COURSE OUTLINE : PHY 101H
D Credit – Degree Applicable
COURSE ID 004035
Cyclical Review: February 2020

COURSE DISCIPLINE : PHY

COURSE NUMBER : 101H

COURSE TITLE (FULL) : Honors Physics for Scientists and Engineers: A

COURSE TITLE (SHORT) : H Phy for Sci and Eng: A

CALIFORNIA STATE UNIVERSITY SYSTEM C-ID : PHYS 205 - Calculus-Based Physics for Scientists and Engineers: A

CATALOG DESCRIPTION

PHY 101H is the first course in a three-semester sequence intended for students majoring in engineering and the physical sciences. The course covers topics in classical mechanics, including motion, kinematics, forces, work, energy, momentum, angular motion, static equilibrium, and Newtonian gravity. Vectors and derivatives are used extensively throughout the course. Computers and numerical techniques are used extensively in the laboratory component of the course. The honors course will be enhanced in one or more of the following ways: 1. Readings from Principia, Newton's original formulation of mechanics; 2. A written paper and an oral presentation on topics in contemporary mechanics such as gyroscopic stability, G.P.S. systems, and celestial mechanics; 3. Advanced homework problem sets.

Total Lecture Units: 4.00

Total Laboratory Units: 1.00

Total Course Units: 5.00

Total Lecture Hours: 72.00

Total Laboratory Hours: 54.00

Total Laboratory Hours To Be Arranged: 0.00

Total Contact Hours: 126.00

Total Out-of-Class Hours: 144.00

Prerequisite: MATH 103E and MATH 104E (may be taken concurrently). Recommended Preparation: High school physics.

ENTRY STANDARDS

	Subject	Number	Title	Description	Include
1	MATH	103E	Calculus and Analytic Geometry	find limits of functions at real values and at infinity using numerical, graphical, and algebraic approaches;	Yes
2	MATH	103E	Calculus and Analytic Geometry	find the derivative of a function as a limit;	Yes
3	MATH	103E	Calculus and Analytic Geometry	use the derivative for rate of change problems;	Yes
4	MATH	103E	Calculus and Analytic Geometry	find the equation of a tangent line to a function at a point;	Yes
5	MATH	103E	Calculus and Analytic Geometry	compute derivatives using differentiation formulas: constants, power rule, product rule, quotient rule and chain rule. Calculate higher order derivatives;	Yes
6	MATH	103E	Calculus and Analytic Geometry	use differentiation to solve applications such as related rate problems and optimization problems;	Yes
7	MATH	103E	Calculus and Analytic Geometry	find derivatives of transcendental functions: trigonometric, exponential, logarithmic, and others;	Yes
8	MATH	103E	Calculus and Analytic Geometry	graph functions using the methods of calculus;	Yes
9	MATH	103E	Calculus and Analytic Geometry	evaluate a definite integral as a limit of Riemann sums;	Yes
10	MATH	103E	Calculus and Analytic Geometry	apply integration to find areas, apply properties of integrals;	Yes
11	MATH	103E	Calculus and Analytic Geometry	use substitution to integrate;	Yes
12	MATH	104E	Calculus and Analytic Geometry	determine work done in applications involving liquids and springs;	Yes
13	MATH	104E	Calculus and Analytic Geometry	evaluate definite and indefinite integrals using a variety of techniques, including integration by parts, trigonometric substitution, and partial fractions;	Yes
14	MATH	104E	Calculus and Analytic Geometry	evaluate improper integrals;	Yes
15	MATH	104E	Calculus and Analytic Geometry	graph conic sections;	Yes

EXIT STANDARDS

1 analyze the motion of objects with constant acceleration;
2 apply Newton's laws of motion to the dynamics of physical systems;
3 calculate the work performed by forces;
4 explain conservation of energy, momentum, and angular momentum;
5 use conservation laws to predict the state of dynamical systems;
6 calculate forces necessary for the static equilibrium of physical objects;
7 describe Newtonian gravity, and apply it to planetary motion;
8 collect quantitative data from observations of physical phenomena;
9 organize data in tables, and present data using graphs;
10 use computers to perform calculations and to make graphs.

