VANITA VISHRAM WOMEN'S UNIVERSITY

SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF PHYSICS

MASTER OF SCIENCE (M.Sc.) PHYSICS PROGRAMME

SEMESTERS 1

Syllabus applicable to the students seeking admission in

M.Sc. Physics

w.e.f. the Academic Year 2021-2022

1. Preamble – VVWU

Vanita Vishram Women's University (VVWU) is the First-ever Women's University of Gujarat approved by the Government of Gujarat under the provisions of the Gujarat Private Universities Act, 2009. It is a University committed to achieve Women's Empowerment through Quality Education, Skill Development, and by providing employment opportunities to its girl students through its model curriculum, integration of technology in pedagogy and best-in-class infrastructure. The focus is on prioritizing practical component and experiential learning supported through academia-industry linkages, functional MoUs, skill development training, internships etc. It aims at providing opportunities to the girl students for holistic development and self-reliance.

VISION

Empowerment of women through quality education and skill development, so as to make them strong pillars of stability in the society.

MISSION

To provide Education & Professional Training to all women for their all-round development, so as to enable them to become economically independent and socially empowered citizens.

2. Introduction of the Programme

Physics is essentially one of the most fundamental scientific disciplines, and its main goal is to understand how the universe behaves. It seeks to understand natural phenomena in a quantitative manner, and to answer some of the oldest and deepest questions ever asked by human beings. Master of Science (M.Sc.) in Physics is one of the most preferred academic degree courses after graduating with Physics as a major subject.

Vanita Vishram Women's University (VVWU) is the First-ever Women's University of Gujarat proposed under Public-Private-Partnership with the Government of Gujarat under the Gujarat Private Universities Act, 2009. VVWU is committed to provide quality education and employment opportunities to its girl students through its revamped curriculum and pedagogy. Various courses at undergraduate and postgraduate level have been started under VVWU. We have state-of-the-art laboratories for conducting the various laboratory classes. We also have ICT-enabled classroom facilities to provide the students with the best learning experience.

3. Programme Specific Objectives (PSOs)

- ☞ The students are expected to understand the fundamentals, principles, physical concepts and recent developments in the subject area.
- ☞ The student can understand the role of Physics in society and has a background to consider ethical problems.
- ☞ To create an ample amount of prospects for the students in various fields like academics, industry, research organization, consultancy, defense and entrepreneurial pursuit at national and international level.
- ☞ To prepare students to take up challenges as a researcher in diverse areas of theoretical and experimental physics.
- ☞ Create the environment to perform the high end research through Dissertation work.
- ☞ To develop the scientific research approach among students, in defining problems, execution through analytical methods, and systematic presentation of results keeping in line with the research ethics through dissertations.

4. Programme Specific Outcomes (PSOs):

After the completion of the course student will:

PSO-1. Have proficiency in various mathematical concepts for the proper understanding of application in all physical systems especially in Nuclear physics, Statistical Mechanics, Spectroscopy, Electronics, Electromagnetism, Materials Science, Classical and Quantum Mechanics.

PSO-2. Have fundamental and advanced level knowledge in various subjects of physics such as advanced mathematical physics, classical mechanics, quantum mechanics, statistical mechanics, nuclear and particle physics, solid state physics, materials science and electronics.

PSO-3. Learn the laboratory skills, enabling measurements in a Physics Laboratory and analysis of the measurements to draw valid conclusions.

PSO-4. Have fundamental and advanced level knowledge in physics so as to handle the computational tools and scientific software.

PSO-5. Get opportunities to acquire or develop skills and expertise, a comprehensive understanding of techniques, and a thorough knowledge of the literature, applicable to their own research.

PSO-6. Have cross cultural competency exhibited by working as a member or in teams.

