| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| BPHY202L | Classical Mechanics | 3 | 0 | 0 | 3 |
| Pre-requisite | NIL | Syllabus Version | | | |
| | | 1.0 | | | |

**Course Objectives**

1. Students should understand the utility of Newtonian approach to solve advanced problems involving the dynamic motion of classical mechanical systems.
2. Students will be introduced about the forces, angular momentum and knowledge about the constraint.
3. How to use differential equations and other advanced mathematics in the solution of the problems considered in item 1.
4. To understand different formalisms in classical mechanics.

**Course Outcomes**

1. Understand basic mechanical concepts related to advanced problems involving the dynamic motion of classical mechanical systems.
2. Apply the notion of force along with work energy theorem and collision.
3. Explain Lagrangian formalism.
4. Understand the importance of Hamiltonian formalism.
5. Describe and understand the motion of planets through laws of Gravitation.

| Module:1 | Fundamentals of Dynamics | 6 hours |
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Reference frames - Inertial frames - Galilean transformations - Galilean invariance - Review of Newton's Laws of Motion - Dynamics of a system of particles - Centre of Mass - Principle of conservation of momentum - Impulse

| Module:2 | Forces | 4 hours |
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Fundamental forces - Gravity - Principle of equivalence - Electrostatic force - Phenomenological forces - Contact forces, tension, normal force and friction

| Module:3 | Work – Energy | 7 hours |
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Work and Kinetic Energy Theorem - Conservative and nonconservative forces - Potential Energy - Energy diagram - Stable and unstable equilibrium - Elastic potential energy - Force as gradient of potential energy - Work and Potential energy - Work done by non-conservative forces - Law of conservation of Energy

| Module:4 | Collision | 6 hours |
|---|---|---|

Momentum in collisions - KE in collision - Elastic and inelastic collisions between particles -Equal and different mass – 2D collision - Centre of Mass and Laboratory frames

| Module:5 | Lagrangian Formalism | 7 hours |
|---|---|---|

Generalized coordinates - Principle of virtual work – D' Alembert's principle - Lagrangian formulation and simple applications

| Module:6 | Hamiltonian Formalism | 7 hours |
|---|---|---|

Hamiltonian equations of motion - Cyclic coordinates - Phase space and Liouville's theorem - Comparison with Lagrangian approach

| Module:7 | Gravitation | 6 hours |
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Laws of gravitation - Kepler's laws - Gravitational potential energy - Inertial and gravitational mass - Potential and field due to spherical shell and solid sphere - Geosynchronous orbits - Weightlessness - Basic idea of global positioning system (GPS) - Physiological effects on astronauts

| **Module:8** | **Contemporary Issues** | **2 hours** |
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| Guest lecture from industry and R & D organisations | | |
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| | **Total Lecture hours:** | **45 hours** |

| **Text Book(s)** | |
|---|---|
| 1. | D. Kleppner, R.J. Kolenkow, An introduction to Mechanics, 2017, 1st Edition, McGraw Hill Education, India. |
| 2. | H. Goldstein, Classical Mechanics, 2011, 3rd Edition, Pearson Education. |
| **Reference Books** | |
| 1. | A. P. French, Newtonian Mechanics (MIT Introductory Physics Series), 2017, Viva Norton Student Edition, India. |
| 2. | C. Kittel, W. Knight, M.A. Ruderman, C. A. Helmhotz, B.J. Moyer, Mechanics: Berkeley Physics, Vol.1, 2017, 2nd Edition, McGraw Hill, India. |
| 3. | Resnick, Halliday and Walker, Principles of Physics, 2015, 10th Edition, Wiley, India. |
| 4. | D.S. Mathur and P.S. Hemne, Mechanics, 2021, S.Chand Publishing, India. |
| 5. | Rana and Joag, Classical Mechanics, 2017, McGraw Hill Education, India. |
| 6. | G.R. Fowles and G.L. Cassiday, Analytical Mechanics 2005, Cengage Learning. |
| 7. | R.P. Feynman, R.B. Leighton, M. Sands, Feynman Lectures, Vol. I, 2012, Pearson Education. |
| 8. | R. Resnick, Introduction to Special Relativity, 2007, 1st Edition, Wiley, India. |
| 9. | F.W. Sears, M.W. Zemansky, H.D Young, University Physics. 2015, Student Edition, Addison Wesley. |
| 10. | Ronald Lane Reese, University Physics, 2003, Thomson Brooks/Cole. |
| 11. | J.W. Jewett, R.A. Serway, Physics for scientists and Engineers with Modern Phys., 2018, 10th Edition, Brooks/Cole. |
| 12. | M.R. Spiegel, Theory and Problems of Theoretical Mechanics, 2017, Tata McGraw Hill. |

Mode of Evaluation: CAT, Written Assignment, Quiz and FAT

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| Recommended by Board of Studies | 20-06-2023 | | |
| Approved by Academic Council | No. 70 | Date | 24-06-2023 |