The University of Burdwan

Syllabus for 3-year Degree/ 4-year Honours
in
Physics
Under Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) as per NEP, 2020
with effect from 2023-24

SEMESTER WISE & COURSE WISE CREDIT DISTRIBUTION STRUCTURE UNDER CCFUP AS PER NEP, 2020

Semester	Course Type with Code	Level	Course Title	Credit	Lect.	Tuto.	Practical	Full Marks	Distribution of Marks		
									Theory	Prac-tical	Internal Assessment
I	Major/DS Course (Core) Code: PHYS1011	100-199	MATHEMATICAL PHYSICS-I	4	3	0	1	75	40	20	15
	Minor Course Code: PHYS1021	100-199	MATHEMATICAL PHYSICS-I	4	3	0	1	75	40	20	15
	Multi/Inter disciplinary Code: PHYS1031		CNCEPTS OF PHYSICS 1	3	2	1	0	50	40	00	10
	Ability Enhancement Course (AEC) [L_1-1 MIL] Code: AEC1041		Arabic/ Bengali/ Hindi/ Sanskrit/ Santali/ Urdu or Equvlnt. Course from SWAYAM /Any other UGC recognized platform	2	2	0	0	50	40	00	10
	Skill Enhancement Course (SEC) Code: PHYS1051		RENEWABLE ENERGY AND ENERGY HARVESTING	3	2	1	0	50	40	00	10
	Common Value Added (CVA) Course Code: CVA1061		Environmental Science/ Education	4	3	0	1	100	60	20	20
	Total			**20**				**400**			

Semester	Course Type with Code	Level	Name of the Course	Credit	Lect.	Tuto.	Practical	Full Marks	Distribution of Marks		
									Theory	Prac-tical	Internal Assessment
II	Major/DS Course (Core) Code: PHYS2011	100-199	MECHANICS	4	3	0	1	75	40	20	15
	Minor Course Code: PHYS2021	100-199	MECHANICS	4	3	0	1	75	40	20	15
	Multi/Interdisciplinary Code: PHYS2031		CNCEPTS OF PHYSICS 2	3	2	1	0	50	40	00	10
	Ability Enhancement Course (AEC)[L_2-1] Code: AEC2041		English or Equvlnt. Course from SWAYAM//Any other UGC-recognized platform	2	2	0	0	50	40	00	10
	Skill Enhancement Course (SEC) Code: PHYS2051		ELECTRICAL CIRCUITS AND NETWORK SKILLS	3	2	1	0	50	40	00	10
	Common Value Added (CVA) Course Code: CVA2061		Understanding India/Digital & Technological Solutions/Health & Wellness,Yoga Education, Sports & Fitness	4	3/3	1/0	0/1	100	80/60	0/20	20
Skill based vocational course (addl. 4 Cr) during summer term for 8 weeks, who will exit the programme after securing 40 cr.											
For UG Certificate 40 cr + Additional 4 cr (work based vocational course) = 44 cr. Students are allowed to re-enter within 3 years and complete the program within the stipulated max. period of 7 years											
	Total			**20**				**400**			

MAJOR-PHYSICS COURSE

Semester I

MAJOR-I: PHYS1011: MATHEMATICAL PHYSICS-I (Credits: Theory-03, Practical - 01)

F.M. = 75 (Theory – 40, Practical – 20, Internal Assessment –15)

COURSE OBJECTIVE: The aim of this course is to equip the students with mathematical methods that are important prerequisites for physics courses.

Theory: 45 Lectures

Calculus:

Recapitulation: Limits, Continuity, Average and instantaneous quantities, Differentiation. Plotting functions. Intuitive ideas of continuous, differentiable etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only).

(3 Lectures)

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of the existence and the Uniqueness theorem for Initial Value Problems. Particular Integral.

(9 Lectures)

Calculus of functions of more than one variable: Partial derivatives, Exact and inexact differentials.

(6 Lectures)

Vector Calculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

(5 Lectures)

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

(6 Lectures)

Vector Integration: Ordinary integrals of vectors, Multiple integrals, Jacobian. Notion of an infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field, Gauss' divergence theorem. Green's and Stokes Theorems and their applications (no rigorous proofs).

