Department of Physics

Debraj Roy College (Autonomous)

Program Structure for 1st, 2nd and 3rd Semester of FYUGP

(Effective from the session 2024-25)

Year	Semester	Course	Title of the Course	Total Credit
1st	1st	PHYM101	Mechanics and Properties of Matter	4
		PHYMIN101	Mechanics and Properties of Matter	4
		PHYGEC101	Evolution of Science	3
		PHYSEC101	Electrical Wiring and Maintenance	3
		AEC-101*	Modern Indian Language	4
		VAC-101*	----------	2
		Total		**20**
	2nd	PHYM201	Waves and Optics	4
		PHYMIN201	Waves and Optics	4
		PHYGEC201	Materials Today / Digital and Space Technologies	3
		PHYSEC201	Mastering Productivity with Google Workspace	3
		AEC-201*	English Language and Communication Skills	4
		VAC-201*	----------	2
		Total		**20**
2nd	3rd	PHYM301	Mathematical Physics-I	4
		PHYM302	Computational and Numerical techniques in Physics -I	4
		PHYMIN301	Mathematical Physics-I	4
		PHYGEC301	The Universe / Atmosphere of the Earth	3
		PHYSEC301	Basic Excel Skills	3
		AEC-301*	----------	2
		VAC-301*	----------	
		Total		**20**

- AEC and VAC courses and their credit distribution are yet to be finalized

Syllabus of 1st Semester Major Course

Course title: **Mechanics and Properties of Matter**

Course code: PHYM101

Nature of the course: Core

Total credits:4 (Theory-3, Practical -1)

Distribution of marks:

(A) Summative Assessment -60 (Theory -45, Practical-15)

(B) Formative Assessment – 40 (Theory -30, Practical-10)

Course Objective: To impart the basic level of knowledge of Newtonian Mechanics, properties of matter, simple harmonic motion, gravitation and to improve laboratory skill in mechanics and properties of matter.

Learning Outcome: After completing this course, a student will be able to

(i) Understand the basic concepts of Newtonian Mechanics
(ii) Understand basic conservation Laws
(iii) Analyze simple harmonic oscillators
(iv) Understand the properties of matter
(v) Analyze central force motion
(vi) Examine the laws and measure the properties in laboratory.

PHYM101T: Mechanics and Properties of Matter (Theory)

Distribution of Marks: 45 (Summative) + 30 (Formative)

[Revisit: Vector Algebra- Addition, Resolution, dot and cross product, triple product, Interpretation of differentiation and integration]

Unit	Content	L	T	P	M	Hr
Unit 1: Newtonian Mechanics	**1.1**:Frames of Reference, Inertial Frames, Galilean Transformations, Galilean Invariance; Dynamics of a System of Particles, Centre of Mass, Principle of Conservation of Linear Momentum	6			4 6	6
	1.2: The Work-Energy Theorem, Conservative and Non-conservative Forces, Conservation of Mechanical Energy, Work done by non-conservative forces, Force as gradient of potential energy, Energy Diagram, Stable and unstable equilibrium.	6			4 6	6
	1.3: Principle of Conservation of Angular Momentum, Rotation about a fixed axis, Moment of Inertia, Radius of Gyration, Calculation of Moment of Inertia for rectangular, cylindrical and spherical bodies, Kinetic Energy of Rotation, Motion involving both translation and rotation	8			5 8	8
Unit 2: Properties of Matter	**2.1**: Relation between Elastic constants, Twisting torque on a Cylinder or Wire.	4			7	4
	2.2: Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube	3			5	3
Unit 3: Oscillations	Simple Harmonic Motion (SHM) and Oscillations, Differential Equation of SHM and its solution, Kinetic Energy, Potential Energy, Total energy and their time average values, Damped oscillation, Forced oscillations, Resonance, Power Dissipation and Quality Factor.	9			15	9
Unit 4: Gravitation and Central Force Motion	Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and 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).	9			5 10	9
	Total	**45**			**75**	**45**

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

** The underlined parts are for formative assessment only

Reading resources:

1. Mechanics, D.S. Mathur, (S. Chand and Company Limited)
2. Mechanics, Berkeley Physics, Vol.1, C.Kittel, W.Knight, et.al. (Tata McGraw Hill).
3. Elements of Properties of Matter, D S Mathur, (S. Chand and Company Limited)
4. Theoretical Mechanics, M. R. Spiegel, (McGraw Hill Book Company)