5. Structure of the Programme:

Sem-1	Sem-2	Sem-3	Sem-4
Core Course-I	Core Course-VII	Core Course-XII	Core Course -XVII
Core Course-II	Core Course-VIII	Core Course-XIII	Core Course -XVIII
Core Course-III	Core Course-IX	Core Course-XIV	Core Course-XIX
Core Course-IV	General Elective-I	Departmental Elective-I Or Departmental Elective-I	Departmental Elective-V Or Departmental Elective-VI Or Departmental Elective-VII
Core Course -V Practical	Core Course -X Practical	Departmental Elective-III Or Departmental Elective-IV	Core Course -XX Practical
Core Course -VI Practical	Core Course -XI Practical	Core Course-XV Practical	Core Course -XXI Dissertation
		Core Course-XVI Project Work	

6. Structure of the Course:

Sem-1	Sem-2	Sem-3	Sem-4
Mathematical Methods of Physics (4+1)	Quantum Mechanics-I (4+1)	Quantum Mechanics-II (4+1)	Nuclear & Particle Physics (4+1)
Classical Mechanics (4+1)	Statistical Mechanics (4+1)	Condensed Matter Physics (4+1)	Modern Optics (4+1)

Computational Physics (4+1)	Electrodynamics and Plasma Physics (4+1)	Atomic and Molecular Physics (4+1)	Molecular Spectroscopy OR Experimental Techniques for Material Characterization OR Solar Photovoltaics (3+1)
Electronics (4+1)	Introduction to Nanoscience and Nanotechnology (3+1)	Material Science OR Advanced Electronics (3+1)	Physics Experiments Lab-VI (4+1)
General Physics Lab-I (4)	General Physics Lab-II (4)	Atomic and Laser Spectroscopy OR Thin Film Physics & Vacuum Technology (3+1)	Dissertation (12)
Electronics Lab-I (4)	Electronics Lab-II (4)	Physics Experiments Lab-V (4)	-
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7. Course Objectives – Course Outcomes – Course Contents

SEMESTER-1

CC1 MATHEMATICAL METHODS OF PHYSICS
(PH21010)

Credits: 4 (Theory) + 1 (Learning Outside the Class)
Contact hours per week: 4

Course Objectives:

- ☞ The main objective of the course is to introduce students to various methods of mathematical physics to solve problems in classical mechanics, quantum mechanics, electrodynamics and many other related fields.

Prerequisites:

Before taking up this course, students should have basic knowledge of:

- ✓ Determinants
- ✓ Matrix Algebra
- ✓ Differential Equations and their solutions
- ✓ Basic Vector Analysis
- ✓ Cartesian and Polar Coordinate Systems

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Matrices**	12	20
2.	**Integral (Fourier) Transform**	15	25
3.	**Integral (Laplace) Transform**	17	28
4.	**Curvilinear Coordinates and Tensor Analysis**	16	27
	Total	**60**	**100**

Course outcome:

CO-1. Upon completion of the course, the student should be able to
CO-2. Understand the phenomena of different types of matrices
CO-3. Understand the concept of integral transformation and its implementation to solve various physics problem.
CO-4. Gain the knowledge of Curvilinear Coordinates and Tensor Analysis for their use to solve variety of physics problem.