(10 Lectures)

Orthogonal Curvilinear Coordinates:

Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

(6 Lectures)

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Vector Analysis, M R Spiegel, Schaums Outline Series.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Higher Engineering Mathematics, B S Grewal, Khanna Publisher.
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Mathematical Physics, H K Dass and R Verma, S. Chand & Company Pvt. Ltd.
8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley&M.P.Hobson, 2011, Cambridge Univ. Press

MAJOR-I: PHYS1011: MATHEMATICALPHYSICS-I

Practical:

COURSE OBJECTIVE: The aim of this course is to learn computer programming and numerical analysis and to emphasize its role in solving problems in Physics.

Practical: 30 Lectures

Topics	**Description with Applications**
Introduction and Overview	Computer architecture and organization, Memory, Input/Output devices.
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, Algorithms, Sequence, Selection and Repetition, Single and double precision arithmetic, Underflow and overflow, Emphasize the importance of making equations in terms of dimensionless variables, Iterative methods.

Errors and Error-Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming Fundamentals	Introduction to Programming, Constants, Variables, Data types, Operators and expressions, I/O statements, scanf and printf, cin and cout, Manipulators for data formatting, Control statements (Decision making statements: if statement, if else Statement, Nested if structure, else if ladder statement, Ternary Operator, goto statement, switch case statement. Unconditional and conditional looping: while loop, do-while loop, for loop, break and continue statements, Nested loops). Arrays (1D & 2D), Strings, User defined functions, Structure and Union, Idea of classes and objects.

Programs:

1. Write and execute a program in C/C++ to compute the factorial of a positive integer including Zero.
2. Write and execute a program in C/C++ to calculate sum of squares of n natural numbers.
3. Write and execute a program in C/C++ to find the area and the volume of a Sphere by varying the radius.
4. Write and execute a program in C/C++ to display Fibonacci series.
5. Write and execute a program in C/C++ to find the value of Sine function using power series (The argument will be given during execution).
6. Write and execute a program in C/C++ to find the value of Cosine function using power series (The argument will be given during execution)
7. Write and execute a program in C/C++ to find the value of ex (x will be given during execution of the program).
8. Write and execute a program in C/C++ to sort elements of an array of elements in ascending/ descending order.
9. Write and execute a program in C/C++ to separate odd and even integers in arrays.
10. Write and execute a program in C/C++ to find the largest and smallest in a given set of numbers.
11. Write and execute a program in C/C++ to calculate value of π.

COURSE OUTCOME: On completion of this course, the student must be able to perform different mathematical operations like calculus and vector operations which are extremely essential to study theoretical and experimental physics.

Reference Books

1. Introduction to Numerical Analysis, S .S.Sastry,5 thEdn., 2012 ,PHI Learning Pvt.Ltd.
2. Schaum's Outline of Programming with C++ .J.Hubbard,2000, McGraw-Hill Pub.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al, 3rd Edn., 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M. Ascher & C.Greif, 2012, PHI Learning.
5. Elementary Numerical Analysis,K.E.Atkinson, 3rd Edn., 2007, Wiley India Edition.
6. An Introduction to Computational Physics, T.Pang, 2nd Edn., 2006, Cambridge Univ. Press
7. Computational Physics, DarrenWalker, 1st Edn., 2015, Scientific International Pvt. Ltd.
8. Programming in ANSI C, E Balagurusamy, McGraw Hill Education.
9. Object Oriented Programming with C++, E. Balagurusamy, McGraw Hill Education.
10. Let Us C, Y Kanetkar, BPB Publications.

MAJOR-PHYSICS COURSE

Semester II

MAJOR II: PHYS2011: MECHANICS (Credits: Theory - 03, Practical - 01)

F.M. = 75 (Theory- 40, Practical – 20, Internal Assessment –15)

COURSE OBJECTIVE: The objectives of this course is to provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamics of classical mechanical systems.

Theory: 45 Lectures

Fundamentals of Dynamics: Reference frames, Inertial frames, Review of Newton's Laws of Motion. Galilean transformations, Galilean invariance. Momentum of variable-mass system: Motion of a rocket, Motion of a projectile in Uniform gravitational field, Dynamics of a system of particles: Centre of Mass, Motion relative to the centre of mass, Principle of conservation of momentum, Impulse.

(6 Lectures)

Work and Energy: Work-Energy theorem, Conservative and non-conservative forces, Potential energy, Energy diagram, Stable and unstable equilibrium, Force as gradient of potential energy, Work and potential energy, Work done by non-conservative forces, Law of conservation of Energy.