PHYM101P: Mechanics and Properties of Matter (Lab)

Distribution of Marks: 15 (Summative) + 10 (Formative)

Unit	Content (List of Experiments)	L	T	P	M	Hr
Mechanics and Properties of Matter	1. Measurements of length (or diameter) using vernier calliper, screw gauge and travelling microscope. 2. To study the random error in observations. 3. To determine the height of a building using a Sextant. 4. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity. 5. To determine g and velocity for a freely falling body using Digital Timing Technique 6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). 7. To determine the Modulus of Rigidity of a Wire by Maxwell's needle. 8. To determine the elastic Constants of a wire by Searle's method. 9. To determine the value of g using Bar Pendulum. 10. To determine the value of g using Kater's Pendulum			15	25	30
	Total			15	25	30

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr - Hours

Reading Resources:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, (Asia Publishing House)
2. B.Sc. Practical Physics, C. L. Arora (S Chand)
3. A Textbook on Practical Physics, K G Mazumdar, B. Ghosh (Sreedhar Publishers)

Syllabus of 2nd Semester Major Course

Course title: **Waves and Optics**

Course code: PHYM201

Nature of the course: Core

Total credits: 4 (Theory-3, Practical -1)

Distribution of marks:

(A) Summative Assessment -60 (Theory -45, Practical-15)

(B) Formative Assessment – 40 (Theory -30, Practical-10)

Course Objective: To develop theoretical and experimental knowledge of waves, oscillations, superpositions and various phenomena of light.

Learning Outcome: After completing this course, a student will be able to

(i) learn the basics of wave motions
(ii) know about the wave nature of light
(iii) observe and analyse various properties of waves and light experimentally
(iv) relate the experimental observation with theoretical foundation.

PHYM201T: Wave and Optics (Theory)

Distribution of Marks : 45 (Summative) + 30 (Formative)

Unit	Content	L	T	P	M	Hr
Unit 1: Superposition of Harmonic Oscillations	1.1: Linearity and Superposition Principle. Superposition of two collinear oscillations having equal frequencies and different frequencies (Beats).	3			5	3
	1.2: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their use	2			3	2
Unit 2: Wave Motion	2.1: Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Travelling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation of a Wave, Pressure of a Longitudinal Wave, Energy Transport, Intensity of Wave.	6			2 8	6
	2.2: Velocity of Transverse Vibrations of Stretched Strings, Velocity of Longitudinal Waves in a Fluid in a Pipe, Newton's Formula for Velocity of Sound, Laplace's Correction	4			7	4
Unit 3: Harmonic Waves	Standing (Stationary) Waves in a String: Fixed and Free Ends, Analytical Treatment, Phase and Group Velocities, Changes with respect to Position and Time, Energy of Vibrating String, Transfer of Energy, Normal Modes of Stretched Strings, Plucked and Struck Strings, Melde's Experiment, Longitudinal Standing Waves and Normal Modes, Open and Closed Pipes	8			13	8
Unit 4: Wave optics	Electromagnetic nature of light, definition and properties of wave front, Huygens principle, Temporal and Spatial coherence	2			3	2
Unit 5: Interference	Division of wavefront and amplitude, intensity distribution in an interference pattern, Young's double slit experiment, Fresnel's Biprism. Phase change on reflection: Stokes' treatment, Interference in Thin Films: parallel and wedge-shaped films, Newton's Rings: Measurement of wavelength and refractive index, Michelson interferometer	8			4 9	8
Unit 6: Diffraction	Fresnel and Fraunhofer diffraction. Fresnel's Half-Period Zones for Plane Wave. Fresnel diffraction pattern of a straight edge and at a circular aperture. Fraunhofer diffraction: Single slit. Double slit. Diffraction grating. Resolving power of grating	8			3 10	8
Unit 7: Polarization	Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering. Polarization by double refraction and Huygen's theory, Nicol prism, Production and analysis of circularly and elliptically polarized light	4			3 5	4
	Total	45			75	45

