PHYS 780, Spring 2023: Magnetospheric Physics

Time: Wednesdays. 10:00 am - 12:50 pm
Room: 203 Faculty Memorial Hall (FMH)
Office Hour: Thursdays, 10:00 am- 12:00 pm, other times by appointment

INSTRUCTOR

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DESCRIPTION

The aim of this course is to introduce the near-Earth space environment by focusing on the physical processes between the energy carried by the Sun's magnetic field and particles, and the Earth's magnetic environment ("magnetosphere"). The course will cover basic concepts of the Sun, solar wind, and their interactions with the Earth, and how space-borne and ground-based data are utilized to understand the environments. Students will also learn elementary concepts of the impacts of this environment on modern technologies ("space weather") such as communication and navigation systems, aviation, spacecraft and power systems. While the course will not involve intense mathematics, the expected background is calculus, vector and tensor algebra, and electricity and magnetism. It serves as the foundation course for all space science and engineering graduate students.

TEXTS (desired but not required in class)

- Margaret G. Kivelson and Christopher T. Russell, Introduction to Space Physics, Cambridge University Press, 1995.
- Mark Moldwin, An Introduction to Space Weather, Cambridge University Press, 2022.
- Wolfgang Baumjohann and Rudolf A Treumann, Basic Space Plasma Physics, World Scientific Publishing Co. LTD., 2022.
- Michael J. Carlowicz and Ramon E. Lopez, ***Storms from the Sun***, The Joseph Henry Press, Washington, D.C., 2002. Available as .pdf download from the National Academies Press http://www.nap.edu/catalog.php?record_id=10249 or from Amazon.com in Hardback or paperback.

GRADING

The final grade will be based on the following:

30% Homework assignments
40% Research project and presentation
30% Final exam

The conversion of term average values to letter grades will use the following cutoff values:

85-100%	A
80-84%	B+
70-79%	B
65-69%	C+
50-64%	C
40-49%	D
Below 40%	F

HOMEWORK ASSIGNMENTS

The homework assignments will be posted via Canvas and their due dates will be notified either via Canvas or in class. A scanned copy of your solutions (in pdf) should be uploaded via Canvas. If you have a legitimate excuse for late submissions for homework assignments, seek permission to turn it in late from the instructor. Otherwise, you will receive 5% reduction in credit per day for a late submission. All the late submissions need to be submitted prior to the end of the reading day (May 4, 2023) to receive any credits.

RESEARCH PROJECT AND ORAL PRESENTATION

Each student is expected to choose a research project topic based on what is covered in class. Students may consult with the instructor to discuss the research project. If desired, a project team can be formed. However, no more than two team members are allowed. A written report and a 15-min oral presentation are required at the end of the semester. The students forming each group will receive the same grade. So be sure to collaborate with each other and have frequent interactions.

FINAL EXAM

There will be a final exam during the exam week(the exact date TBD). Make-ups for missed exams are only with advance permission from both your instructor and the Dean of Students.

ACADEMIC INTEGRITY

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

Refer to the "Best Practices" document developed and published on the Provost's website (on the policies page) or directly at https://www.njit.edu/provost/sites/njit.edu.provost/files/Best_Practices_related_to_Academic_Integrity.pdf .

LECTURE SCHEDULE FOR SPRING 2023

Note: For reference purposes, the following is a tentative schedule on which we will discuss specific topics. Please refer to Canvas for the most up-to-date schedule and topics.

Week	Activity
Week 1 (1/18)	Introduction, a brief history of solar-terrestrial physics
Week 2 (1/25)	Physics of space plasmas
Week 3 (2/1)	The Sun, solar wind, Sun-Earth connection
Week 4 (2/8)	The Earth's magnetic field
Week 5 (2/15)	The magnetosphere (bow shock, magnetopause, magnetotail, magnetic reconnection)
Week 6 (2/22)	The magnetosphere (plasmapause, radiation belt, ring current)
Week 7 (3/1)	The magnetosphere (geomagnetic storm, substorm)
Week 8 (3/8)	Waves in space plasmas
Week 9 (3/15)	No class (spring recess)
Week 10 (3/22)	Magnetospheric dynamics
Week 11 (3/29)	Upper atmosphere and ionosphere
Week 12 (4/5)	Auroras and auroral ionosphere
Week 13 (4/12)	Research project discussion
Week 14 (4/19)	Space weather
Week 15 (4/26)	Research project presentation
Week 16 (5/8, Fri)	Final exam (time TBD)
5/11 (Thu)	Research project report due