Classical Mechanics

PHYS-301

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**Office hours:** Mon, Wed and Fri 9am-10am

**COURSE OBJECTIVES**

Classical mechanics is where it all started. Newton demonstrated that the same forces and laws of mechanics that apply to apples and everyday objects also govern the behavior of the moon and the planets. In a wide array of physical situations, classical mechanics is all you need to be able to predict the motion of apples, baseballs, bones, bridges, cars, cats, and so on. For these two reasons  
alone: the universality of the laws and their wide range of applicability, classical mechanics  
is an essential topic for students of physics. In this course we will encounter more advanced techniques and solve a wider variety of problems.

**LEARNING OUTCOMES**

Through this course, the students will be able to:

• Acquire the basic concepts that can be treated with elementary mathematics.

• Enhance the working knowledge of the elementary physics principles related to the course, as well as

their application,

• Design a system, component or process to meet desired needs.

**COURSE OUTLINES**

Study of the motion of particles and system of particles, Direct application of Newtonian mechanics;

Lagrangian formulation; Hamiltonian formulation; Motion under an inverse force field; Two body

problems; planetry orbital motion; legendre transformations; canonical transformations and their

properties; Poisson’s brackets, theorems and invariance, laboratory

**Prerequisites**

PHYS 103 or Math 302

**Course Materials:**

1. **Classical mechanics** , Herbert Goldstein, Addison-Welsey reading, 1950
2. **Mechanics,** L.D. Landau and E.M. Lifshitz, Pergamon, Oxford, 1960

**Course grading:**

Your final grade will be based on the following:

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| --- | --- |
| Assignments or Quizzes 0r Presentations | 40% |
| Midterm Test | 30% |
| Final Examination | 30% |
|  | 100% |

**Syllabus and Tentative schedule:**

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| **Week** | **Learning Activity** |
| **1** | Brief Survey of Newtonian mechanics  of a single and system of particles |
| **2** | Generalized coordinates; Constraints; |
| **3** | Lagrange’s equation and its Applications |
| **4** | Calculus of variation and Hamilton’s principle |
| **5** | Hamilton’s principle and Lagrange’s equation |
| **6** | Legendre transformation and Hamilton equation of motion |
| **7** | Cyclic coordinates, integrals of motion |
| **8** | Conservation theorems and physical  significance of Hamiltonian for simple cases |
| **9** | 2 body central force problem |
| **10** | Equation of motion and solution for one body problem |
| **11** | Centre of mass coordinate systems and their mutual  transformations, Rutherford scattering formula |
| **12** | Canonical transformations and their examples |
| **13** | Lagrange’s and Poisson’s brackets |
| **14** | Poisson’s theorems and invariance, Revision |

**Attendance:**

Students are required to attend all the lectures. Those students whose attendance falls below 70%.