(4 Lectures)

Collisions: Elastic and inelastic collisions between particles in Centre of mass and Laboratory frames.

(3 Lectures)

Rotational Dynamics: Angular momentum of a particle and a system of particles, Torque and the principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia, Calculation of moments of inertia for regular shaped bodies, Kinetic energy of rotation. Motion involving both translation and rotation.

(8 Lectures)

Elasticity: Elastic properties of matter, Hooke's Law, Relation between Elastic constants, Twisting torque on a cylinder or a wire, Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane and a concentrated load W is applied at the midpoint.

(4 Lectures)

Gravitation and Central Force Motion: Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Gravitational potential and the gravitational field due to a spherical shell and a solid sphere.

(4 Lectures)

Motion of a particle under a central force field: Two-body problem, its reduction to one-body problem and its solution, the energy equation and energy diagram. Kepler's Laws, Satellite in circular orbit and

applications. Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS).

(6 Lectures)

Oscillations: Simple Harmonic Oscillations: Differential equation of SHM and its solution, Kinetic energy, potential energy, Total energy and their time-averaged values. Damped oscillation, Forced oscillations: Transient and steady states, Resonance, Sharpness of resonance, Power dissipation and Quality Factor, Compound pendulum.

(6 Lectures)

Non-Inertial Systems: Non-inertial frames and fictitious forces: Uniformly rotating frame, Laws of Physics in rotating coordinate systems, Centrifugal force, Coriolis force and its applications. Components of velocity and acceleration in cylindrical and spherical coordinate

(4 Lectures)

COURSE OUTCOME: This course in Mechanics serves as the foundation for further progress towards the study of physics at graduate or post-graduate level. Upon completion of the course, the student will be able to apply Newton's laws of motion to different force fields for a single particle and for a system of particles.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
6. An Introduction to Classical Mechanics, R G Takwale & P S Puranik, TMG Hill.
7. Mechanics, P K Srivastava, New Age International Pvt. Ltd.
8. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
9. Vibrations, Waves and Acoustics, D Chattopadhyay and P C Rakshit, Books and Allied Pvt. Ltd.
10. Advanced Acoustics, D P Roychaudhuri and P Banerjee, The New Book Stall, 2009

MAJOR-II: PHYS2011: MECHANICS

Practical: 30 Lectures

Practical:

1. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna,11thEdn,2011,KitabMahal.
3. Engineering Practical Physics, S.Panigrahi &B.Mallick,2015,CengageLearningIndiaPvt.Ltd.
4. Practical Physics,G.L.Squires,2015, 4thEdition,CambridgeUniversityPress.
5. Practical Physics, D Chattopadhyay, P C Rakshit and B Saha, Books and Allied Pvt. Ltd.
6. Advanced Practical Physics, B Ghosh and K G Mazumdar, Sreedhar Publishers.
7. B. Sc. Practical Physics, Harnam Singh and P S Heme, S Chand and Company Limited.
8. B. Sc. Practical Physics, C L Arora, S Chand and Company Limited.

MINOR-PHYSICS COURSE

Semester I

MINOR-I: PHYS1021: MATHEMATICAL PHYSICS-I (Credits: Theory - 03, Practical - 01)

F.M. = 75 (Theory - 40, Practical - 20, Internal Assessment - 15)

COURSE OBJECTIVE: The aim of this course is to equip the students with mathematical methods that are important prerequisites for physics courses.

Theory: 45 Lectures

Calculus:

Recapitulation: Limits, Continuity, Average and instantaneous quantities, Differentiation. Plotting functions. Intuitive ideas of continuous, differentiable etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only).

(3 Lectures)

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of the existence and the Uniqueness theorem for Initial Value Problems. Particular Integral.

(9 Lectures)

Calculus of functions of more than one variable: Partial derivatives, Exact and inexact differentials.

(6 Lectures)

Vector Calculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

(5 Lectures)

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

(6 Lectures)

Vector Integration: Ordinary integrals of vectors, Multiple integrals, Jacobian. Notion of an infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field, Gauss' divergence theorem. Green's and Stokes Theorems and their applications (no rigorous proofs).