M.Sc. Physics Semester-1

Subject	Hours
CC1 MATHEMATICAL METHODS OF PHYSICS	**4 Hours /week**
Topic	**Hours**
Unit – I	
Matrices: Rank of matrix, Eigen Values, Caley-Hamilton Theorem, Eigen Vectors, Orthogonal Vectors, Diagonalisation of a Matrix, Powers of matrix by Diagonalisation, Transpose of a Conjugate Matrix, Hermitian and Skew Hermitian Matrix, Periodic and Idempotent Matrix, Unitary Matrix.	**12**
Unit – II	
Integral Transforms (Fourier Transform): Introduction, Types of Integral Transforms Fourier Integral Theorem, Fourier Transform, Fourier SINE and COSINE Transforms, Examples of Fourier Transform in Physics: The Uncertainty Principal, Fraunhofer diffraction; Properties of Fourier Transforms, Convolution, Fourier Transform of derivatives, Relationship between Fourier and Laplace Transforms, Fourier Transforms of Partial Derivative of a function, Applications: Partial Differential Equation, Heat Conduction	**15**
Unit – III	
Integral Transforms (Laplace Transform): Introduction, Laplace Transform, Important Formulae, Properties of Laplace Transform, Laplace Transform of the Derivative of f(t), Laplace Transform of Derivative of Order n, Laplace Transform of Integral of f(t), Evaluation of Integrals, Inverse Laplace Transforms, Important Formulae, Inverse Laplace Transforms of Derivatives, Inverse Laplace Transforms of Integrals. Applications of Laplace Transform: Periodic Function, Convolution Theorem, Harmonic Oscillator, Solution of Differential Equations By Laplace Transform, Electric Circuit, Solution of Heat Flow.	**17**
Unit – IV	
Curvilinear Coordinates: Curvilinear Coordinates, Vector Operators In Orthogonal Curvilinear Coordinates, Non-Cartesian Tensors **Tensor Analysis:** Introduction, Cartesian Tensors, Tensor Notation and Operations, Inertia Tensor, Kronecker Delta and Levi-Civita Symbol, Pseudovectors and Pseudotensors, Applications: Stress Tensor, Stress-Strain and Hook's Law;	**16**

Note: In addition to above content, numerical solved/unsolved problems to be discussed from each unit.

Reference books:

1. Mathematical methods in the Physical Sciences By Mary L. Boas, 3rd Edition, John Wiley & Sons
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris-, 7th Edn. 2013, Elsevier.
3. Mathematical Physics by H.K.Das and Dr. Rama Verma, 8th Edition, S. Chand Publishing, New Delhi
4. Mathematical Physics by B.S. Rajput, 31st Edition, Pragati Prakashan, Meerut
5. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
6. An introduction to ordinary differential equations, E.A. Coddington, - 2009, PHI learning.
7. Differential Equations, George F. Simmons, - 2007, McGraw Hill.

SEMESTER-1

CC2 CLASSICAL MECHANICS
(PH21020)

Credits: 4 (Theory) + 1 (Learning Outside the Class)
Contact hours per week: 4

Course Objectives:

- ☞ To define and interpret the concepts of Lagrangian and Hamiltonian Mechanics.
- ☞ To explain the Canonical transformation & Poisson brackets.
- ☞ To illustrate the dynamics of a rigid body and non-inertial frames of reference.
- ☞ To formulate the method of Hamilton-Jacobi and action-angle variable techniques.
- ☞ Understanding the basics of non-linear dynamics in physics and their applications.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Lagrangian Formulation	18	30
2.	Hamiltonian Mechanics	15	25
3.	Rotational Dynamics of rigid body	13	22
4.	Theory of Small Oscillations	14	23
	Total	**60**	**100**

Course outcome:

CO-1. Understanding the drawback of Newtonian formulation of mechanics. Construct Lagrangian for differential physical systems and Lagrange's equation of motion and solve it.
CO-2. Understanding the Hamiltonian formalism in solving physics problems and understand Poisson bracket method in tackling physical problems.
CO-3. Understanding the techniques for solving the problems of rigid body mechanics based on Lagrange's formulation.
CO-4. Understanding the Hamiltonian-Jacobi formulation and it's applications, solving simple problems based on action-angle variables. Understanding the basic features of non-linear dynamics.

