

Syllabus

Indiana Wesleyan University
PHYS-502: Classical Mechanics
Winter/Spring II 2022
3/1/2022 – 4/25/2022
Format: Online Asynchronous
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Course Description

This course focuses on Newtonian (non-relativistic) mechanics and its Lagrangian formulation with applications to the motions of particles in three dimensions, systems of particles, gravitation and orbits, rigid body rotations and small vibrations).
Prerequisites: a bachelor's degree with a physics major or be state certified (in any state) to teach Physics at a secondary school level, and PHYE-501 or equivalent.

Note: This course is designed for those seeking the credentials required by many regional accrediting bodies in order to be able to teach advanced placement, concurrent early college, and community college Physics courses.

Credit Hours: 3

Prerequisite Courses: PHYE-501 or equivalent

Prerequisite Skills and Knowledge: A bachelor's degree with a physics major or be state certified (in any state) to teach Physics at a secondary school level, and PHYE-501 or equivalent. Undergraduate coursework must include calculus (through multivariate) and ordinary differential equations.

Course Outcomes

Upon successful completion of this course, you should be able to:

1. Apply Newton's Laws of Motion and the Universal Law of Gravitation to solve for the motions of particles, systems of particles, rigid objects and small oscillations.
2. Demonstrate the origin and application of conservation laws in the Newtonian context.
3. Develop the Lagrangian, Hamiltonian and Hamilton-Jacobi formulations of Newton's Laws.
4. Apply the Lagrangian and Hamiltonian formulations to solve problems for systems with holonomic constraints using generalized coordinates.
5. Translate between mathematical descriptions and experimentally observable behavior.

- Solve systems of differential equations for motion numerically using technology (e.g. Mathematica, Maple).

Course Textbook

Goldstein, H., Poole, C., & Safko, J. (2002). *Classical mechanics*. San Francisco: Addison Wesley.

Taylor, J. R. (2002). *Classical mechanics*. Sausalito, CA: University Science Books.

Course Technology

Each student will receive a short-term site license for Mathematica Online. This is arranged through Indiana Wesleyan.

Problem sets will be required to be submitted as a PDF formatted using LaTeX. LaTeX is a free download for Mac, PC, and Linux. The .tex file for each problem set can be downloaded and completed. In the event there is difficulty with compiling a LaTeX document, scanned work may be submitted for partial credit.

IWU Diversity Statement

IWU, in covenant with God's reconciling work and in accordance with the Biblical principles of our historic Wesleyan tradition, commits to build a community that reflects Kingdom diversity.

We will foster an intentional environment for living, teaching, and learning, which exhibits honor, respect, and dignity. Acknowledging visible or invisible differences, our community authentically values each member's earthly and eternal worth. We refute ignorance and isolation and embrace deliberate and courageous engagement that exhibits Christ's commandment to love all humankind. (2016)

Grading Scale

NOTE: In graduate level courses, a grade of C- or below will require the course to be repeated.

Grade	Quality Points Per Credit	Percentage	Score
A	4.0	95%–100%	1222-1285
A-	3.7	92%–94.9%	1183-1221

B+	3.3	89%–91.9%	1145-1182
B	3.0	85%–88.9%	1093-1144
B-	2.7	82%–84.9%	1055-1092
C+	2.3	79%–81.9%	1016-1054
C	2.0	75%–78.9%	965-1015
C-	1.7	72%–74.9%	926-964
D+	1.3	69%–71.9%	887 – 925
D	1.0	65%–68.9%	836 – 886
F	0.0	0%–64.9%	0 – 835

Grading Policies

Your grading policy for your course is dependent on your school and program. Your grading policies can be found in the [IWU Catalog](#).

Letter Grade Equivalencies

NOTE: In graduate level courses, a grade of C- or below will require the course to be repeated.

