Grande Prairie Regional College
Department of Science and Technology

W 97

PC 1310 MECHANICS
4.3(3-2/2-3/2) UT(4.3) Winter
U of A Equivalent - EN PH 131
Course Information

Calendar Description:

PC 1310 Mechanics 4.3(3-1-1.5) UT(4.3) Kinematics and dynamics of particles; gravitation; work and energy; linear momentum; angular momentum; systems of particles; introduction to dynamics of rigid bodies. This course is intended for engineering students.

Prerequisite: MA1000, EG2300
Corequisite: MA1010 Pre or Corequisite PC1300

Instructor	Dr. Jaime P. Santiago J209, 539-2865	
Lecture	TR	9:30 - 10:50 a.m., J229
Laboratory	M	3:00 - 5:50 p.m., J103
Seminar	R	1:30 - 2:50 p.m., J201
Primary Textbook	**Engineering Mechanics, Statics and Dynamics** **7th Edition** by R. C. Hibbeler	
Secondary Textbook	**Fundamentals of Physics, 4th Edition** by David Halliday, Robert Resnick and Jearl Walker	
Laboratory Manual	**Physics Laboratory Manual** **PHYS 130/137** **EN PH 131 Second Edition** by Physics Department, University of Alberta (McGraw-Hill Ryerson)	

Grading		
	Assignments	5%
	Seminars	5%
	Laboratory	20%
	Midterm Examination	20%
	Final Examination	50%

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Marking:

Students must pass the laboratory course in order to pass the course. A student who fails to pass the laboratory course must repeat the entire course. Students who have previously taken the course and passed the laboratory component with at least 65% may choose not to repeat the lab.

We have a common final examination with the Faculty Engineering, U of A.

Re-writing of the final examination may be allowed in special circumstances under rules approved by the College.

Seminars:

Students will be required to solve 2 to 3 problems to be handed in at the end of the 1-hour period. Help in doing these problems will be available from the instructor. Students absent during seminars will receive a mark of zero unless excused by the instructor. If a seminar session is canceled due to weather, fire alarms, and/or other College sanctioned activities, students in the canceled seminar will not be required to hand them in for marking. Appropriate adjustments will be made to their grades. Seminar problems are the same as U of A's whenever possible.

Assignments:

There will be approximately 10 problem sets in this course. Assignments are normally due Tuesdays. The actual number of assignments and their due dates may change depending on class progress. Appropriate adjustments will be made to take into consideration topics already covered in the lecture. Problem sets will be the same as U of A's whenever possible.

Laboratory:

Laboratory work is performed every other week (alternating with chemistry lab). Laboratory reports are due at the end of the period. No late reports will be accepted. Lab reports should be handwritten (pencils are OK) on black Physics Laboratory Books available at the bookstore. A student who misses a lab due to illness or other extreme reasons may perform the lab at a different time if the lab equipment for the experiment is still set up or if the lab technician agrees to set them up again.

Midterm Examination:

The midterm exam will be written on Thursday, February 20, 1997. There is no provision for rescheduling if a student misses the exam.

Final Examination:

Final exams are 3 hours long and are normally held at the College Gym. Dates and times will be announced later by the registrar's office. Any conflicts should be reported to the registrar.

PC 1310 - MECHANICS
Course Outline (1997)

A. Introductory Material (1)

1. Mechanics - Where does dynamics of particles fit into the field of mechanics?
2. Brief Historical Survey
3. Fundamental Quantities
   - definitions of mass, length and time
4. Idealizations
   - particles and concentrated forces
   - when can a finite body be considered a particle?
5. Units of measurement
6. Dimensions
7. Numerical calculation
   - significant figures
8. Trigonometry and geometry review
9. Calculus review
   - it is assumed that students know how to differentiate and integrate polynomial functions of a single variable.

B. Kinematics of rectilinear motion of a particle (4)

1. Absolute motion of a particle along a line
2. Definition of position, speed, velocity and acceleration
3. Difference between average speed, velocity and acceleration and instantaneous values of speed, velocity and acceleration.
4. Special case: constant acceleration, freely falling bodies.
5. General case: variable acceleration - solution of problems using separation of variables
   - consider $a = a(t)$, $a = a(v)$, and $a = a(s)$.
6. Graphical methods

C. Kinematics of planar motion of a particle (4)

1. Position, velocity and acceleration vectors
2. Vector addition and subtraction
3. Scalars and magnitude of a vector
4. Scalar (dot) product, components of a vector
5. Rectangular Cartesian component; motion of a projectile
6. Normal and tangential component; general planar motion; special case: uniform circular motion (v = constant, ρ = constant)
7. Absolute dependent motion of two or more particle; pulley systems
8. Relative motion of two or more particles; relative motion along a line; relative planar motion

D. Dynamics of a particle (4)

1. Newton's laws for a single particle; definition of force; inertial frames of reference
2. Newton's law of gravitational attraction; mass and weight
3. Free body diagram; equations of motion of a single particle
4. Rectangular Cartesian components; friction
5. Normal and tangential components
6. Motion in a circle: uniform circular motion
7. Central force motion
   - Kepler's laws: state these laws in complete form but apply to circular orbits only
   - introduce angular momentum of a particle as $\mathbf{r} \times \mathbf{p}$
   - significance of a central force

. **Systems of particles I** (1)

1. Extension of Newton's second law to a system of particles; definition of the system being considered; internal and external forces to the system
2. Importance of the center of mass of the system of particles
3. Center of mass, center of gravity, and centroid
4. Center of mass of a discrete system of particles.

F. Work and Energy (3)

1. Work done by a force
   - spring force (Hooke's law)
   - force of gravitational attraction
   - weight
   - friction
2. Principle of work and energy for a single particle
3. System of particles II
   - extension of the work-energy principle to a system of particles
4. Power and mechanical efficiency
5. Conservative forces and potential energy
6. Conservation of mechanical energy

G. Linear momentum and impulse (3)

1. Definition of linear momentum
   - Newton's second law written in terms of linear momentum
2. Principle of linear impulse and momentum
   - definition of the impulse of a force
3. Systems of particles III
   - extension of the principle of linear impulse and momentum to a system of particles
4. Conservation of linear momentum for a system of particles
5. Collisions
   - definition of the coefficient of restitution, e
   - impacts with two or more particles along a line: $0 < e < 1$
   - special cases: elastic impact, $e = 1$ and plastic impact $e = 0$
   - oblique impact of two particles

H. Introduction to dynamics of a rigid body (about a fixed axis) (3)

1. Definition of a rigid body
2. Angular displacement, velocity and acceleration of a rigid body; kinematics
3. Kinetic energy of a rigid body
4. Definition of the moment of inertia
   - computation of moment of inertia for simple bodies
5. Vector cross product
6. Moment of a force about a point
7. Relation between moment of force and angular acceleration
   - moments about a fixed point
   - moments about the center of mass
8. Equations of motion for a rigid body in planar motion
   - free body diagram

I. Angular momentum (moment of momentum) and angular impulse (2)

1. Definition of angular momentum (moment of momentum) and angular impulse
2. Principle of angular momentum for a system of particles
3. Conservation of angular momentum
4. Angular momentum of a rigid body

Laboratory Work

Lab No.	Title
1	The Acceleration Due to Gravity
2	Non-Uniform Motion
3	Atwood's Pulley
4	Conservation of Mechanical Energy
5	Collision: Ramp
6	Lab Test