M.Sc. Physics Semester-1	
Subject	**Hours**
CC2 CLASSICAL MECHANICS	**4 Hours /week**
Topic	**Hours**
Unit – I	
Lagrangian formulation: Mechanics of a system of particles (brief review), Constraints, Generalized coordinates, Principle of virtual work, D'Alembert's Principle and Lagrange's equations, Cyclic Co-ordinates, Calculus of variations and Derivation of Lagrange's equations form it, Conservation laws of Linear & Angular Momentum and Symmetry Properties. Application of Lagranges equation to Central force problem: Equivalent one-dimensional problem, General properties of Central Force Motion, Effective Potential, Classification of orbits, The differential equation for orbits, Kepler's Problem.	**18**
Unit – II	
Hamiltonian Mechanics: The Hamiltonian of a System, Hamilton's Equation of Motion, Derivation of Hamilton's equation from variation principle, Integrals of Hamilton's Equations, Canonical Transformations, Poisson Brackets, Equations of motion in Poisson Bracket Form, Angular momentum Poisson Bracket relations. Δ-Variation, The Principle of Least Action, Hamilton-Jacobi Theory: Hamilton-Jacobi Equation, Hamilton's Characteristic Function, Harmonic Oscillator problem.	**15**
Unit – III	
Rotational dynamics of Rigid Body: Introduction, Angular Momentum, Kinetic Energy, Inertia Tensor, Principal Axes, Euler's Angles, Infinitesimal rotations, Rate of change of vector, coriolis force, Euler's Equations of motion, Force free motion of symmetrical top	**14**
Unit – IV	
Theory of Small Oscillations: Equilibrium and Potential Energy, Theory of Small Oscillations, Normal Modes, Two Coupled Pendulum: Resonant Frequencies, Normal Modes; Longitudinal Vibrations of CO_2 Molecule: Normal Frequencies, Normal Modes, Normal Coordinates.	**13**

Note: In addition to above content, numerical solved/unsolved problems to be discussed from each unit.

Reference books:

1. Classical Mechanics By H. Goldstein, C. Poole and J. Safko, 3rd Ed., Pearson (2011).
2. Classical Mechanics By J.C. Upadhyay, ,Himalaya Publishing House, (2014).
3. Classical Mechanics By G. Aruldhas, PHI Learning Pvt. Ltd., (2008).

4. Introduction to Classical Mechanics By RG Takwale and PS Puranik, 1st Ed., McGraw Hill Education (2017).
5. Classical Mechanics By N. C. Rana and P.S. Joag, TMH (2017).
6. Classical Mechanics By W. Greiner, 2nd Ed., Springer (2009).

CC3 COMPUTATIONAL PHYSICS
(PH21030)

Credits: 4 (Theory) + 1 (Learning Outside the Class)
Contact hours per week: 4

Course Objective:

☞ This course is intended to introduce the application of numerical methods for solving problem in physics.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Curve fitting and Interpolation**	15	25
2.	**Solution of algebraic and transcendental equations and Initial Value Problems for Ordinary Differential Equations**	15	25
3.	**Numerical Differentiation and Numerical Integration**	15	25
4.	**Boundary Value and Eigen Value Problems, Solution of Partial Differential Equations**	15	25
	Total	**60**	**100**

Course Outcome:

At the end of the course, the students will be able to

CO-1. Familiarize interpretation and curve fitting using numerical methods.
CO-2. Understand and use the appropriate method of numerical differentiation and integration to solve complicated problems in Physics.
CO-3. Demonstrate the use of different methods to find the solution of ordinary differential equation.
CO-4. Solve problems related to boundary value and Eigen value and understand the application of partial differential equation in physics.

M.Sc. Physics (Semester-1)	
Subject	**Hours**
CC3 COMPUTATIONAL PHYSICS	**4 Hours /week**
Topic	
Unit – I	
Curve fitting: Least square Fit- Straight line, Multiple linear regression, Polynomial regression, Exponential and Power Function, Goodness of a fit. **Interpolation**: Introduction, Interpolation with Evenly Spaced Points-Newton's Forward/Backward Difference Interpolation, Gauss's Forward/Backward Interpolation, Interpolation with Unevenly Spaced Points-Lagrange Interpolation, Newton's Divided Difference Interpolation and Spline Interpolation.	**15**
Unit – II	
Solution of algebraic and transcendental equations: Bisection Method, Method of False position, Newton-Raphson method, Gauss elimination method, Gauss-Jacobi Iteration Method, Gauss-Seidel Iteration Method **Numerical Solution of Ordinary Differential Equations**: Taylor's series method, Picard's methods, Euler's method, Runge-Kutta Methods.	**15**
Unit – III	
Numerical Differentiation: Introduction, Derivatives using Newton's Forward/Backward Difference Formula, Errors in Numerical Differentiation, maximum and minimum values of tabulated function. **Numerical Integration:** Introduction, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Error in Trapezoidal Rule, Simpson's 1/3 rule and Simpson's 3/8 rule, Numerical Integration with different step sizes.	**15**
Unit – IV	
Boundary Value and Eigen Value Problems: Shooting method, Finite difference method, Solving Eigenvalue problems, Power method, Finite element method. **Solution of Partial Differential Equations**: Solution of Laplace and Poisson equations, Solution of Heat conduction equation, Bender- Schmidt method, Solution of wave equation.	**15**