(10 Lectures)

Orthogonal Curvilinear Coordinates:

Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

(6 Lectures)

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Vector Analysis, M R Spiegel, Schaums Outline Series.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Higher Engineering Mathematics, B S Grewal, Khanna Publisher.
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
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8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley&M.P.Hobson, 2011, Cambridge Univ. Press

MINOR-I: PHYS1021: MATHEMATICALPHYSICS-I

Practical:

COURSE OBJECTIVE: The aim of this course is to learn computer programming and numerical analysis and to emphasize its role in solving problems in Physics.

Practical: 30 Lectures

Topics	**Description with Applications**
Introduction and Overview	Computer architecture and organization, Memory, Input/Output devices.

Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, Algorithms, Sequence, Selection and Repetition, Single and double precision arithmetic, Underflow and overflow, Emphasize the importance of making equations in terms of dimensionless variables, Iterative methods.
Errors and Error-Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming Fundamentals	Introduction to Programming, Constants, Variables, Data types, Operators and expressions, I/O statements, scanf and printf, cin and cout, Manipulators for data formatting, Control statements (Decision making statements: if statement, if else Statement, Nested if structure, else if ladder statement, Ternary Operator, goto statement, switch case statement. Unconditional and conditional looping: while loop, do-while loop, for loop, break and continue statements, Nested loops). Arrays (1D & 2D), Strings, User defined functions, Structure and Union, Idea of classes and objects.

Programs:

1. Write and execute a program in C/C++ to compute the factorial of a positive integer including Zero.
2. Write and execute a program in C/C++ to calculate sum of squares of n natural numbers.
3. Write and execute a program in C/C++ to find the area and the volume of a Sphere by varying the radius.
4. Write and execute a program in C/C++ to display Fibonacci series.
5. Write and execute a program in C/C++ to find the value of Sine function using power series (The argument will be given during execution).
6. Write and execute a program in C/C++ to find the value of Cosine function using power series (The argument will be given during execution)
7. Write and execute a program in C/C++ to find the value of ex (x will be given during execution of the program).
8. Write and execute a program in C/C++ to sort elements of an array of elements in ascending/ descending order.
9. Write and execute a program in C/C++ to separate odd and even integers in arrays.
10. Write and execute a program in C/C++ to find the largest and smallest in a given set of numbers.
11. Write and execute a program in C/C++ to calculate value of π.

COURSE OUTCOME: On completion of this course, the student must be able to perform different mathematical operations like calculus and vector operations which are extremely essential to study theoretical and experimental physics.

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1. Introduction to Numerical Analysis, S .S.Sastry,5 thEdn., 2012 ,PHI Learning Pvt.Ltd.

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3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al, 3rd Edn., 2007, Cambridge University Press.

4. A first course in Numerical Methods, U.M. Ascher & C.Greif, 2012, PHI Learning.

5. Elementary Numerical Analysis,K.E.Atkinson, 3rd Edn., 2007, Wiley India Edition.

6. An Introduction to Computational Physics, T.Pang, 2nd Edn., 2006, Cambridge Univ. Press

7. Computational Physics, DarrenWalker, 1st Edn., 2015, Scientific International Pvt. Ltd.

8. Programming in ANSI C, E Balagurusamy, McGraw Hill Education.

9. Object Oriented Programming with C++, E. Balagurusamy, McGraw Hill Education.

10. Let Us C, Y Kanetkar, BPB Publications.

MINOR-PHYSICS COURSE

Semester II

MINOR II : PHYS2021: MECHANICS (Credits: Theory - 03, Practical - 01)

F.M. = 75 (Theory - 40, Practical – 20, Internal Assessment –15)

COURSE OBJECTIVE: The objectives of this course is to provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamics of classical mechanical systems.

Theory: 45 Lectures

Fundamentals of Dynamics: Reference frames, Inertial frames, Review of Newton's Laws of Motion. Galilean transformations, Galilean invariance. Momentum of variable-mass system: Motion of a rocket, Motion of a projectile in Uniform gravitational field, Dynamics of a system of particles: Centre of Mass, Motion relative to the centre of mass, Principle of conservation of momentum, Impulse.

(6 Lectures)

Work and Energy: Work-Energy theorem, Conservative and non-conservative forces, Potential energy, Energy diagram, Stable and unstable equilibrium, Force as gradient of potential energy, Work and potential energy, Work done by non-conservative forces, Law of conservation of Energy.

(4 Lectures)

Collisions: Elastic and inelastic collisions between particles in Centre of mass and Laboratory frames.