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

** The underlined parts are for formative assessment only

Reading Resources

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford (Tata McGraw-Hill)
2. Fundamentals of Optics, F.A. Jenkins and H.E. White (McGraw-Hill)
3. Principles of Optics, Max Born and Emil Wolf, (Pergamon Press).
4. Optics, Ajoy Ghatak, (Tata McGraw Hill)
5. The Physics of Vibrations and Waves, H. J. Pain, (John Wiley and Sons).
6. The Physics of Waves and Oscillations, N.K. Bajaj, (Tata McGraw Hill)
7. Fundamental of Optics, A. Kumar, H.R. Gulati and Khanna, (R. Chand Publications)

PHYM201P: Waves and Optics (Lab)

Distribution of Marks: 15 (Summative) + 10 (Formative)

Unit	Content (List of Experiments)	L	T	P	M	Hr
Waves and Optics	(1) To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law (2) To determine the refractive index of the Material of a prism using sodium source. (3) To determine the dispersive power and Cauchy constants of the material of a prism using mercury source. (4) To determine wavelength of sodium light using Fresnel Biprism. (5) To determine wavelength of sodium light using Newton's Rings. (6) To study the diffraction pattern of single/double slit (7) To determine wavelength of a light source using plane diffraction grating. (8) To determine dispersive power and resolving power of a plane diffraction grating. (9) To determine the specific rotation of sugar solution using Polarimeter (10) To analyze elliptically polarized Light by using a Babinet's compensator			15	25	30
	Total			15	25	30

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

** The underlined parts are for formative assessment only

Reading Resources:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, (Asia Publishing House)
2. B.Sc. Practical Physics, C. L. Arora (S Chand)
3. A Textbook on Practical Physics, K G Mazumdar, B. Ghosh (Sreedhar Publishers)

Syllabus of 3rd Semester Major Course

Course title: **Mathematical Physics-I**

Course code: PHYM301

Nature of the course: Core

Total credits: 4 (Theory-4, Practical -0)

Distribution of marks:

(A) Summative Assessment -60 (Theory -60, Practical-0)

(B) Formative Assessment – 40 (Theory -40, Practical-0)

Course Objective: To develop the requisite mathematical skills of a student to understand the fundamental topics in Physics and to prepare them for more advanced level of Physics

Learning Outcome: After completing this course, a student will be able to

(i) Write a problem in Physics in the language of Mathematics.

(ii) Identify a range of diverse mathematical techniques to formulate and solve a problem in basic Physics.

(iii) Analyze some of the basic mathematical concepts and methods.

(iv) Apply the knowledge and understanding of these mathematical methods to solve problems in a number of elementary branches of Physics like mechanics, electromagnetic theory, statistical Physics, thermal Physics etc.

PHYM301T: Mathematical Physics-I

Distribution of Marks : 60 (Summative) + 40 (Formative)

Unit	Content	L	T	P	M	Hr
Unit 1: Calculus	**1.1**: Functions and their plotting, Continuity and Differentiability of functions, Approximation methods: Taylor series, Maclaurin series.	2			4	2
	1.2: First Order Differential Equations, Integrating Factor, Second Order Differential Equations, Homogeneous and Inhomogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.	10			16	10
	1.3: Calculus of functions of more than one variable: Partial Derivatives, Exact and Inexact Differentials, Integrating Factor, Constrained Maximization using Lagrange Multipliers.	6			10	6
Unit 2: Vector Calculus	**2.1**: 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	10			7 10	10
	2.2 Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of 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).	14			23	14
Unit 3: Orthogonal Curvilinear Coordinates	Orthogonal Curvilinear Coordinates, Spherical Polar Coordinates, Cylindrical Coordinates; Derivation of Gradient, Divergence and Curl in Cartesian, Spherical and Cylindrical Coordinate Systems	8			13	8
Unit 4: Dirac Delta Function	Definition of Dirac Delta Function, Representation as limit of a Gaussian function and Rectangular function, Properties of Dirac Delta Function	4			7	4
Unit 5: Matrices	Definition, Addition and Multiplication of matrices, Transpose of a matrix, Hermitian conjugate of a matrix, Trace and Determinant, Inverse of a matrix, Special types of square matrices- Diagonal, Symmetric and Skew-symmetric, Hermitian and Skew-Hermitian.	6			3 7	6
	Total	**60**			**100**	**60**

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

** The underlined parts are for formative assessment only

Reading Resources:

1. Mathematical Physics, H K Dass, Dr. Rama Verma (S Chand Ltd.)
2. Vector Analysis, M R Spiegel, (McGraw Hill Education)
3. Matrix Operations, R Bronson (McGraw-Hill Education)
4. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris (Elsevier)

Syllabus of 3rd Semester Major Course

Course title: **Computational and Numerical techniques in Physics -I**

Course code: PHYM302

Nature of the course: Core

Total credits: 4 (Theory-2, Practical -2)

Distribution of marks:

(A) Summative Assessment -60 (Theory -30, Practical-30)

(B) Formative Assessment – 40 (Theory -20, Practical-20)

Course Objective: To impart the basic level of knowledge of computer architecture, algorithm and programming in python.

Learning Outcome: After completing this course, a student will be able to

(i) understand how a computer works

(ii) step-by-step development of algorithm to solve a problem

(iii) basic programming skills in python

PHYM302T: Computational and Numerical techniques in Physics -I

Distribution of Marks : 60 (Summative) + 40 (Formative)

Unit	Content	L	T	P	M (Th)	Hr. (Th)
Unit 1: Introduction	Computer architecture and organization, memory and Input/output devices Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Illustration with examples.	3		3	5	3
Unit 2: Python Basics	Introduction to Python, identifiers and keywords, python types, variable types and assignment, arithmetic operations, conversions.	3		3	5	3
Unit 3: Strings	Definition and properties of strings, string operations	3		3	5	3
Unit 4: Decision control Instruction	Use of *if*, *else* and *elif*; use of logical operators	3		3	5	3
Unit 5: Loops	Use of *while* and *for, break* and *continue*	3		3	5	3
Unit 6: Functions	Defining and using Functions, parameters and arguments, functional programming	3		3	5	3
Unit 7: Scope and lifetime of variables	Local, global and non-local variables	1		1	2	1
Unit 8: Modules and Packages	Python modules, importing a module, module properties. Python packages	4		4	7	4
Unit 9: Data Structures	Lists, Tuples, and Dictionaries; Sets and frozen sets; Comprehensions, Iterators, Generators	4		4	6	4
Unit 10: File Handling and Exception	Reading from and Writing to Files, Working with file paths, handling exceptions	3		3	5	3
	Total	30		30	50	30

*L- Lecture, T- Tutorial, P- Practical, M(Th) – Marks in theory, Hr(Th) – Hours for theory

** The underlined parts are for formative assessment only

Syllabus of 1st Semester Minor Course

Course title: **Mechanics and Properties of Matter**

Course code: PHYMIN101

Nature of the course: Minor

Total credits: 4 (Theory-3, Practical -1)

Distribution of marks:

(A) Summative Assessment -60 (Theory -45, Practical-15)

(B) Formative Assessment – 40 (Theory -30, Practical-10)

Course Objective: To impart the basic level of knowledge of Newtonian Mechanics, properties of matter, simple harmonic motion, gravitation and to improve laboratory skill in mechanics and properties of matter.

Learning Outcome: After completing this course, a student will be able to

(i) Understand the basic concepts of Newtonian Mechanics
(ii) Understand basic conservation Laws
(iii) Analyse simple harmonic oscillators
(iv) Understand the properties of matter
(v) Analyse central force motion
(vi) Examine the laws and measure the properties in laboratory.

PHYMIN101T: Mechanics and Properties of Matter (Theory)

Distribution of Marks : 45 (Summative) + 30 (Formative)

Unit	Content	L	T	P	M	Hr
Unit 1: Newtonian Mechanics	**1.1**: Frames of Reference, Inertial Frames, Galilean Transformations, Galilean Invariance; Dynamics of a System of Particles, Centre of Mass, Principle of Conservation of Linear Momentum	6			4 6	6
	1.2: The Work-Energy Theorem, Conservative and Non-conservative Forces, Conservation of Mechanical Energy, Work done by non-conservative forces, Force as gradient of potential energy, Energy Diagram, Stable and unstable equilibrium.	6			4 6	6
	1.3: Principle of Conservation of Angular Momentum, Rotation about a fixed axis, Moment of Inertia, Radius of Gyration, Calculation of Moment of Inertia for rectangular, cylindrical and spherical bodies, Kinetic Energy of Rotation, Motion involving both translation and rotation	8			5 8	8
Unit 2: Properties of Matter	**2.1**: Relation between Elastic constants, Twisting torque on a Cylinder or Wire.	4			7	4
	2.2: Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube	3			5	3
Unit 3: Oscillations	Simple Harmonic Motion (SHM) and Oscillations, Differential Equation of SHM and its solution, Kinetic Energy, Potential Energy, Total energy and their time average values, Damped oscillation, Forced oscillations, Resonance, Power Dissipation and Quality Factor.	9			15	9
Unit 4: Gravitation and Central Force Motion	Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and 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).	9			5 10	9
	Total	45			75	45