References Books:

1. Introductory Methods of Numerical Analysis by S.S. Sastry, 5th Edition, Prentice Hall (2012).
2. Numerical Methods by S.R.K. Iyengar and R. K. Jain, 6th Edition, New Age International Private Limited (2012)
3. S. C. Chapra and R. P. Canale, Numerical Methods for Engineers, Tata McGraw Hill (2002)
4. Numerical Methods by E. Balagurusamy, Tata McGraw – Hill (2000)
5. Numerical Analysis by Francis Scheid, 2nd Ed. McGraw-Hill (2009)

6. Numerical Methods for Scientists and Engineers by K Sankara Rao, 4th Ed. PHI (2018).
7. An introduction to Computational Physics by Tao Pang, 2nd Edition, Cambridge University Press (2006).
8. Computational Methods For Physics by Joel Franklin, 1st Edition cambridge university press (2013).
9. Numerical methods in Physics with Python by Alex Gezerlis, Cambridge University Press (2020).
10. Numerical methods by V. N. Vedamurthy and N.Ch. S. N. Iyengar, 1st Edition, Vikas Publishing House Pvt. Ltd (2015).

CC4 ELECTRONICS
(PH21040)

Credits: 4 (Theory) + 1 (Learning Outside the Class)
Contact hours per week: 4

Course Objective:

☞ The course is designed to understand the advanced topics of analog and digital circuits.

Prerequisites:

Before taking up this course, students should have basic knowledge of:

- ✓ Different types of logic gates
- ✓ Different types of logic operations
- ✓ Combinational logic circuit

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Operation Amplifier (Op-Amp), Op-Amp Circuits, Active Filters and Oscillators**	15	25
2.	**Flip-Flops**	15	25
3.	**Timing Circuit and Shift Register**	15	25
4.	**Counters, D/A Conversion and A/D Conversion**	15	25
	Total	**60**	**100**

Course Outcomes:

After the completion of this course,

CO-1. A student understands the fundamental concept of Op-Amp, Various Op-Amp circuit and its applications.

CO-2. A student also learns various types of Flip-Flops and its working operations. In addition to this, a student also studies about the conversation Flip-Flops and its various applications.

CO-3. A student understands the concept of timing circuit, shift register, counters and D/A Conversion and A/D Conversion and also able to Design different types of registers and counters.

M.Sc. Physics (Semester-1)	
Subject	**Hours**
CC4 ELECTRONICS	**4 Hours /week**
Topic	
Unit – I	
Operational Amplifiers (Op-Amp): Op-Amp Input Modes and Parameters, Negative Feedback, Op-Amps with Negative Feedback, Effects of Negative Feedback on Op-Amp Impedances, Bias Current and Offset Voltage **Op-Amp Circuits:** Comparators, summing amplifier, Integrators, Differentiator and Logarithmic amplifier. **Active Filters and Oscillators:** Basic Filter Responses, Filter Response Characteristics, Active Low-Pass Filters, Active High-Pass Filters, Active Band-Pass Filters Active Band-Stop Filters, Oscillators with RC Feedback Circuits, Oscillators with LC Feedback Circuits.	**15**
Unit – II	
Flip-Flops: Introduction to latches and Flip-Flops, S-R Latch using NOR and NAND, Gated/Enabled S-R and D Latches, Edge-Triggered Flip Flops (S-R, D, J-K and T- Flip Flops), Asynchronous Inputs, Master Slave or Pulse-Triggered Flip Flops (S-R, D, and J-K Flip-Flops), Conversion of Flip-Flops, Timing Diagram of Flip-Flops, Flip-Flop Operating Characteristic and Applications of Flip-Flops.	**15**
Unit – III	
Timing Circuit: Monostable (one stop) multivibrator, and Astable multivibrator **Shift Register:** Types of Registers, Serial In-Serial Out Shift Registers, Serial In-Parallel Out Shift Registers, Parallel In-Serial Out Shift Registers, Parallel In-Parallel Out Shift Registers, Bidirectional Shift Registers, Universal Shift Registers, Applications of Shift Register.	**15**
Unit – IV	
Counters: Asynchronous Counters, Synchronous Counters, Up/down synchronous counter and Shift Register Counters **D/A Conversion and A/D Conversion:** Variable, Resistor Networks, Binary Ladders, D/A Converters, D/A Accuracy and Resolution, A/D Converter-Simultaneous Conversion, A/D Converter-Counter Method, Continuous A/D Conversion.	**15**