(3 Lectures)

Rotational Dynamics: Angular momentum of a particle and a system of particles, Torque and the principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia, Calculation of moments of inertia for regular shaped bodies, Kinetic energy of rotation. Motion involving both translation and rotation.

(8 Lectures)

Elasticity: Elastic properties of matter, Hooke's Law, Relation between Elastic constants, Twisting torque on a cylinder or a wire, Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane and a concentrated load W is applied at the midpoint.

(4 Lectures)

Gravitation and Central Force Motion: Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Gravitational potential and the gravitational field due to a spherical shell and a solid sphere.

(4 Lectures)

Motion of a particle under a central force field: Two-body problem, its reduction to one-body problem and its solution, the energy equation and energy diagram. Kepler's Laws, Satellite in circular orbit and

applications. Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS).

(6 Lectures)

Oscillations: Simple Harmonic Oscillations: Differential equation of SHM and its solution, Kinetic energy, potential energy, Total energy and their time-averaged values. Damped oscillation, Forced oscillations: Transient and steady states, Resonance, Sharpness of resonance, Power dissipation and Quality Factor, Compound pendulum.

(6 Lectures)

Non-Inertial Systems: Non-inertial frames and fictitious forces: Uniformly rotating frame, Laws of Physics in rotating coordinate systems, Centrifugal force, Coriolis force and its applications. Components of velocity and acceleration in cylindrical and spherical coordinate systems.

(4 Lectures)

COURSE OUTCOME: This course in Mechanics serves as the foundation for further progress towards the study of physics at graduate or post-graduate level. Upon completion of the course, the student will be able to apply Newton's laws of motion to different force fields for a single particle and for a system of particles.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
6. An Introduction to Classical Mechanics, R G Takwale & P S Puranik, TMG Hill.
7. Mechanics, P K Srivastava, New Age International Pvt. Ltd.
8. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
9. Vibrations, Waves and Acoustics, D Chattopadhyay and P C Rakshit, Books and Allied Pvt. Ltd.
10. Advanced Acoustics, D P Roychaudhuri and P Banerjee, The New Book Stall, 2009

MINOR II : PHYS2021: MECHANICS

Practical: 30 Lectures

Practical:

1. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna,11thEdn,2011,KitabMahal.
3. Engineering Practical Physics, S.Panigrahi &B.Mallick,2015,CengageLearningIndiaPvt.Ltd.
4. Practical Physics,G.L.Squires,2015, 4thEdition,CambridgeUniversityPress.
5. Practical Physics, D Chattopadhyay, P C Rakshit and B Saha, Books and Allied Pvt. Ltd.
6. Advanced Practical Physics, B Ghosh and K G Mazumdar, Sreedhar Publishers.
7. B. Sc. Practical Physics, Harnam Singh and P S Heme, S Chand and Company Limited.
8. B. Sc. Practical Physics, C L Arora, S Chand and Company Limited.

MULTI-DISCIPLINARY COURSE (PHYSICS)

Semester I

MULTI-DISCIPLINARY-1: PHYS1031: CNCEPTS OF PHYSICS 1 (Credits: 03)

F.M. = 50 (Theory- 40, Internal Assessment – 10)

COURSE OBJECTIVE: The aim of the course is to enable the students to be familiar with basic Physics.

Theory: 45 Lectures

Unit, Dimensions and Measurement of Physical Quantities

Need for a measurement, Units of measurement, Systems of units, SI units, Fundamental and derived units. Length, mass and time measurements, Accuracy and precision of measuring instruments, Errors in measurements, Significant figures. Dimensions of physical quantities, Dimensional analysis and its applications.

(4 Lectures)

Kinematics

Motion in a Straight Line, Uniform and non-uniform rectilinear motion, Average speed and instantaneous velocity, Uniformly accelerated motion, Velocity-time and position-time graphs, Kinematic equations for uniformly accelerated motion (graphical treatment).

(3 Lectures)

Scalar and vector quantities

Unit vector, Position and displacement vectors, Equality of vectors, Multiplication of vectors by a real number, Addition and subtraction of vectors, Relative velocity, Resolution of a vector in a plane, Rectangular components, Scalar and vector product of two vectors.

(3 Lectures)

Motion in a plane

Uniform circular motion, projectile motion.