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

** The underlined parts are for formative assessment only

Reading resources:

(i) Mechanics, D.S. Mathur, S. Chand and Company Limited

(ii) Mechanics, Berkeley Physics, Vol.1, C.Kittel, W.Knight, et.al. Tata McGraw Hill.

(iii) Elements of Properties of Matter, D S Mathur, S. Chand and Company Limited

(iv) Theoretical Mechanics, M. R. Spiegel, McGraw Hill Book Company

PHYMIN101P: Mechanics and Properties of Matter (Lab)

Distribution of Marks : 15 (Summative) + 10 (Formative)

Unit	Content (List of Experiments)	L	T	P	M	Hr
Mechanics and Properties of Matter	1. Measurements of length (or diameter) using vernier calliper, screw gauge and travelling microscope. 2. To study the random error in observations. 3. To determine the height of a building using a Sextant. 4. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity. 5. To determine g and velocity for a freely falling body using Digital Timing Technique 6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). 7. To determine the Modulus of Rigidity of a Wire by Maxwell's needle. 8. To determine the elastic Constants of a wire by Searle's method. 9. To determine the value of g using Bar Pendulum. 10. To determine the value of g using Kater's Pendulum			15	25	30
	Total			15	25	30

L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr - Hours

Reading Resources:

(i) Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, (Asia Publishing House)

(ii) B.Sc. Practical Physics, C. L. Arora (S Chand)

(iii) A Textbook on Practical Physics, K G Mazumdar, B. Ghosh (Sreedhar Publishers)

Syllabus of 2nd Semester Minor Course

Course title: **Waves and Optics**

Course code: PHYMIN201

Nature of the course: Minor

Total credits:4 (Theory-3, Practical -1)

Distribution of marks:

(A) Summative Assessment -60 (Theory -45, Practical-15)

(B) Formative Assessment – 40 (Theory -30, Practical-10)

Course Objective: To develop theoretical and experimental knowledge of waves, oscillations, superpositions and various phenomena of light.

Learning Outcome: After completing this course, a student will be able to

(i) learn the basics of wave motions
(ii) know about the wave nature of light
(iii) observe and analyse various properties of waves and light experimentally

relate the experimental observation with theoretical foundation

PHYMIN201T: Wave and Optics (Theory)

Distribution of Marks: 45 (Summative) + 30 (Formative)

Unit	Content	L	T	P	M	Hr
Unit 1: Superposition of Harmonic Oscillations	1.1: Linearity and Superposition Principle. Superposition of two collinear oscillations having equal frequencies and different frequencies (Beats).	3			5	3
	1.2: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their use	2			3	2
Unit 2: Wave Motion	2.1: Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Travelling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation of a Wave, Pressure of a Longitudinal Wave, Energy Transport, Intensity of Wave.	6			2 8	6
	2.2: Velocity of Transverse Vibrations of Stretched Strings, Velocity of Longitudinal Waves in a Fluid in a Pipe, Newton's Formula for Velocity of Sound, Laplace's Correction	4			7	4
Unit 3: Harmonic Waves	Standing (Stationary) Waves in a String: Fixed and Free Ends, Analytical Treatment, Phase and Group Velocities, Changes with respect to Position and Time, Energy of Vibrating String, Transfer of Energy, Normal Modes of Stretched Strings, Plucked and Struck Strings, Melde's Experiment, Longitudinal Standing Waves and Normal Modes, Open and Closed Pipes	8			13	8
Unit 4: Wave optics	Electromagnetic nature of light, definition and properties of wave front, Huygens principle, Temporal and Spatial coherence	2			3	2
Unit 5: Interference	Division of wavefront and amplitude, intensity distribution in an interference pattern, Young's double slit experiment, Fresnel's Biprism. Phase change on reflection: Stokes' treatment, Interference in Thin Films: parallel and wedge-shaped films, Newton's Rings: Measurement of wavelength and refractive index, Michelson interferometer	8			4 9	8
Unit 6: Diffraction	Fresnel and Fraunhofer diffraction. Fresnel's Half-Period Zones for Plane Wave. Fresnel diffraction pattern of a straight edge and at a circular aperture. Fraunhofer diffraction: Single slit. Double slit. Diffraction grating. Resolving power of grating	8			3 10	8
Unit 7: Polarization	Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering. Polarization by double refraction and Huygen's theory, Nicol prism, Production and analysis of circularly and elliptically polarized light	4			3 5	4
	Total	45			75	45