Grade	Description of Work
A	Clearly stands out as excellent performance. Has unusually sharp insights into material and initiates thoughtful questions. Sees many sides of an issue. Articulates well and writes logically and clearly. Integrates ideas previously learned from this and other disciplines. Anticipates next steps in progression of ideas. Example "A" work should be of such nature that it could be put on reserve for all cohort members to review and emulate. The "A" cohort member is, in fact, an example for others to follow.
B	Demonstrates a solid comprehension of the subject matter and always accomplishes all course requirements. Serves as an active participant and listener. Communicates orally and in writing at an acceptable level for the degree program. Work shows intuition and creativity. Example "B" work indicates good quality of performance and is given in recognition for solid

	work; a "B" should be considered a good grade and awarded to those who submit assignments of quality less than the exemplary work described above.
C	Quality and quantity of work in and out of class is average. Has marginal comprehension, communication skills, or initiative. Requirements of the assignments are addressed at least minimally.
D	Quality and quantity of work is below average. Has minimal comprehension, communication skills, or initiative. Requirements of the assignments are addressed at below acceptable levels.
F	Quality and quantity of work is unacceptable and does not qualify the student to progress to a more advanced level of work.

Course Workshop Summary

Workshop	Devotional / Science Philosophy Discussion	Practical Applications Discussion	Concepts Quiz	Problem Set (Includes a Mathematical Component)	Total Points
Module One	15	55	10	80	160
Module Two	15	55	13	80	163
Module Three	15	55	10	80	160
Module Four	15	55	9	80	159
Module Five	15	55	12	80	162
Module Six	15	55	9	80	159

Module Seven	15	55	13	80	163
Module Eight	15	55	9	80	159
TOTAL	120	440	85	640	1285

Module One Outline

Title	Due Dates	Time	Points
1.1 Discussion: New Ideas	Due by noon of the second day; comments due by end of module	1 hour	15
1.2 Reading	Due by the end of the module	4 hours	0
1.3 Discussion: Modern Discoveries	Initial post due by the end of the third day; two responses due by the end of the module	3 hours	55
1.4 Quiz: Reading Check	Due by the end of the fourth day of the module	1 hour	10
1.5 Assignment: Physics Problems	Due by the end of the module	5 hours	80
Totals		14 hours*	160

Module Two Outline

Title	Due Dates	Time	Points
2.1 Discussion: All Things in Time	Initial post due by noon of the second day of the module; comments due by end of module	1 hour	15
2.2 Reading	Due by the end of the module	4 hours	0
2.3 Discussion: Lagrange's Equations in Action	Initial post due by the end of the third day; two responses due by the end of the module	3 hours	55

Title	Due Dates	Time	Points
2.4 Quiz: Reading Check	Due by the end of the fourth day of the module	1 hour	13
2.5 Assignment: Physics Problems	Due by the end of the module	5 hours	80
Totals		14 hours*	163

Module Three Outline

Title	Due Dates	Time	Points
3.1 Discussion: Meaning in Toil	Initial post due by noon of the second day of the module; comments due by end of module	1 hour	15
3.2 Reading	Due by the end of the module	4 hours	0
3.3 Discussion: Hamiltonian's Equations in Action	Initial post due by the end of the third day; two responses due by the end of the module	2 hours	55
3.4 Quiz: Reading Check	Due by the end of the fourth day of the module	1 hour	10
3.5 Assignment: Physics Problems	Due by the end of the module	5 hours	80
Totals		13 hours*	160

Module Four Outline

Title	Due Dates	Time	Points
4.1 Discussion: Endless Hunger	Due by noon of the second day; comments due by end of module	1 hour	15
4.2 Reading	Due by the end of the module	3 hours	0

Title	Due Dates	Time	Points
4.3 Discussion: Virial Theorem	Initial post due by the end of the third day; two responses due by the end of the module	2 hours	55
4.4 Quiz: Reading Check	Due by the end of the fourth day of the module	1 hour	9
4.5 Assignment: Physics Problems	Due by the end of the module	5 hours	80
Totals		12 hours*	159

