Name of the Department/Centre: Physics

Course Type (Please tick appropriate box):

Major	X	Discipline Specific Core		Ability Enhancement	
Minor		Multidisciplinary		Skill Enhancement	
Value Added		Any other			

Course Title: MECHANICS I

Semester: I

Total Credits: 3 **Lecture-Tutorial-Practical (LTP) breakup:** NOT APPLICABLE

Maximum Marks: 100 **No of seats:** ……

Course Advisor Name: Prof. Lekha Nair

Course Advisor's Email: lnair@jmi.ac.in

Prerequisites: Class XII Physics

Special Requirements (if any): No

Expected Learning Outcomes: The objective of this course is to impart the fundamental knowledge on mechanics. The course first teaches the fundamentals of linear and rotational motions to understand any dynamical systems. The laws of motion, the laws of conservations and other fundamental ideas will be given. The students will also learn about different kind of oscillations.

Course Syllabus (Unit wise):

Unit I: Fundamentals of Dynamics

Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Newton's Laws of motion, dynamics of a system of particles, centre of mass, conservation of momentum, impulse, variable mass system. Work-energy theorem, potential energy, conservative and non-conservative forces, force as gradient of potential energy. Stable and unstable equilibrium, Work done by non-conservative forces. Law of conservation of Energy.

Unit II: Rotational Dynamics

Angular momentum of a system of particles, torque and conservation of angular momentum, rotation about a fixed axis, moment of inertia tensor: its calculation for regular bodies, kinetic energy of rotation; Elastic and inelastic collisions between particles, centre of mass and laboratory frame. 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 III: Simple Harmonic Oscillations

Simple Harmonic Motion, Simple pendulum, Compound pendulum, Linearity and Superposition Principle, Superpositions of two and N collinear oscillations, Superposition of two perpendicular oscillations, Graphical and Analytical method, Lissajous Figures.

Unit IV: Damped, Forced and Coupled Oscillations

Free Damped oscillation. Forced oscillations: Transient and steady states; Resonance, Power Dissipation and Quality Factor, Coupled oscillations, normal modes.

References Books:

1. An introduction to mechanics : Kleppner & Kolenkow.
2. Feynman Lectures-Volume I,
3. Newtonian Mechanics : A.P.French,
4. Mechanics : Berkeley Physics Course
5. Vibrations and Waves : A. P. French.
6. The Physics of Waves and Oscillations : N.K. Bajaj

Name of the Department/Centre: **Physics**

Course Type (Please tick appropriate box):

Major	X	Discipline Specific Core		Ability Enhancement	
Minor		Multidisciplinary		Skill Enhancement	
Value Added		Any other			

Course Title: **MATHEMATICAL PHYSICS I**

Semester: I

Total Credits: 3 **Lecture-Tutorial-Practical (LTP) breakup:** NOT APPLICABLE

Maximum Marks: 100 **No of seats:** ……

Course Advisor Name: Dr. Pumlian Munga

Course Advisor's Email: pumlianmunga@jmi.ac.in

Prerequisites: Class XII Physics

Special Requirements (if any): No

Expected Learning Outcomes: Physics is generally referred as mathematical description of nature. To understand the underlying physical laws in nature one has to be equipped with proper mathematical training. In this mathematical physics course students will be exposed to different mathematical topics which they need to understand other areas of physics which they will read in their first year. It will also help them to understand the next level courses of mathematical physics as well.

Course Syllabus (Unit wise):

Unit I: Matrices and Linear Vector Space :

Matrix algebra; Different types of matrices; Quotient space; Inner Product; Abstract Systems; Binary Operations; Groups; Fields; Linear Vector Spaces; Subspaces; Linear Independence and Dependence; Basis; Dimensions; Change of basis; Homomorphism, Isomorphism, Linear and Non-singular Transformations, completeness and closure properties, linear operators system of linear equations, eigen values and eigen vectors, similarity transformation and diagonalization.

Unit II: Vector and Multivariate Calculus :

Vector algebra; Fields; Directional derivatives; normal derivative; Gradient; Divergence; Curl; Laplacian, Vector identities, Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of infinitesimal line, surface, volume elements; Line, surface, volume integrals of vector fields. Flux of a vector field, Gauss theorem, Green's theorem and Stokes Theorems, Orthogonal curvilinear coordinates: Calculation of divergence, gradient, curl and Laplacian in spherical polar and cylindrical coordinates. Multiple Integrals, Jacobian. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Differentiation of composite functions. Implicit functions. Taylor series expansion of function of more than one variable. Maxima and minima. Integrating factor, Constrained Maximization using Lagrange Multipliers.

Unit III: Ordinary Differential Equations :

FODE homogeneous and nonhomogeneous with variable coefficients, Integrating factors, Second Order Differential equations: Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems, Second-Order homogeneous and nonhomogeneous equations with constant and variable coefficients Particular Integral.

Unit IV: Fourier Series and Dirac Delta Function:

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function Properties and representation of Dirac delta function in 1D, 2D, 3D; integral representation; Fourier series: Periodic functions; Dirichlet Conditions; Fourier coefficients; complex form, Expansion of arbitrary period function, non-periodic function, even and odd functions; Half range expansions; Summing of infinite series; Parseval Identity.

References Books:

1.Vector Analysis : Schaum Series
2. Advanced Engineering Mathematics : Kreyzig
3. Linear Algebra : Schaum Series
4. Complex Variable : Spiegel
5. Linear Vector Spaces : M. C. Jain