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

** The underlined parts are for formative assessment only

Reading Resources

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford (Tata McGraw-Hill)

2. Fundamentals of Optics, F.A. Jenkins and H.E. White (McGraw-Hill)
3. Principles of Optics, Max Born and Emil Wolf, (Pergamon Press).
4. Optics, Ajoy Ghatak, (Tata McGraw Hill)
5. The Physics of Vibrations and Waves, H. J. Pain, (John Wiley and Sons).
6. The Physics of Waves and Oscillations, N.K. Bajaj, (Tata McGraw Hill)
7. Fundamental of Optics, A. Kumar, H.R. Gulati and Khanna, (R. Chand Publications)

PHYMIN201P: Waves and Optics (Lab)

Distribution of Marks : 15 (Summative) + 10 (Formative)

Unit	Content (List of Experiments)	L	T	P	M	Hr
Waves and Optics	(1) To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law (2) To determine the refractive index of the Material of a prism using sodium source. (3) To determine the dispersive power and Cauchy constants of the material of a prism using mercury source. (4) To determine wavelength of sodium light using Fresnel Biprism. (5) To determine wavelength of sodium light using Newton's Rings. (6) To study the diffraction pattern of single/double slit (7) To determine wavelength of a light source using plane diffraction grating. (8) To determine dispersive power and resolving power of a plane diffraction grating. (9) To determine the specific rotation of sugar solution using Polarimeter (10) To analyze elliptically polarized Light by using a Babinet's compensator			15	25	30
	Total			15	25	30

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

** The underlined parts are for formative assessment only

Reading Resources:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, (Asia Publishing House)
2. B.Sc. Practical Physics, C. L. Arora (S Chand)
3. A Textbook on Practical Physics, K G Mazumdar, B. Ghosh (Sreedhar Publishers)

Syllabus of 3rd Semester Major Course

Course title: **Mathematical Physics-I**

Course code: PHYMIN301

Nature of the course: Minor

Total credits: 4 (Theory-4, Practical -0)

Distribution of marks:

(A) Summative Assessment -60 (Theory -60, Practical-0)

(B) Formative Assessment – 40 (Theory -40, Practical-0)

Course Objective: To develop the requisite mathematical skills of a student to understand the fundamental topics in Physics and to prepare them for more advanced level of Physics

Learning Outcome: After completing this course, a student will be able to

(i) Write a problem in Physics in the language of Mathematics.

(ii) Identify a range of diverse mathematical techniques to formulate and solve a problem in basic Physics.

(iii) Analyze some of the basic mathematical concepts and methods.

(iv) Apply the knowledge and understanding of these mathematical methods to solve problems in a number of elementary branches of Physics like mechanics, electromagnetic theory, statistical Physics, thermal Physics etc.

PHYMIN301T: Mathematical Physics-I

Distribution of Marks : 60 (Summative) + 40 (Formative)

Unit	Content	L	T	P	M	Hr
Unit 1: Calculus	**1.1**: Functions and their plotting, Continuity and Differentiability of functions, Approximation methods: Taylor series, Maclaurin series.	4			4 3	4
	1.2: First Order Differential Equations, Integrating Factor, Second Order Differential Equations, Homogeneous and Inhomogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.	10			16	10
	1.3: Calculus of functions of more than one variable: Partial Derivatives, Exact and Inexact Differentials, Integrating Factor, Constrained Maximization using Lagrange Multipliers.	10			10 6	10
Unit 2: Vector Calculus	**2.1**: 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	12			7 13	12
	2.2 Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of 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).	14			25	14
Unit 5: Matrices	Definition, Addition and Multiplication of matrices, Transpose of a matrix, Hermitian conjugate of a matrix, Trace and Determinant, Inverse of a matrix, Special types of square matrices- Diagonal, Symmetric and Skew-symmetric, Hermitian and Skew-Hermitian.	10			3 13	10
	Total	60			100	60

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

** The underlined parts are for formative assessment only

Reading Resources:

(1) Mathematical Physics, H K Dass, Dr. Rama Verma (S Chand Ltd.)

