Mizoram University

UG/Bachelor's Degree Programme with Multiple Entry and Exit Options

Under the New Education Policy 2020

in

PHYSICS

First Semester

Semester	Course Code	Course Name	Components with Credits		Total credits
			Theory	Practical	
I	PHY/MJ/100	Mathematical Physics - I	3	1	4
	PHY/MJ/101	Mechanics	4	-	4
	PHY/MN/102	Mechanics	4	-	4
		Introductory Course (Interdisciplinary)	3	-	3
	AEC/103	MIL/English I	3	-	3
	VAC/104	Understanding India	2	-	2
					20

Mathematical Physics - I

PHY/MJ/101
Credits: 4 (Theory 3 + Lab 1)

Unit 1

Calculus Limits, continuity and differentiation. Application of derivatives: maxima-minima, tangents-normal, rate of change, increasing and decreasing functions. Binomial theorem and Expansion and Taylor's expansion and application.
Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials with simple illustration.
Integral Calculus Integration as opposite of differentiation, Standard Integrals with simple illustrations, Integration as limit of a Sum, Definite integrals, calculation of area.

Unit 2

Matrices: A review of matrix addition and multiplications, Transpose and conjugate transpose of a matrix, Adjoint and inverse of a matrix, Transpose and inverse of product of two matrices.
Special matrices: Singular matrices, symmetric and skew symmetric matrices, Hermitian and skew Hermitian matrices, orthogonal and unitary matrices. Application of matrices: solution of linear algebraic equation by matrix methods, Rank of matrix.
Characteristic equation: eigen values, eigen vectors, calculation of eigen values and eigen vectors of (2x2) matrices, properties of eigen values & eigen vectors of Hermitian & unitary matrices, Trace of a matrix, diagonalisation of symmetric (2x2) and (3x3) matrix with examples.

Unit 3

Vector Calculus: Recapitulation of vectors: Scalars and Vectors, Vector product- dot and cross, Scalar and vector triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.
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

Unit 4

Vector Integration: Ordinary Integration of Vectors, Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (Qualitative ideas only).
Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, unit vectors in curvilinear co-ordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Laboratory

One (1) experiment is to be performed within 3 hours in the End Semester examination. A minimum of 4 experiments is to be performed by the students during the semester.

1. Determine the acceleration due to gravity by Bar pendulum.
2. Determine the Young's modulus of a wire by Searle method.
3. Determine the co-efficient of viscosity of water by Capillary method.
4. Determine the modulus of rigidity of a cylindrical body by statical method.
5. Determination of surface tension of a liquid by Capillary rise method.
6. Determine the frequency of tuning fork by Meldes' experiment.
7. Determination of acceleration due to gravity by Kater's pendulum.

Suggested Readings

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. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical Physics, B.D. Gupta, 2005, Vikas Publishing House, New Delhi
6. Mathematical Physics, Goswami, 1st edition, Cengage Learning
7. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
8. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.
9. A Handbook of Mathematical Physics, S. Gurung & L. Sailo, 2020, PUC & GSC Publn.
10. K. G. Majumdar and B. Ghosh: *A Textbook of Practical Physics*, Vol-I&II, Sreedhar Publications, Kolkata.
11. H Singh: *B.Sc. Practical Physics*, S. Chand & Co. Ltd. (latest edition)
12. C.L. Arora: *Practical Physics*, S. Chand & Co., Delhi.
13. S. K. Ghosh: *A Textbook of Practical Physics*, New Central Book Agency, Kolkata
14. C. R. Dasgupta: *A Textbook of Practical Physics*, Book Syndicate(P) Ltd, Kolkata

Mechanics

PHY/MJ/101
Credits: 4

Unit 1

Fundamentals of Dynamics Review of Newton's Laws of Motion. Momentum of variable-mass system: motion of rocket. Motion of a projectile in Uniform gravitational field, Dynamics of a system of particles: Centre of Mass, Motion of centre of mass. Principle of conservation of momentum. Impulse.

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

Unit 1

Gravitation and Central Force Motion Newton's law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Gravitational Potential and field due to bodies of various shapes (qualitative ideas and application). Motion of a particle under a central force field. Kepler's Laws. Satellite in circular orbit and applications.

Collisions Elastic and **inelastic** collisions in one and two dimensions.

Rotational Dynamics Angular momentum of a particle and system of particles. Torque. **Principle** of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia: Moment of inertia of rectangular, cylindrical and spherical bodies (qualitative ideas and application). Kinetic energy of rotation.

Unit 3

Oscillations SHM: Differential equation of SHM and its solution, Kinetic energy, potential energy, total Energy and their time-average values. Examples of simple harmonic oscillations: spring and mass system, simple and compound pendulum, torsional pendulum.

Free and forced vibration: conditions of maximum amplitude, resonance and quality factor.

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.

Unit 4

Special Theory **of Relativity** Frames of Reference: Inertial and Non-Inertial, Galilean transformations, Galilean invariance. Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations: Simultaneity and order of events, Length contraction, Time dilation, twin paradox. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities, Variation of mass with velocity. Mass less Particles. Mass energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.

Suggested readings

1. A treatise on General properties of Matter, Sen and Chatterjee, NCBA, Kolkata.
2. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
3. Elements of properties of Matter, D S Mathur, S. Chand & Co., New Delhi.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning

5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education.
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. A text book on Mechanics, P C Kalita, Global Net Publication, 2nd Edn. 2022
8. Properties of Matter, Oscillations and Acoustics, L. Sailo and R. Pachuau, 2020, Lois Bet Publn.