(2 Lectures)

Laws of Motion

Intuitive concept of force, Inertia, Newton's first law of motion, Momentum and Newton's second law of motion, Impulse, Newton's third law of motion. Law of conservation of linear momentum and its applications. Static and kinetic friction, Laws of friction, Rolling friction, Lubrication. Dynamics of uniform circular motion, Centripetal force, Examples of circular motion (vehicle on a leveled circular road, vehicle on a banked road).

(8 Lectures)

Work, Energy and Power

Work done by a constant force and a variable force, Kinetic energy, Work-energy theorem, power. Notion of potential energy, Potential energy of a spring, Conservative forces, Conservation of mechanical energy (Sum of kinetic and potential energies), Non-conservative forces, Motion in a vertical circle, Elastic and inelastic collisions in one and two dimensions.

(8 Lectures)

System of Particles and Rotational Motion

Centre of mass of a two-particle system, Momentum conservation and Motion of centre of mass. Centre of mass of a rigid body, Centre of mass of a uniform rod. Moment of a force, Angular momentum, Law of conservation of angular momentum and its applications. Equilibrium of rigid bodies, Rigid body rotation and equations of rotational motion, Comparison of linear and rotational motion. Moment of inertia, Radius of gyration, Values of moments of inertia for simple geometrical objects (no derivation).

(12 Lectures)

Gravitation

Universal law of gravitation, Acceleration due to gravity and its variation with altitude and depth. Gravitational potential energy and gravitational potential, Escape velocity, Orbital velocity of a satellite, Geo-stationary satellites.

(5 Lectures)

COURSE OUTCOME: Students will develop the problem-solving capability and also learn the applications of Newtonian mechanics in daily life.

Reference Books:

1. Vector analysis, M.R. Spiegel, Tata McGraw Hill.
2. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, McGraw-Hill.
3. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. Tata McGraw-Hill.
4. Concepts of Physics, H C Verma, Vol 1 & 2, BharatiBhawan.
5. Mechanics, D.S. Mathur, S. Chand and Company Limited,
6. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, Addison Wesley
7. Theoretical Mechanics, M.R. Spiegel, Tata McGraw Hill.
8. New Simplified Physics, S L Arora, Dhanpat RaI & Co. Pvt. Ltd, Vol.1, 2020

MULTI-DISCIPLINARY COURSE (PHYSICS)

Semester II

MULTI-DISCIPLINARY-2: PHYS2031 CNCEPTS OF PHYSICS 2 (Credits: 03)

F.M.= 50 (Theory-40, Internal Assessment–10)

COURSE OBJECTIVE: The aim of the course is to enable the students to be familiar with basic Physics.

Theory: 45 Lectures

General Properties of Matter

Mechanical properties of solids, Stress-strain relationship, Hooke's law, Elastic moduli. Mechanical properties of fluids, Pressure due to a fluid column, Pascal's law and its applications (hydraulic lift and hydraulic brakes).

Viscosity, Stokes' law, Terminal velocity, Streamline and turbulent flow, Critical velocity, Bernoulli's theorem and its applications.

Surface energy and surface tension, Angle of contact, Excess-pressure across a curved surface, Effects of surface tension to drops, bubbles and capillary rise.

(13 Lectures)

Thermal Properties of Matter

Heat, Temperature, Thermal expansion, Thermal expansion of solids, liquids and gases, Anomalous expansion of water, Specific heat capacity, C_p, C_v – Calorimetry, Change of state, Latent heat capacity.

Processes of heat transfer: Conduction, Convection and Radiation, Thermal conductivity. Blackbody radiation, Planck’s distribution law (qualitative discussion), Wien's displacement Law, Stefan's law.

(8 Lectures)

Behavior of Perfect Gases and Kinetic Theory of Gases

Equation of state of a perfect gas, Work done in compressing a gas, Kinetic theory of gases: Postulates, Concept of pressure, Kinetic interpretation of temperature, RMS speed of gas molecules, Degrees of freedom, the law of equi-partition of energy (statement only) and its application to specific heat capacities of gases, Concept of mean free path, Avogadro's number.

(8 Lectures)

Thermodynamics

Zeroth law of thermodynamics, Heat, work and internal energy, First law of thermodynamics, Isothermal and adiabatic processes, Second law of thermodynamics: Reversible and irreversible processes, Concept of entropy.