(2) Vector Analysis, M R Spiegel, (McGraw Hill Education)

(3) Matrix Operations, R Bronson (McGraw-Hill Education)

(4) Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris (Elsevier)

Syllabus of 1st Semester Multidisciplinary Generic Elective Course

Course title: **Evolution of Science**

Course code: PHYGEC101

Nature of the course: Generic Elective

Total credits: 3 (Theory-3, Practical -0)

Distribution of marks:

(A) Summative Assessment -60 (Theory -60, Practical-0)

(B) Formative Assessment – 40 (Theory -40, Practical-0)

Course Objective: To provide students with

- **(i)** understanding of the historical development of scientific knowledge,
- **(ii)** knowledge of modern physics
- **(iii)** knowledge of the role of experimentation and observation in advancing scientific knowledge.
- **(iv)** Understanding of the impact of science on society

Learning Outcome: After completing this course, a student will be able to

- (i) attain knowledge of the development of science from antiquity to the present era.
- (ii) comprehend the noteworthy scientific breakthroughs, inventions, and contributions that have paved the way for modern science
- (iii) assess the influence of science on human civilization and how scientific progress has positively impacted societal progress

Course Code: PHYGEC101T

PHYGEC101: Evolution of Science

Distribution of Marks: 60 (Summative) + 40 (Formative)

Unit	Content	L	T	P	M#	Hr
Unit 1	Invention of wheel and beginning of science, Science for progress. Science in ancient world Medieval science Renaissance and industrial revolution: Rise of western science Contributions of Aristotle, Galileo Galilei, Robert Hooke, Darwin, Kepler etc. Contributions of Sir Isaac Newton: Laws of motion, Universal law of Gravitation	14			19	14
Unit 2	Nineteenth century and beginning of modern science: Developments of electricity and magnetism, Maxwell's contributions, Contributions of Thomas A. Addison	13			17	13
Unit 3	Einstein and Special Theory of Relativity: The paradigm shift. Quantum Theory, Quantum generation, The Second creation: development of concept of field quantisation, ups and downs. Nuclear era: space science and technology. Electronic age and birth of computers. Laser and optical evolution. Contemporary science and India's contribution.	18			24	18
	Total	**45**			**60**	**45**

For Summative Assessment

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

Reading resources:

a) The Scientific Revolution by Steven Shapin.

b) A history of physics in its elementary branches, including the evolution of physical laboratories by F. Cajori.

c) A brief history of Physics by P. F. Kisak

Syllabus of 1st Semester Skill Enhancement Course

Course title: **Electrical Wiring and Maintenance**

Course code: PHYSEC101

Nature of the course: SEC

Total credits: 3 (Theory-1, Practical -2)

Distribution of marks:

(A) Summative Assessment -60 (Theory -20, Practical-40)

(B) Formative Assessment – 40 (Theory -13, Practical-27)

Course Objective: (i)To develop skill of the students in domestic wiring and troubleshooting through hands-on mode.

(ii) To enable them to prepare working diagram of household electrical wiring.

Learning Outcome: After successful completion of this course, students will be able to identify various electrical devices, circuits and their symbols, familiar with schematic and wiring diagrams of electrical devices, understand electrical installation plan, perform and practice any type of domestic wiring and its maintenance.

