure; principle of least action.

## **Unit - 6 :**

### **Canonical Transformations:**

Equations of canonical transformations; examples; the Harmonic oscillator; Lagrange and Poisson Brackets; 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; action angle variables.

## **Recommended Books**

1. H. Goldstein, Classical Mechanics, 3<sup>rd</sup> ed., Pearson education, 2002 / 2nd ed., Addison Wesley, 1980.
2. J.B. Marion and S.T. Thornton, 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 Lagrangian 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 Experimental Planning**

#### **Unit-1 :**

##### **Measurement :**

Aims of measurement, experimental planning, Types of experiment Design Factors, Experiment Design Protocol and examples. Report writing some General comments, Types of Reports, Contents of a Report.

#### **Unit-2 :**

##### **Transducers :**

Transducers, The variable-Resistance Transducer, The differential Transducer (LVDT), Capacitive Transducers, Piezoelectric Transducers, Photo electric Transducers, photovoltaic cells, Ionization Transducers, Hall Effect Transducers, Digital Displacement Transducers, Problems.

#### **Unit-3 :**

##### **Pressure measurement :**

Pressure measurement - Introduction, Mechanical Pressure-measurement Devices, Bourdon Tube, Diaphragm and Bellows Gages, Low pressure measurement, The McLeod Gage, Pirani Thermal conductivity Gage, Knudsen Gage, Ionization Gage, Alphatron.

#### **Unit-4 :**

##### **Temperature measurement & other Physical Quantity :**

Temperature measurement -Introduction, Temperature Scales, Temperature measurement by Mechanical Effect, Temperature measurement by Electrical Effect, Temperature measurement by Radiation. Thermocouple compensation, Thermal conductivity measurement, Measurement of Viscosity, Humidity measurement, pH measurement.

#### **Unit-5 :**

##### **Strain Measurement :**

Stress and strain - Strain Measurement, Electrical Resistance Strain Gages, Measurement of Resistance Strain-Gage outputs, Temperature compensation, strain gage Rosettes. The unbounded Resistance strain Gage.

## **Unit-6 :**

### **Radiation Measurement**

Detection of Thermal Radiation, Measurement of Emissivity, Reflectivity and Transmissivity measurements, solar Radiation Measurements, Detection of Nuclear Radiation, The Geiger-Muller Counter.

### **Reference Books**

1. J.P. Holman, Experimental Methods for Engineers, Tata-McGraw Hill (seventh Edition 2004)

### **Theory Tutorials (PH-413)**

1. Concepts of Measurement
2. Errors
3. Uncertainty Analysis
4. Chi-square test
5. Graphical Analysis
6. Proof Reader's Marks.

## M.Sc.- (Physics)- Semester - I

### PH-414 : General Electronics

#### Unit-1 :

##### Bipolar Junction Transistors:

The ideal current-controlled source, the function Transistor, The Eber-Moll representation of the BJT, The BJT as a switch, The EJT Small signal Model, Transistor Ratings.

#### Unit-2 :

##### FIELD EFFECT TRANSISTORS :

The ideal voltage- controlled current source, The function field-Effect-Transistor, The JFET Volt Ampere characteristics, The JFET Transfer characteristics, The MESFET, The FET as a switch small-signal FET Models, Advantages and disadvantages of the FET.

#### Unit-3 :

##### Integrated amplifiers :

The differential amplifier rejection of common mode signals, a constant current replacement of  $R_E$ , DC level shifter, a complementary output stage, the operational amplifier, input and out impedances, Ideal characteristics of op-Amp adding operation, integration operation, analog computation, logarithmic amplifier, Simulation of inductance.

#### Unit-4 :

##### Basic digital circuits :

Logic Systems, The Exclusive-OR, NOR and NAND gates, Logic Gate characteristics, The TTL NAND Gate, TTL logic families, comparison of Logic Families.

#### Unit-5:

##### Combinatorial Digital Circuits :

Standard Gate Assemblies, Binary Adders, Arithmetic Functions, Digital Comparator, Parity Checker-Generator, Decoder- Demultiplexer, Data selector, Multiplexer, Encoder, Read only Memory (ROM), ROM applications.

## **Unit-6:**

### **Sequential Circuits and Systems :**

A 1-bit Memory, The circuit properties of a Bistable Latch, The clocked S-R FLIP FLOP, J-K, T and D type FLIP-FLOP, shift Registers Ripple counters, Applications of counters.

### **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.

### **Theory Tutorials (PH-414)**

1. Transistors, h-parameters
2. Feedback Amplifiers
3. Oscillators
4. Multivibrators
5. Electronic Instruments C.R.O., A.F.O., Multimeters, DMM, VTVM

## **M.Sc.- (Physics)- Semester - I**

**PH-415**

### **Practicals**

1. Numerical Method -I
2. Numerical Method -II
3. Fourier Analysis
4. e/m Helical Method
5. Computer Experiment -I
6. Hall Effect
7. Ultrasonic Interferometer
8. Electrical Conductivity of Graphite
9. Michelson's Interferometer
10. 'e' by Millikan's Oil drop Method
11. Normal Mode
12. Operational Amplifier -I & II
13. To design, build & test Oscillator using UJT.
14. To design, build & test 4-bit Multiplexer
15. To design, build & test One Stage FET Amplifier
16. To design, build & test NAND Gate as Universal Gate