STiCM: Special/Select Topics in Classical Mechanics

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Table of Contents and Key words

Unit No.	Lecture No.	Topic	Key Words
0	L01	Introduction to STiCM	Course Overview
1	L02-L06	Equations of Motion	Principles of Newtonian, Lagrangian & Hamiltonian Mechanics; Principle of Causality and Determinism, Linear Response, Principle of Variation, Symmetry and Conservation Laws
2	L07-L10	Oscillators, Resonances, Waves	Linear harmonic Oscillator, Small Oscillations, Damped, Driven Oscillator, Resonances, Electro-mechanical analogoues, Fourier analysis of waves, Dispersion
3	L11-L12	Polar Coordinate Systems	Plane polar, cylindrical polar and spherical polar coordinate systems.
4	L13-L14	Dynamical Symmetry in the Kepler Problem	Symmetry and Conservation Laws, Dynamical Symmetry, Laplace Runge Lenz vector, Kepler problem, 1/r potential.
5	L15-L18	Real Effects of Pseudo Forces	Cause-Effect relationship in Newtonian Dynamics, Principle of causality, Pseudo forces, Centrifugal force, Coriolis force
6	L19-L22	Special Theory of Relativity	Speed of Light, Galilean and Lorentz transformations, Time Dilation, Length Contraction, Twin Paradox

7	L23-L25	Potentials, Gradients, Fields	Directional derivative, Potentials, Gradients, Fields, del/nabla/gradient operator in Cartesian & Polar coordinate systems.
8	L26-L28	Gauss' Law, Equation of Continuity	Fluid Mechanics, Gauss Divergence Theorem/Law, Equation of Continuity, Conservation of mass/charge, Expression for divergence in Cartesian and Polar coordinate systems.
9	L29-L30	Fluid Flow, Bernoulli Principle	Equation of Motion for a fluid, convective derivative, curl of a vector, Vorticity, Stokes' theorem, Expressions for curl of a vector in Cartesian and Polar coordinate systems, Bernoulli's principle,
10	L31-L34	Introduction to Classical Electrodynamics	Divergence & Curl of the electric and magnetic fields, Maxwell's equations, speed of light, special theory of relativity
11	L35-L39	Introduction to Chaotic Dynamical Systems	Non-linear dynamics, Logistic map, Bifurcations, Chaos, Feigenbaum constant, Attractor, Strange Attractor, Fractal, Mandelbrot set.
12	L40	Scope and Limitations of Classical Mechanics	Description of the state of a mechanical system, position and momentum, Applications of Classical Mechanics, Limitations of Classical Mechanics, uncertainty principle, state vector, complete set of commuting operators.