PHYSEC101T: Electrical Wiring and Maintenance

Distribution of Marks: 20 (Summative) + 13 (Formative)

Unit	Content	L	T	P	M#	Hr
Unit 1: Basics of Electrical Circuits	Introductory concepts and basic circuit elements: Concept of Electric current and its unit, Conductors, Insulators, Resistance, potential and potential difference-unitsdifferent voltage sources (AC and DC)- Effects of current- - Ohm's law, heating effect of current, Joule's law of heating, electric power, electric energy, Analysis of DC circuits; Kirchhoff's laws: KCL, KVL, Current and voltage drop across the DC circuit elements. Series circuit, parallel circuit, combination circuit AC current and voltage, single-phase and three-phase alternating current sources, Transformers, transmission of AC Unit of power and energy, kWh, KVA. Different types of light sources like filament bulb, tube (fluorescent) light, CFL, LED and Neon light, Different types of switches, two-way, three-way, four-way switches, fan regulators, dimmer, different types of domestic electrical appliances and their power	4			5	4
Unit 2: Types of Wiring	Various types of tools and wiring accessories, Basics of wiring: casing-capping, PVC conduit wiring, concealed wiring (PVC/MS), comparison of different wire joint (flat and straight), types of wiring systems; selection and design of wiring schemes for particular situation (domestic), selection of wire, cables, wiring accessories and use of protective devices i.e., MCB, ELCB etc.; rating and current carrying capacity of wires, cables, fuse, switches, socket, MCBs, ELCBs and other electrical accessories.	2			3	2
Unit 3: Electrical Drawing and Symbols	Different types of electrical symbols used in domestic installation and power systems as per BIS code. Electrical Schematics. Power circuits and control circuits. Reading of circuit schematics. Understanding the connections of elements and identifying current flow and voltage drop. Wiring diagram of light, fan, bell and	6			8	6

	alarm circuit, staircase wiring, schematic diagram of lighting system of small room, hall and conference room, circuit breakers, inverter connections, Design and drawing of panels, distribution board using MCB, ELCB, main switches and change over switches for domestic installations, Estimation of electrical materials for domestic wiring					
Unit 4: Electrical Protection and Safety	Earthing: Concept and purpose of earthing, different types and procedure of earthing, drawing of plate and pipe earthing, test material and costing and estimating. Safety precautions: Effect of electric shock on human body, first aid for electric shock-rules and standards in house wiring, Introduction to Lightning Arresters – Types - Necessity and Advantages - Layout and Installation, Electrical Hazards and its effects - Basic safety introduction - Personal protection and PPE - Basic injury prevention - Basic first aid - Hazard identification and avoidance	3			4	3
Total		15			20	

PHYSEC101P: Electrical Wiring and Maintenance

Distribution of Marks: 40 (Summative) + 27 (Formative)

Unit	Content	L	T	P	M#	Hr
Unit 1: Basics of Electrical Circuits	1. Safety use in electricity, shock treatment methods, safety precautions. 2. To study & find the specifications of various types of wires and cables. 3. To measure the gauge of a given wire with the help of a wire gauge. 4. Prepare a chart of wattage of different electrical items/ appliances like CFL bulb, LED bulb, Tube light, Ceiling Fan, Table Fan, Gyger, Mixer-grinder, Refrigerator, Water pump, Iron, Xerox Machine, Inverter, TV, Hanging/ pendant Light, Microwave oven etc. 5. Measurements of ac voltage with multimeter. 6. To connect the wires with different electrical accessories. 7. Skinning the cable and joint practice on single and multi-strand wire 8. To make a main switch board for house wiring 9.Installation of common electrical accessories such as switch, holder, plug on board			30	40	60

	10. Installation and wiring connection of ceiling fan, exhaust fan, geyser, and water purifier. 11. Preparation of extension board with switches, sockets and indicator. 12. Demonstrate electrical circuit diagrams related to electrical household appliances. 13. Carry out the earthing of the installed electrical circuit as per standard practice 14. Practice on different types of House Wiring installation and testing 15. House wiring circuits using fuse, switches, sockets, ceiling fan etc. in P.V.C. casing-capping. 16. Prepare one estimate of materials required for CTS wiring for small domestic installation of one room and one verandah within 25 m2 with given light, fan & plug points.					
Total				30	40	60

For Summative Assessment

*L- Lecture, T- Tutorial, P- Practical, M- Marks, Hr – Hours

Reading Resources:

1. Elementary Electrical Engineering- M.L. Gupta (New Heights)
2. Electrical Installation and Estimating- Surjit Singh, (Dhanpatrai and sons)
3. A course in Electrical Installation, Estimating and costing- J B Gupta, S K Kataria and Sons
4. A textbook in Electrical Technology - B L Theraja (S Chand & Co).
5. A textbook of Electrical Technology - A K Theraja