Note: In addition to above content, numerical solved/unsolved problems to be discussed from each unit.

Reference books:

1. Electronic Devices by Thomas L. Floyd, 10th Edition, Pearson India (2008).
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, 4th Edition,Pearson Education (2015)
3. Fundamentals of Digital Circuits by Anand Kumar, 2nd Edition, PHI Learning (2009)
4. Digital Fundamentals by Thomas L. Floyd, 11th Edition, Pearson India (2015)
5. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Edition, Tata McGraw (2011)
6. Electronic Devices and Circuit Theory by Robert L. Boylestad, 11th Edition, Peason New International Edition (2014)
7. Electronic Principles by Albert Malvino, 7th Edition, McGraw Hill Education (2017)
8. Digital Electronics G K Kharate, Oxford University Press (2010).

CC5 GENERAL PHYSICS LAB-I

PH21050

Credits: 4 (Practical)
Contact hours per week: 8

Sr. No.	Name of the Experiment
1	Jacobi method of matrix diagonalization
2	To find the determinant of a matrix, its eigenvalues and eigenvectors.
3	Linear curve fitting and calculation of linear correlation coefficients
4	To analyze complex wave (square, clipped sine wave triangular wave etc.) and to verify the existence of different harmonics and measure their relative amplitudes using Fourier Analysis kit.
5	Numerical Integration By Trapezoidal Method
6	To determine the spot size of laser using knife edge
7	To determine energy and power of laser beam
8	To measure the diameter of a thin wire using (a) interference, and (b) diffraction and compare the results.
9	To study the polarization of light by quarter wave plate
10	Measurement of Acceptance Angle, Numerical Aperture and Attenuation Constant of Optical Fibre
11	B-H Curve: a. Study of the hysteresis curves of transformer stampings, ferrites and other magnetic materials of different shapes and determination of their energy losses. b. Determination of saturation, magnetization, remanence and coercivity of magnetic materials.
12	Determination of Young's Modulus and Ultrasonic Velocity in solids like metals/quartz/glass
13	Stefan's constant by the black copper radiation plates.
14	Determine the electrical charge of an electron by Millikan oil drop experiment and determine the value of e/m.
15	To determine the Landé g-factor in a free radical using an electron spin resonance spectrometer
16	To determine the speed of light in air.
17	To measure the wavelength separation of Sodium D-Lines
18	Coupled Pendulum: a. Study the characteristic frequencies of the uncoupled pendulum

	b. To determine the coupling factors for various coupling lengths, the angular frequencies or "in-phase" and "in opposite phase" vibration, and the angular frequencies of the beat mode. c. To determine the spring constant of the coupling spring.

Note: At least 12 Experiments from the above list to be performed.