STUDENT LEARNING OUTCOMES

1 use computers to collect and analyze data
2 demonstrate the ability use lasers, micrometers, calipers , oscilloscopes, spectrometers, interferometers, and voltmeters accurately and safely
3 use the internet to find information about scientific issues and be able to assess the validity of the information
4 use differential and integral calculus to model physical phenomena
5 apply theoretical knowledge to problems in experimental science and engineering

COURSE CONTENT WITH INSTRUCTIONAL HOURS

	Description	Lecture	Lab	Total Hours
1	Units and Measurements • SI system of units • Conversion of units between the SI system and other systems	5	0	5
2	Motion in One Dimension • Position • Speed • Acceleration • Motion plots, i.e. plots of position or speed or acceleration versus time • Kinematic equations for motion with constant acceleration • Motion of objects in free fall	5	0	5

3	Vectors • Introduction to vectors • Scalar-vector multiplication • Vector addition and subtraction • Dot product and cross product	5	0	5
4	Motion in Two Dimensions • Position • Velocity • Acceleration • Kinematic equations for motion with constant acceleration in two dimensions • Projectile motion	5	0	5
5	Force • Friction • Normal force • Weight • Tension • Spring force • Resistive forces	4	0	4
6	Newton's Laws of Motion	4	0	4
7	Circular Motion • Rotating coordinate systems • Radial and tangential components of velocity • Radial and tangential components of acceleration • Uniform vs. non-uniform circular motion	4	0	4
8	Work • Work done by constant forces • Work done by non-constant forces • Definition of energy • Kinetic energy • Gravitational potential energy near Earth's surface • Spring potential energy • Conservative vs. non-conservative forces • Potential energy and conservative forces • The work-energy theorem • Conservation of energy • Energy plots • Power	5	0	5

9	Linear Momentum • The force-momentum theorem • Conservation of momentum • Head-on collisions • Glancing collisions • Elastic vs. inelastic collisions	5	0	5
10	Rotational Motion • Angular position • Angular velocity • Angular acceleration • Kinematic equations for motion with constant angular acceleration • Moment of inertia	5	0	5
11	Torque • Torque and force • Torque and angular acceleration	5	0	5
12	Angular Momentum • The torque-angular momentum theorem • Conservation of angular momentum	5	0	5
13	System of Many Particles • Center of mass • Rigid bodies • Decomposition of kinetic energy, linear momentum and angular momentum of a rigid body into translational and rotational components	5	0	5
14	Static Equilibrium	5	0	5
15	Universal Gravitation • Newton's law of universal gravitation • Gravitation near surface of Earth • Gravitational potential energy • Gravitational field • Planetary motion	5	0	5

16	Laboratory Content • Introduction to Excel • Measuring the Mass of Earth • Measuring Motion With Computer-Interfaced Ultrasonic Radar Projectile Motion – Excel Simulation • Car Crash Analysis • Falling Bodies and Air Resistance • Introduction to Spherical Coordinates • Measuring the Radius of Earth Using GPS • Ballistic Pendulum • Rocket Dynamics • Video Analysis of a Collision in 2D • Study of Oscillations and Vibrations Using the Sonic Motion Sensor • Damped Harmonic Motion Simulation • Falling Rod Experiment • Rotational Dynamics • Newton's Law of Gravitation and Kepler's Laws of Planetary Motion	0	54	54
				126

OUT OF CLASS ASSIGNMENTS

1 problem sets (e.g. analytical word-problems assigned on a weekly basis);
2 written lab reports (e.g. describe and analyze the results of a collision experiment).

METHODS OF EVALUATION

1 lecture examinations (including multiple-choice questions, short-response questions, and analytical word-problems);
2 final examination (including multiple-choice questions, short-response questions, and analytical word-problems);
3 laboratory practical examinations;
4 evaluation of problem sets;
5 evaluation of written lab reports;
6 a written paper and an oral presentation on topics in contemporary mechanics such as gyroscopic stability, G.P.S. systems, and celestial mechanics.

METHODS OF INSTRUCTION

☑ Lecture

☑ Laboratory

- [ ] Studio
- [ ] Discussion
- [x] Multimedia
- [ ] Tutorial
- [ ] Independent Study
- [ ] Collaboratory Learning
- [x] Demonstration
- [ ] Field Activities (Trips)
- [ ] Guest Speakers
- [ ] Presentations

TEXTBOOKS

Title	Type	Publisher	Edition	Medium	Author	IBSN	Date
Physics for Scientist and Engineers, Vol. 1	Required	Brooks Cole		print	Raymond A. Serway and John W. Jewett	978-1133947271	2013
Physics 101 Laboratory Manual	Required	Glendale Community College		print	R. Guglielmino		2017
Philosophiæ Naturalis Principia Mathematica	Required			print	Newton, Isaac		