Module Five Outline

Title	Due Dates	Time	Points
5.1 Discussion: Wisdom	Due by noon of the second day; comments due by end of module	1 hour	15
5.2 Reading	Due by the end of the module	3 hours	0
5.3 Discussion: Rigid Body Equations of Motion	Initial post due by the end of the third day; two responses due by the end of the module	2 hours	55
5.4 Quiz: Reading Check	Due by the end of the fourth day of the module	1 hour	12
5.5 Assignment: Physics Problems	Due by the end of the module	5 hours	80
Totals		12 hours*	162

Module Six Outline

Title	Due Dates	Time	Points
6.1 Discussion: The Magnitude of Knowledge	Due by noon of the second day; comments due by end of module	1 hour	15
6.2 Reading	Due by the end of the module	3 hours	0
6.3 Discussion: Oscillators	Initial post due by the end of the third day; two responses due by the end of the module	2 hours	55
6.4 Quiz: Reading Check	Due by the end of the fourth day of the module	1 hour	9
6.5 Assignment: Physics Problems	Due by the end of the module	5 hours	80
Totals		12 hours*	159

Module Seven Outline

Title	Due Dates	Time	Points
7.1 Discussion: Remember Your Creator While You are Young	Due by noon of the second day; comments due by end of module	1 hour	15
7.2 Reading	Due by the end of the module	3 hours	0
7.3 Discussion: Special Relativity	Initial post due by the end of the third day; two responses due by the end of the module	2 hours	55
7.4 Quiz: Reading Check	Due by the end of the fourth day of the module	1 hour	13
7.5 Assignment: Physics Problems	Due by the end of the module	5 hours	80
Totals		12 hours*	163

Module Eight Outline

Title	Due Dates	Time	Points
8.1 Discussion: The Conclusion of the Matter	Due by noon of the second day; comments due by end of module	1 hour	15
8.2 Reading	Due by the end of the module	3 hours	0
8.3 Discussion: Action Angles and Perturbation Theory	Initial post due by the end of the third day; two responses due by the end of the module	2 hours	55
8.4 Quiz: Reading Check	Due by the end of the fourth day of the module	1 hour	9
8.5 Assignment: Physics Problems	Due by the end of the module	5 hours	80
8.5 Assignment: Physics Problems	Due by the end of the module	30 minutes	10 extra credit
Totals		12.5 hours*	159

* These times are only estimates. Actual assignment completion times will vary.

Course Assignments

TOTALS	101.5 hours*	1285
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* These timings are based on estimations of average times to complete each assignment. Actual assignment completion times will vary.

Course Development Resources

Kline, M. (2013). *Calculus An Intuitive and Physical Approach (Second Edition)*.

Newburyport: Dover Publications

Lay, D. C. (2012). *Linear algebra and its applications*. Boston: Addison-Wesley.

Serway, R. A., Moses, C. J., & Moyer, C. A. (2005). *Modern physics*. Belmont, CA:

Thomson Brooks/Cole.

Shilov, G. E., & Silverman, R. A. (1977). *Linear algebra*. New York: Dover Publications.

Sochi, T. (2017). *Tensor calculus made simple*. United States: CreateSpace Independent Publishing Platform.

Spain, B. (2003). *Tensor calculus: A concise course*. Mineola (N.Y.): Dover.

Stewart, J. (2016). *Calculus: Early transcendentals*. Boston, MA, USA: Cengage Learning.

Expectations, Policies, and Important Student Information

School/Division	Link
DeVoe School of Business Division of Liberal Arts School of Services and Leadership	View School/Division Expectations, Policies, and Student Information
School of Educational Leadership	View School/Division Expectations, Policies, and Student Information
Wesley Seminary @ IWU	View School/Division Expectations, Policies, and Student Information
Nursing - Undergraduate	View School/Division Expectations, Policies, and Student Information
Nursing - Graduate	View School/Division Expectations, Policies, and Student Information