

PHYS 103 MECHANICS (4Cr.)

Pre-requisite: PHYS 100/PHYS 101 & Calculus – I. or Intermediate with Physics/ A-Levels Physics or equivalent.

Instructor:

Professor Sufian Aslam

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Lecture days/time

Tuesdays and Thursdays 14:00 –15:15 (S007)

Lab

Monday S-029 14:00 – 15:50

Office hours:

11:00 – 13:00 Monday, Wednesday, and Friday

Course Objectives:

The objective of the course is: introduction of fundamental laws which govern physical phenomena, application of these laws to study the statics and dynamics of point particles and rigid bodies and to enable students to have physical interpretation of mathematical solutions.

Learning Outcomes:

By the end of this course my hope is that students will be able to

1. Understand and appreciate that natural phenomena can be explained using fundamental laws of mechanics/physics.
2. Express these laws in mathematical terms.

3. Develop understanding of the material by solving problems.
4. Become familiar with physics principles applicable in other fields of science.

Textbook:

Fundamentals of Physics Extended version, David Halliday, Robert Resnick and Jearl Walker, (7th Edition) John Wiley & Sons, 2002 SBN: 978-1-119-30685-6

Optional Text:

- Physics, Vol. 1, 4th Edition or later, Halliday, Resnick and Krane, John Wiley & Sons, Inc.; New York
- **University Physics with Modern Physics**, Hugh D. Young, Roger A. Freedman, (eleventh edition) (ISBN 81-297-0464-1) Pearson Education Ltd. [LPE] Addison-Wesley, .2004
- **University Physics (Models and Applications)** by William P. Crummett.

Duration:

One 16–week regular (Spring or Fall) semester (5 - 6 weeks in summer) including examinations and preparation time.

Contact time: (Fall and Spring)

Three contact hours (lessons) of theory and two contact hours of laboratory work per week.

Course evaluation:

There will be **two examinations**, mid-term (in 8th week) and final exam (in the 15th week). The tests will be weighted as 20% and 40% of the final course grade respectively. The final examination will cover the entire course. **Assignment, Quizzes, and class participation** will make 40% of the final course grade and material there in can also be cumulative.

All submissions (Assignments and lab work) should **have their pages numbered and contain your roll number/name on each page.**

All students are expected to do their own work on all assignments. In completing homework problems, a distinction between collaboration and copying (plagiarism) must be observed. Any negative activity will result in cancellation of homework problem/assignment.

Credits:		At Mid	After Mid	Total
Theory/ Lab	Attendance/Participation	5	5	10
Tests/Quiz/ Assignments Laboratory Work	Minimum 5 Quiz/Assignments	15	10	30
	Practical Notebook counted as 1 assignment at end of course	–	5	
Mid–Term Test/Exam		20	–	20
Final Examination	20% Lab reports	–	8	40
	80% Final Exam	–	32	
Total		40	60	100
Grades would be calculated as per the University criteria (given in the student handbook/catalogue)				

Calculation of marks in each assignment/quiz test is per the following formulae.

$$\frac{\text{Your Marks}}{\text{Maximum marks in Class}} \times \text{Weightage}$$

Required Work:

- Attend ALL classes. Arrive on time and stay the entire period.
- Perform all laboratory work and submit all homework assignments on time.
- Take the quizzes and exams.
- Explore, be attentive, interact – pose questions to me or to each other and figure things out.

Note:

1. An assignment/quiz will be posted/given to the class fortnightly (weekly in summer semester) on the average (see syllabus below).
2. The Notebook/Lab Worksheets need to be submitted weekly.
3. Absences will be approved ONLY in the case of extenuating circumstances. Non-approved absences will quickly erode your course grade.
4. **Note that this Syllabus does NOT provide for makeup exams, resits, rescheduling and/or extensions.**
5. You can bring only a one A4 page of notes to the two examination (if held on campus) and no other references.
6. Bring your own calculators to all graded quizzes and exams – **MOBILE PHONES CANNOT SUBSTITUTE AS CALCULATORS.**
7. **Gradable Course Work comprises:**
8. A minimum of 5–8 pieces of gradable work, which are likely to be in the form of 20–50 minute quiz of either TF/MCQ or short–questions or a combination, one being the midterm and the last being the final exam.
9. **All examination, tests and assignments shall be CUMULATIVE, i.e., may or may not contain material from previous assignments and tests.**
10. **Homework:**
11. The solutions to Homework may be reached independently or collaboratively (your choice). However, ALL Homework MUST be written up in your OWN words (see section below on **Academic Honesty**). As already mentioned, Homework

assignments can be done in teams, but all team members **MUST turn in an individual set** of homework solutions neatly written or typed.

Attendance:

The students are required to attend all the lectures. Those students whose attendance falls below 67% MIGHT not be allowed to sit in the final examination as per college policy.

