P.B. SIDDHARTHA COLLEGE OF ARTS & SCIENCE

Siddhartha Nagar, Vijayawada – 520 010

Autonomous -ISO 9001 - 2015 Certified

CLASSICAL MECHANICS

Offered to : M.Sc.(PHYSICS) **Course Code**: 22PH1T1

Course Type : Core **Course: CLASSICAL MECHANICS**

Year of Introduction :2004 **Year of offering :** 2022

Year of Revision :2022 **Percentage of Revision :** Nil

Semester : I **Credits : 4**

Hours Taught : 60 hrs. per Semester **Max.Time** : 3 Hours

Course Description : Classical mechanics (22PH1T1) is introduced for describing the motion of macroscopic objects as well as astronomical objects under the influence of a system of forces. It is concerned with the set of physical laws describing the motions of bodies mathematically and is highly essential for the enhancing the logical and analytical thinking of the students. For objects governed by classical mechanics, if the present state is known, it is possible to predict how it will move in the future as well as how it has moved in the past. The classical mechanics was based the foundational works of Sir Isaac Newton, and the mathematical methods by Leibniz, Lagrange, Leonhard Euler, etc., in the 17th century. Later, more abstract methods were developed, leading to the reformulations of classical mechanics known as Lagrangian mechanics and Hamiltonian mechanics. They are used in all areas of modern physics.

Course Objectives:

1. To understand the Lagrangian equations for simple classical systems
2. To learn the concept of Hamiltonian mechanics for classical systems
3. To learn the Hamilton-Jacobi formalism of simple classical systems.
4. Tounderstand the canonical transformations and passion bracket relations
5. To impart the methods of solving rigid body dynamics

Course Outcomes: At the end of this course, students should be able to:

CO1:Understand the concepts of Lagrangian formulation and can describe the motion of mechanical
systems using Lagrangian formulation.

CO2:Apply the Hamilton formalism to solveproblems.

CO3:Apply the concepts of canonical transformations and poission brackets formulation on physical
systems

CO4:Understand the formulation of Hamilton-Jacobi equation.
CO5:Apply knowledge the concept of rigid body dynamics and rotating frames on different systems.

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**NewtonianMechanicsandLagrangianmechanics** Newton'slaws,Mechanicsofaparticle:Conservationlaws,Mechanicsofasystemofparticles:Conservation laws, Constraints, D'Alembert's principle and Lagrange's equations, Velocity Dependentpotentials and the Dissipation function, L-C Circuit, Lagrangian for a Charged Particle Moving in anElectromagneticfield. (CO1)	12
II	Variationalprinciples Hamilton's principle,Deduction of Hamilton's equations from modified Hamilton principle,Derivationof Lagrange'sequations from variational Hamilton'sprinciple, Simple applicationsof the HamiltonprincipleFormulation-Simplependulum,Principleof LeastAction. (CO2)	12
III	Canonicaltransformations Legendretransformations,EquationsofcanonicaltransformationExamplesofCanonicaltransformations, The harmonic Oscillator, Poisson brackets and other Canonical invariants, Equations ofmotion,Infinitesimalcanonicaltransformations,andconservationtheoremsinthePoissonbracketformulation,theangularmomentumPoissonbracketrelations. (CO3)	12
IV	Hamilton–JacobiMethod Hamilton – Jacobi equation of Hamilton's principal function, The Harmonic oscillator problem as anexample of the Hamilton – Jacobi Method, Hamilton –Jacobi equation for Hamilton's characteristicfunction,Action–angle variablesinsystemsof onedegreeoffreedom. (CO4)	12
V	Dynamics ofarigidbody Independent coordinates of rigid body,The Eulerangles,infinitesimal rotations as vectors (angularvelocity), components of angular velocity, angular momentum and inertia tensor, principal moments ofinertia, rotational kinetic energy of a rigid body, Symmetric bodies, Euler's equationsof motion for arigidbody,Torque-free motionof arigidbody. (CO5)	12

Reference Books:

1. ClassicalMechanics,H.GOLDSTEIN(AddisonWesley) 2005.
2. ClassicalMechanics, J.C.UPADHYAYA(HimalayaPublishingHouse) 2010.
3. ClassicalMechanics,Gupta,KumarandSharma, PragatiPrakashan,2001
4. ClassicalMechanics,G.Aruldass,PHILearningPrivateLtd,2009

Course Delivery method : Face-to-face / Blended
Course has focus on : Employability
Websites of Interest :https://nlist.inflibnet.ac.in/vsearch.php
Co-curricular Activities Quiz.

P.B. Siddhartha College of Arts & Science, Vijayawada - 520 010.
(An Autonomous College in the jurisdiction of Krishna University)
M.Sc., (PHYSICS) Programme – I Semester
Course Code: 20PH1T1 Title: CLASSICAL MECHANICS
(w.e.f admitted batch 2022-23)

Time: 3 Hours **Max. Marks: 70**

SECTION-A

Q.NO **Answer All Questions 5x4=20M**

1. (A)Explain the concept of generalized co-ordinates
   (Or) (CO1) L2
   (B)Explain Newton's laws of motions with examples

2. (A)Discuss about Hamiltonian function (H)
   (Or) (CO2) L2
   (B)Explain variational principle

3. (A) What are Legendre transformations?
   (Or) (CO3) L1
   (B) Define Poisson Bracket.

4. (A)What is Hamilton's principle function?
   (Or) (CO4) L1
   (B)What are action-angle variables?

5. (A)Define inertia tensor with examples
   (Or) (CO5) L1
   (B)What are space coordinate systems?

SECTION-B
Answer All Questions5x10=50M

6. What are constraints? Classify them with suitable examples.
   (Or)
   State D'Alemberts principle and simply Lagrange's equation of motion from it. (CO1) L2

7. A) State and explain the Hamilton's principle.
   (Or)
   B) Demonstrate Hamilton's equations from modified Hamilton's principle. (CO2) L2

8. A) Apply canonical transformations to the harmonic oscillator problem.
   (Or)
   B) Solve the that Poisson's brackets and their properties from canonical transformations (CO3) L3

9. A) Explain the harmonic oscillator problem using Hamilton-Jacobi method.
   (Or)

B) Explain the significance of Hamilton's characteristic function. (CO4) L2

10. A) Explain Euler's angles and obtain transformation matrix.

(Or)

B) Explain the rotational kinetic energy of a rigid body. (CO5) L2

Note: Question paper contains 5 short answers with internal choice from each unit and 5 long answer questions with internal choice from each unit.