(8 Lectures)

Oscillations and Waves

Oscillations: Periodic motion, Time period, Frequency, Displacement as a function of time, Simple harmonic motion (S.H.M): Differential equation, Phase, Oscillations of a loaded spring, Restoring force and force constant, Energy in S.H.M., Kinetic and potential energies, Derivation of the expression for the time period of a simple pendulum. Free, Forced and Damped oscillations (qualitative ideas only), Resonance.

(8 Lectures)

COURSE OUTCOME: Students will develop the problem-solving capability and also learn the applications of Newtonian mechanics in daily life.

Reference Books:

1. Thermal Physics, S.Garg, R.Bansal and C.Ghosh,1993,Tata McGraw-Hill.
2. New Simplified Physics, S L Arora, Dhanpat RaI & Co. Pvt. Ltd, Vol.1, 2020
3. Concepts of Physics, H C Verma, Vol 1 & 2, Bharati Bhawan.
4. Waves: Berkeley Physics Course,vol.3,FrancisCrawford,2007,TataMcGraw-Hill.
5. Heat Thermodynamics and Statistical Physics, Brijlal, Subrahmanyam, Heme, S Chand.
6. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa.
7. A Treatise on Heat, Meghnad Saha and B.N.Srivastava, 1969, Indian Press.

SEC-PHYSICS

Semester-I

SEC-1:PHYS1051: RENEWABLE ENERGY AND ENERGY HARVESTING (Credits: 03)

F.M. = 50 (Theory - 40, Internal Assessment - 10)

COURSE OBJECTIVE: To impart knowledge and hands on learning about various alternative energy sources like Wind, Solar, Mechanical, Ocean, Geothermal etc. To review the working of various energy harvesting systems which are installed worldwide.

Theory: 45 Lectures

Fossil Fuels and Alternate Sources of Energy: Fossil fuels and nuclear energy, Their limitation, Need of renewable energy, Non-conventional energy sources. An overview of the developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, Solar energy, Biomass, Biochemical conversion, Biogas generation, Geothermal energy, Tidal energy, Hydroelectricity. (8 Lectures)

Solar energy: Solar energy and its importance, Storage of solar energy, Solar pond, Non-convective solar pond, Applications of solar pond and solar energy, Solar water heater, Flat plate collector, Solar distillation, Solar cooker, Solar green houses, Solar cell, Absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits and sun tracking systems. (8 Lectures)

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces and grid interconnection topologies. (5 Lectures)

Ocean Energy: Ocean Energy, Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. (5 Lectures)

Geothermal Energy: Geothermal resources, Geothermal technologies. (4 Lectures)

Hydro Energy: Hydropower resources, Hydropower technologies, Environmental impact of hydro power sources. (5 Lectures)

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modelling piezoelectric generators, Piezoelectric energy harvesting applications, Human power. (5 Lectures)

Electromagnetic Energy Harvesting: Linear generators, Related Physics, Mathematical models, Recent applications, Carbon captured technologies, cell, Batteries, Power consumption, Environmental issues and Renewable sources of energy, Sustainability. (5 Lectures)

COURSE OUTCOME: The students are expected to learn not only the theories of the renewable sources of energy, but also to have hands-on experiences on them wherever possible.

Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy
8. Snatak Padartha Vigyan, Renewable Energy Sources, A M Rudra, A Bhattacharya and A Dan, The New Book Stall, 2018.

SEC-PHYSICS

Semester-II

SEC-2: PHYS2051: ELECTRICAL CIRCUITS AND NETWORK SKILLS (Credits: 03)

F.M.= 50 (Theory - 40, Internal Assessment - 10)

COURSE OBJECTIVE*:* The aim of this course is to enable the students to understand the basics of electronic circuits. Practical design and trouble shoot of electronic instrument is also a major objective of this Couse.

Theory: 45 Lectures

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. (5 Lectures)

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

(8 Lectures)

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. (5 Lectures)

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. (5 Lectures)

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. (5 Lectures)

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources (5 Lectures)

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) (5 Lectures)

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. (7 Lectures)

COURSE OUTCOME: After the completion of the course the student will acquire necessary skills/ hands on experience /working knowledge on Multimeter, voltmeters, ammeters, electric circuit elements, dc power sources. With the knowledge of basic electronics a student can able to detect troubleshoot and repair some of the electronic instruments used in our daily life.

Reference Books:

1. A Text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A Text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.