SEMESTER-1

CC6 ELECTRONICS LAB-I

PH21060

Credits: 4 (Practical)
Contact hours per week: 8

Sr. No.	Name of the Experiment
1	Fabricate a DC regulated power supply of specific voltage using Zener Diode and transformer
2	Studies on the characterization of MOSFET
3	To study the truth table of half subtractor and full subtractor using logic gates also subtract two bits numbers
4	To study the truth table of half adder and full adder using logic gates also add two bits numbers
5	Wien's Bridge oscillator using operational amplifier
6	Characteristics and applications of Silicon Controller Rectifier
7	Diode pump staircase generator using UJT
8	Voltage Control oscillator using IC-566
9	Functional generator using IC-8083
10	Constant current source using OP-AMP
11	Design, build and test oscillator - LC oscillator
12	OP-AMP logarithmic amplifier
13	Voltage to Frequency/ Frequency to Voltage convertor using OP-AMP
14	Measurement of efficiency of a power amplifier (IC 810) and study of its frequency response
15	Study of Negative and Positive Feedback using Op-Amp
16	Study I-V and P-V characteristics for a photovoltaic module (Solar Cell) and to determine MPP (Maximum Power Point) and calculate fill factor and Efficiency of Solar Cell
17	Frequency response of RC coupled Amplifier.
18	Study of Inverting and Non-inverting Amplifier using Op-Amp

Note: At least 12 Experiments from the above list to be performed.

8. Teaching Methodology:

- Direct Instructions
    - Chalk and Talk
    - ICT based teaching
- Flipped Classroom
- Competency based learning
- Kinesthetic Learning
- Differentiated Instruction
- Personalised learning
- Inquiry-based Learning
- Expeditionary Learning
- Flipped Classroom
- Cooperative Learning
- Spaced Learning
- Use of maximum demonstration to explain theoretical concepts.

9. Glossary:

CC – Core Course
GEC – General Elective Course
DEC – Department Elective Course
(P) – Practical
PW – Project Work
DW - Dissertation

VANITA VISHRAM WOMEN'S UNIVERSITY

SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF PHYSICS

GENERIC ELECTIVE (GE) PHYSICS SYLLABUS

under

Learning Outcomes-based Curriculum Framework (LOCF)

for Under Graduate (UG) Education

SEMESTERS 1

Syllabus applicable to the students seeking admission in the under graduate program of any discipline

Under LOCF

w.e.f. the Academic Year 2021-2022

SEMESTER-1

MECHANICS AND PROPERTIES OF MATTER (Theory) (PH13010)

Credits: 4 (Theory) + 2 (Practical)
Contact hours per week: 4 (Theory) + 4 (Practical)

Objectives of the course:

- ☞ The emphasis of this course is to enhance the understanding of the basics of mechanics.
- ☞ By the end of this course, students should be able to solve the seen or unseen problems/numerical in mechanics.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Motion in two or three dimensions, Force and Motion, Work and Energy	14	23
2.	Centre of mass and Linear Momentum, Rotational Dynamics	18	30
3.	Gravitation and Central Force Motion, Non-Inertial Frame	14	24
4.	Kinematics of moving fluid, Equilibrium and Elasticity	14	23
	Total	**60**	**100**

Course outcome:

CO-1. Understand the motion in two or three dimensions, various Newton's laws of motion and relationship between work and energy.
CO-2. Explain the conservation of energy, momentum, angular momentum and apply them to basic problems.
CO-3. Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.

