P320 - Analytical Mechanics

Fall Semester 2016
COURSE INFORMATION

Instructor

Gregory Clark Office is room SCIC 112
Office Hrs: M & W, 11:00 – 11:50 AM, or, as seems to work best for many, by appointment.
Phone: 982-5071 (Office) and 982-7588 (Home – not after 9 PM, please)
Email: GWClark on the MC network

The Course

Newtonian mechanics and its underlying mathematical basis provide the foundation for much of physics, both classical and modern. This course will focus on the classical description of motion for particles and systems of particles, including rigid bodies, as developed by Newton, Joule, Liebniz, Kepler, and others. The overarching goal of this course is the mastery of the use of Newton's laws of motion for problem solving.

Text and References

John R. Taylor, **Classical Mechanics**, Seventh Edition (University Science Books, 2005). Assignments and readings will be mostly from this text. It is often helpful to refer to alternative approaches to material, so I encourage you to peruse the optional mechanics texts that can be found in the Funderberg library. Other good texts at the level of this course include **Classical Dynamics of Particles and Systems** by Marian & Thornton and **Analytical Mechanics** by Fowles & Cassiday.

Class Meetings

Class meetings will be held from 9:00 to 10:15 AM on Tuesdays and Thursdays, in SCIC 202. Discussion, questions, and dialogue are encouraged and expected. Class participation is a requirement for this course. Cell phone use is forbidden. It is your responsibility to inform me of any anticipated absences from classes or exams. You will get the most out of class meetings if you read the material beforehand; this is a requirement of the course. A large part of your education as a scientist must include learning the skills associated with reading scientific literature at many different levels. These skills are only honed through regular practice!

I will keep you informed of what we will be covering; we will pretty much follow the order of topics as in the textbook, skipping a few chapters and/or sections here and there. The intention is to cover most of chapters 1 through 7 with the possible inclusion of highlights from chapters 8 and 10. Keep in mind that our goal is not only to learn about classical mechanics, but also to understand the mathematical formalism and methods involved. Much of the framework is applicable to other areas of physics and will be encountered again!

Homework, Exams, and Grading

Homework will be assigned daily! Homework assigned on Tuesday is due by Friday at 6:00 pm; Thursday homework is due by the following Tuesday at 6:00 pm. Late papers will receive no credit. Each problem should begin on a new page with the problem number clearly indicated in the right margin; use only one side of the page. Solutions must include: an explanation of the problem (indicating all known quantities), any assumptions that you make, a sketch of the problem (if relevant), algebraically correct manipulation of variables, a boxed or circled answer, and any relevant analysis or justifications of your answer. Each homework page must include your name, the due date, and the homework assignment number in the upper right hand corner. A well-written solution includes a written explanation of what you are doing; a bunch of equations and a final answer will rarely be sufficient for full credit. Consult a copy of the *Homework Checklist* from **General Physics** for a reminder of the details of my homework expectations. Plagiarism in any form (from classmates, data mining, *etc.*) is forbidden. Plagiarized work will receive zero credit; repeat plagiarism offenses may result in failure of the course.

Analytical Mechanics is a W (Writing) course. This means that writing in the discipline will play a significant role in the course. The point is to strengthen your scientific writing skills. Homework will include two abstracts of papers from the scientific literature and a research paper related to a specific area of classical mechanics. I encourage you to peruse the journals we have in the library (available online), *The Physics Teacher, The American Journal of Physics*, and *Physics Today,* at you leisure to become familiar with the style of writing in the world of physics. The abstracts will be due in class on 04 Oct 2016 and 08 Nov 2016. The research papers are due at the beginning of class on 01 Dec 2016 for the first draft and 09 Dec 2016 for the final copy. You may find it useful to connect the research paper topic to your lab research project, if you are enrolled in the laboratory section of this course. More

details on these assignments will be forthcoming.

Some homework assignments will require the use of Maple 18, an advanced mathematical problem solving software package, which is available on the campus network. Students may purchase discounted copies of the software for their personal use from MapleSoft.com. Details will be forthcoming.

Quizzes

We will have quizzes, on occasion, over the topics at hand and over "things any good physicist/engineer should know." Since the prerequisites for this course include two semesters of **General Physics** and two semesters of calculus, from the outset I must be able to assume that you are familiar with and understand the basic principles behind the following:

Vector products: dot (scalar) and cross (vector) products	Newton's law of gravity
Newton's laws of motion (all three; by number)	Law of conservation of energy
Kepler's laws of planetary motion (all three; by number)	Conservation of angular momentum
Conservation of linear momentum	Everything on the GP knowsheets

We will be studying the above concepts in more detail this semester and it will be important that you commit to memory some of the related details. As we encounter these details, I will let you know what you need to "memorize." Ideally, you will understand the basic concepts well enough so that "memorization" is unnecessary; you will simply know the material!

