Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Bengaluru
22PHY106- Computational Physics (L-2, T-0, P-3): 3 Credits
Odd Semester: 2022-23; B.Tech AIE First Semester

Course Objectives

- The course will lay down the basic concepts and techniques needed for verticals such as robotics.
- It will explore the concepts initially through computational experiments and then try to understand the concepts/theory behind them.
- It will help the students to perceive the engineering problems using the fundamental concepts in physics.
- Another goal of the course is to provide the connection between the concepts of physics, mathematics, and computational thinking.

Course Outcomes (COs)

CO1	Apply the principles of statics to solve elementary problems in physics.
CO2	Apply computational techniques to solve elementary problems in statics.
CO3	Apply computational techniques to solve elementary problems in dynamics.
CO4	Analyze the motion of rigid bodies by applying fundamental principles of dynamics.

Programme Outcomes (POs)

PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

PSO1	Have the ability to apply mathematical and analytical techniques to model complex problems.
PSO2	Have a strong foundation in programming, together with knowledge of modern languages, tools and technologies needed to build secure, robust software systems.
PSO3	Have the knowledge of AI and ML techniques required for the design and development of intelligent systems to solve real world problems.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	3	-	-	-	2	2	-	2	3	-	-
CO2	3	2	-	-	3	-	-	-	2	2	-	2	3	-	-
CO3	3	2	-	-	3	-	-	-	2	2	-	2	3	-	-
CO4	3	2	2	-	3	-	-	-	2	2	-	2	3	-	1

Syllabus

Unit 1	Newton's Laws of Motion, Force as 3D Vector, Resolution of Forces, Resultant of Forces.
Unit 2	Equilibrium about a Point, Moment, Couple, Equivalent System, Equilibrium of Rigid Bodies, Degree-of-freedom and Constraints at Supports, Free Body Diagram.
Unit 3	Kinematics of particles, assumptions, Cartesian, Cylindrical and Spherical frames, and motion of particles in them. Translation and rotation of rigid bodies in 2D – Translation and rotation of rigid bodies in 3D.
Unit 4	Kinematics of interconnected rigid bodies– Definition of a linkage – Definition of a mechanism –Four-bar mechanism.

Text Books / References

Beer F.P. and Johnston E.R., Vector Mechanics for Engineers - Volume I - Statics, Volume II - Dynamics, McGraw Hill, New York, 2004.

Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - statics, Volume 11- dynamics, John Wiley & Sons, New York, 2018.

Hibbeler R. C., Engineering Mechanics: Statics and Dynamics, 11th edition, Pearson Education India, 2017

Saha, S. K., Introduction to Robotics, McGraw-Hill, 2014.

Rattan, S. S., Theory of Machines, McGraw-Hill, 2014.

Course Plan

Week 1	Introduction to Course, Newton's Laws of Motion, Introduction to Vector Algebra
Week 2	
Week 3	Force as Vector, Resolution and Resultant of Forces [Tool: GeoGebra in Labs]
Week 4	Equilibrium about a point [Tool: GeoGebra]
Week 5	Equilibrium of Rigid bodies [Tool: GeoGebra]
Week 6	Degree-of-freedom, Constraints at Supports (Beams), Free Body Diagram (Truss, Friction, etc.)
Week 7	
Week 8	Kinematics of Particles [Tool: MATLAB]
Week 9	
Week 10	Kinematics of Rigid Body [Tool: RoboAnalyzer, HTM Module]
Week 11	
Week 12	Kinematics of Mechanisms [Tool: GeoGebra and MechAnalyzer]
Week 13	
Week 14	Analysis of Planar Mechanisms [Tool: MATLAB, GeoGebra and MechAnalyzer]
Week 15	

Proposed Evaluation Scheme

Component	Event Type	Weightage
Internal (70%)	**Assignments 3: Two Lab Evaluations and One Project (Team of 2 Students)**	30%
	Quizzes 2	20%
	Mid Term Exam (During T2 of Other Branches)	20%
External (30%)	**End Semester Exam**	30%