Sem-1 for the courses of all Disciplines	
Subject	**Hours**
MECHANICS AND PROPERTIES OF MATTER (Theory)	**4 Hours /week**
Topic	**Hours**
Unit – I	
Motion in two or three dimensions: Projectile Motion, Uniform Circular motion, Relative motion in one and two dimensions **Force and Motion:** Newton's first and second laws, some particular forces, Applying Newton's law, Friction, Drag forces and Terminal velocity. **Work and Energy:** Kinetic Energy, Work and Kinetic Energy, Work done by gravitational force and spring force, Work done by general variable force, Power, Potential Energy, Conservation of Mechanical Energy, Reading a potential energy curve, Work Done on a System by an External Force and Conservation of energy.	14
Unit – II	
Centre of mass and Linear Momentum: Centre of mass, Newton's second law for a system of particles, Linear momentum, Collision and Impulse, Conservation of linear momentum, Momentum and Kinetic energy in collision, Collision in one and two dimensions, System with varying mass (A Rocket) **Rotational Dynamics:** Rotational variables, Rotation with constant angular acceleration, Relating the linear and angular variables, Kinetic energy of rotation, Calculation of rotational Inertia, Torque, Newton's second law for rotation, Work and rotational kinetic energy, Rotational and translational motion of rolling system, Forces and Kinetic Energy of rolling, Angular momentum, Newton's second Law in Angular form, Angular momentum of a rigid body, Conservation of angular momentum.	18
Unit – III	
Gravitation and Central Force Motion: Newton's law of gravitation, Gravitation and The Principle of Superposition, Gravitation near Earth's surface, Gravitation inside Earth, Gravitational Potential Energy, Kepler's laws of Planetary Motion, Orbits and Energy of Satellites, Einstein and Gravitation, Basic idea of global positioning system (GPS). **Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications.	14
Unit – IV	
Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. **Equilibrium and Elasticity:** Conditions for equilibrium, Centre of gravity, Stress-	14

Strain and Elastic Moduli, Stress-strain curve: Hook's law, elasticity & Plasticity; Elastic Potential Energy of strained body, Relations connecting the elastic constants, Poisson's Ratio, Determination of elastic constants in laboratory: Searle's method (Static and Dynamic), Maxwell's method, Poisson's ratio by Rubber Tube; Twisting couple on cylinder.	

Note: In addition to above content, numerical solved/unsolved problems to be discussed from each unit.

Textbooks:

1. Fundamentals of Physics by Haliday, Resnick & Walker, 11th Edition, Wiley (2018).

2. University Physics by F.W Sears, M.W Zemansky, H.D Young, 15th Edition (2019). Pearson

Reference books:

1. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
2. Concepts of Physics, Vol-1 By H.C. Verma, Bharti Bhavan Publishers & Distributors
3. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
4. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole

MECHANICS AND PROPERTIES OF MATTER (Practical)

(PH13020)

Credits: 2 (Practical)
Contact hours per week: 4 (Practical)

Objectives of the course:

- ☞ Students will learn the basics of errors in measurement and methods of rectifying the errors.
- ☞ Students will learn the calibration of the mechanical equipment in order to determine accurate measurement.
- ☞ Students will correlate the concepts of mechanics with the real time experiments and will draw the important conclusions.
- ☞ To provide hands-on experience to perform experiments to study some properties of matter and oscillations

Course Outcome:

CO-1. In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, vernier callipers, Travelling microscope) student shall embark on verifying various principles learnt in theory.

CO-2. Students will measure 'g' using Bar Pendulum, Kater pendulum and measuring elastic constants of materials, viscous properties of liquids etc. and will draw the conclusions.

Practical Code	Fundamentals of Physics Lab-I (Practical)
MECH-1	Measurements of length (or diameter) using vernier calliper, screw gauge and travelling microscope.
MECH-2	To study the random error in observations.
MECH-3	To determine the height of a building using a Sextant.
MECH-4	To study the motion of Spring and calculate (a) 'g' and (b) Modulus of rigidity.
MECH-5	To determine the moment of inertia of a flywheel.
MECH-6	To determine 'g' and velocity for a freely falling body using digital timing technique
MECH-7	To determine coefficient of viscosity of water by capillary flow method (Poiseuille's method).
MECH-8	To determine the Young's modulus of a wire by optical lever method.
MECH-9	To determine the modulus of rigidity of a wire by Maxwell's needle.

MECH-10	To determine the elastic constants of a wire by Searle's method.
MECH-11	To determine the value of 'g' using bar pendulum.
MECH-12	To determine the value of 'g' using Katter's pendulum.
MECH-13	To determine the Modulus of Rigidity of given wire using Tortional Pendulum
MECH-14	To determine the Young Modulus (Y) by bending of beam supported at the ends and loaded in the middle
MECH-15	To determine the Young Modulus (Y) using cantilever

Note: To be performed any 12 Experiments.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted, 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
4. Engineering Practical Physics, S. Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.