Grading Scale:

Grade	Quality Pts	Numerical Value	Meaning
A	4.00	93-100	Superior
A-	3.70	90-92	
B+	3.30	87-89	Good
B	3.00	83-86	
B-	2.70	80-82	
C+	2.30	77-79	Satisfactory
C	2.00	73-76	
C-	1.70	70-72	
D+	1.30	67-69	Pass
D	1.00	60-66	
F/NS	0.00	59 or below	Fail
W	Not applicable to CGPA		

Course Contents:

The course will cover the study of nature of basic forces. Mathematical representation for time dependent forces will be developed. Dynamics of single and many particles will be studied. Translational and rotational motion of rigid bodies will be discussed. Special theory of relativity will also be studied. Laboratory
Tentative schedule: (Revised January 2023)

Week	Topic/Chapter	Details of topics to be covered	Assign/Quiz
1 st	1 and 2	Measurement and dimension analysis. Basic calculus and equations of motion using vector calculus. Motion in one dimension	
2 nd	3 and 4	Vectors, Coordinate system; Addition of vectors in one or more dimensions; Applications of Newton's Laws (Statics) Projectile motion	
3 rd	4 and 5	Particle dynamics: Force Laws, frictional force, uniform circular motion, equations of motion and non-constant forces; Time dependent forces (analytical methods) drag forces and motion of projectiles.	A
4 th	6-7	Work by a constant force, work by a variable force (one dimensional) reference frame.	Q
5 th	7, 8	Conservation of energy, conservation of energy in a system,	A
6 th	9	System of particles, linear momentum of a system conservation of momentum	Q
7 th	10	Collisions in one and two dimensions, Centre of mass	
8 th	10, 11,	Rotational variables rotation with constant acceleration, rotational dynamics	
		(Mid-term exam)	
9 th	12	KE of rotation and rotational inertia Rotational Inertia of solid bodies, rotational and translational motion	
10 th	13	Angular momentum of a particle and a system of particles, angular momentum and angular velocity,	A

		conservation of angular momentum	
11 th	13	SHM, simple oscillator, applications, SHM and circular motion, damped motion and resonance	Q
12 th	14	Gravitation overview, Newton's law of gravitation, gravity near the surface GPE, satellites, universal gravitation,	A
13 th	39	Special theory of relativity, postulates, Galilean, and Lorentz transformations	Q
14 th	39	Relativistic energy/Revision	
		(Final exam)	

Lab:

Experiments list would be provided in the Laboratory.

Course Outlines/Topics (Textbook of Halliday/Resnick/Walker):

Topic -1: Measurements

Physical quantities, SI units, Changing units, Length, Time, Mass, Accuracy, Precision, Practice problems.

Topic -2: Vectors

Vector and Scalars, adding vectors geometrically, Components of vectors, Unit vectors, adding vectors by components, Multiplying vectors, Practice problems.

Topic -3: Motion along a straight line

Description of motion, Position and displacement, Average velocity and average speed, Instantaneous velocity and speed, Acceleration, Constant acceleration (a special case), Free fall acceleration, Practice problems.

Topic -4: Motion in 2-D & 3-D

Motion in two or three dimensions, Position and displacement, Average velocity and instantaneous velocity, Average acceleration and instantaneous acceleration, Projectile motion, Uniform circular motion, practice problems.

Topic -5: Force and Motion

Newton's first law, Force, Mass, Newton's second law, Newton's 3rd law, Applying Newton's laws, Friction, The drag force and terminal speed, Uniform circular motion, practice problems.

Topic -6: Work and Energy

Energy, work, Work-KE theorem, Work done by a gravitational force, Work done by a spring force, Work done by a general variable force, Power, Potential energy, Path independence of conservative forces, Conservation of mechanical energy and total energy, practice problems.

Topic -7: Systems of Particles

Center of mass, Newton's 2nd law for a system of particles, Linear momentum and its conservation, Elastic and inelastic collisions in one dimension, practice problems.

Topic -8: Rotation

Rotational variables, Are angular quantities vectors? Rotation with constant angular acceleration, Relating the linear and angular variables, Kinetic energy of rotation, Rotational inertia, Torque,

Newton's 2nd law for rotation, Work and rotational KE, Angular momentum & its conservation, practice problems.

Topic -9: Oscillations

Oscillations, Simple harmonic motion, Velocity, acceleration and energy in SHM, the force law of SHM, SHM and Uniform circular motion, Damped SHM, Forced oscillations and resonance, practice problems.

Topic -10: Gravitation

Newton's Gravitational Law, Gravitation near Earth's surface, Gravitation inside Earth, Gravitational PE, Escape speed, Planets, and satellites: Kepler's laws, Einstein and gravitation, Gravitation in terms of curvature of space time, practice problems.