Examinations and Grading

There will be two *in-class* examinations: Thursday, 29 Sept 2016 and Thursday, 03 Nov 2016. The cumulative final exam will be during final exam week (time and date to be announced). For exams, you will be allowed to bring with you one 3 by 5 index card with anything you want written on it EXCEPT for equations specifically requested that you commit to memory (we'll keep tabs on these as the semester progresses; certainly, you already have the General Physics Knowsheets committed to memory - none of these will be allowed!). You will be required to turn in each index card with your exam.

All work in this course will be graded on a 12-point scale, rather than the standard 10-point scale. The ranges for the letter grades are: A = 100 - 88, B = 76 - 87, C = 64 - 75, D = 52 - 63, F = 51 - 0. Grading will be based on classwork, homework, and exam performance. The grade breakdown will be:

Classwork, quizzes, and homework	46%
Writing assignments	8%
In-class examinations (14% each)	28%
Final examination	18%

Course Topics [*NOTES: we will only cover a portion of Ch 10; we may or may not have time for Ch 9!*]

I.	Newton's Laws of Motion	(Chapter 1)
II.	Projectiles and Charged Particles	(Chapter 2)
III.	Momentum, Angular Momentum, and the Moment of Interia	(Chapters 3 & 10)
IV.	Energy and Work	(Chapter 4)
V.	Oscillations (including damped and driven harmonic motion)	(Chapter 5)
VI.	Calculus of Variations and Lagrange's Equations	(Chapters 6 & 7)
VII.	Two-Body Central Forces	(Chapter 8)

Important Dates

29 Sept 2016 (Thursday) - Exam I
04 Oct 2016 (Thursday) - Abstract I
03 Nov 2016 (Thursday) - Exam II
08 Nov 2016 (Thursday)- Abstract II
01 Dec 2016 (Thursday) - Draft of research paper
09 Dec 2016 (Thursday) - Final copy of research paper
TBA during Final Exam Week - Final Exam

Manchester University Essential Information

Title IX Reporting Requirements

While students should feel comfortable approaching the professor with issues they may be struggling with or concerns they may be having, they should be aware that faculty members have some reporting requirements that are part of their job duties at Manchester University.

For example, if a student informs a faculty member of an issue of sexual harassment, sexual assault, or discrimination, the faculty member will keep the information as private as possible, but the faculty member is required to bring it to the attention of the institution's Title IX Coordinator (ext. 5052 or ajmachielson@manchester.edu) or the Human Resources office (ext. 5038). Additionally, students can report incidents or complaints to Campus Safety (ext. 5999 or in Fort Wayne: 260-266-1800). Students can also obtain support from the University Counseling Services (ext. 5306).

Finally, students should know that if, for some reason, the interaction between a student and faculty member involves a disruptive behavior or potential violation of policy, the faculty member will inform the appropriate Student Experience staff, even when the student and faculty member may have reached an informal resolution to the incident. The purpose of this is to keep University leaders apprised of any behaviors and what was done to resolve them.

Campus Resources

Health Services
260-982-5306
http://www.manchester.edu/OSD/Health/Index.htm

Counseling Center
260-982-5306
http://www.manchester.edu/OSD/Counseling/Index.htm

Safety
NM: 260-982-5999; FW: 260-266-1800
http://www.manchester.edu/OSD/Security/index.shtml

Disability Services:

Student Disability and Reasonable Accommodation Statement
Manchester University, in compliance with federal guidelines, is committed to assuring students with disabilities equal access to programs and activities that are provided to students without disabilities. Any student who feels s/he may need an accommodation based on the impact of a disability should contact Audrey Hampshire, the Director of Academic Support and Disability Services, to establish eligibility and to coordinate reasonable accommodations. It is the student's responsibility to self-disclose his or her disability. Students whose accommodation requests are approved will be provided with confidential letters to deliver to their professors which verify the nature of the student's disability and documents the need for auxiliary aids and services and/or academic adjustments/accommodations. Students are encouraged to meet with each professor early in the semester to discuss the academic implications of the disability as they relate to the specific course and to request appropriate accommodation. The Disability Support Services office is located in the Success Center (second floor of the JYS Center). Telephone (260) 982.5036 or (260) 982.5888 to schedule an appointment.

Medical Emergency/Evacuation Assistance Statement
Please speak to your instructor immediately if (1) you may require medical attention during class, or (2) you have a disability, chronic condition, or a temporary injury that may limit or affect your ability to evacuate the classroom/building in an emergency. You and your instructor should discuss your specific needs and the type of precautions that should be made in advance of such an event. In the event of a fire or other situation requiring emergency evacuation, students with ambulatory disabilities are to go with or without assistance to the nearest stairwell area. Faculty and staff will assist with evacuation management efforts until such time as the Campus Safety and/or Police and Fire Departments arrive on the scene to assist in student evacuation from the building. Elevators are not to be used for evacuation by any persons. Students who need special arrangements in the event of an evacuation should also register with Audrey Hampshire as early as possible in the semester to help facilitate the provision of needed emergency assistance.

Academic Dishonesty:

Information on Academic Dishonesty and Grievance policies can be found on the course website.