



SPACE POLICY INSTITUTE

IAFF 6158.11

Issues in U.S. Space Policy: Tools and Scenarios

Spring 2024

Syllabus

Instructor: Prof. Scott Pace

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Office: ESIA B14 or Suite 403

Office Hours: By Appointment

Course Details

Modality: In-person

Class Time: Tu 5:10 pm - 7:00 pm

Class Location: ESIA B14

Credits: 3

Course Description & Goals

This course will address international space policy issues facing the United States and provides an overview of common tools (e.g., orbital mechanics, cost estimation, regulation) used in space policy making and implementation. The course will address current policy and regulatory issues facing U.S. space programs with regard to dual-use technologies, including export controls, spectrum management, and licensing of commercial remote sensing systems. Conflicts over dual-use technologies will be examined for their implications for a range of national interests. The course will also address strategic choices facing other nations in space activities, including dependence on U.S., European, and Russian space capabilities, developing indigenous space programs, and use of commercial space capabilities.

Learning Outcomes & Objectives

- Students will be able to identify and understand the interaction of technical and regulatory factors applicable to dual-use space technologies.
- Students will be able to understand and evaluate the elementary impacts of organizational, budgetary, and cost uncertainties on the acquisition and operation of space systems.

- Students will be able to work collaboratively with others by participating in problem-solving and decision-making situations characterized by imperfect information.

The course will involve student team presentations of important space functions such as space launch, remote sensing, environmental monitoring, missile warning, satellite navigation, and communications. Short problem sets (requiring basic algebra) will be used to illustrate the physics of the space environment. The class will conclude with a group exercise involving the interaction of diplomatic, intelligence, military, and economic interests in a hypothetical space conflict. Students will take on the role of national decision-makers in responding to unfolding events involving the conflicting space interests of the United States, China, Russia, the European Union, Japan, and other space powers in a scenario set ~2034. It will be played during two class sessions and involve intra- and inter-team communications outside of class.

Methods of Instruction

This course uses the following methods of instruction:

- *Lectures*: weekly lectures. Copies of slides will be posted on Blackboard.
- *Readings*: a range of primary and secondary sources related to each week's topic.
- *Student presentations*: student teams will prepare brief presentations on primary space-related functions. The presentations are intended to be brief tutorials on the functions.
- *Problem Sets*: Six problem sets illustrating space-related spending, acquisition costs, orbital mechanics, and rocket propulsion.
- *Team Exercise*: student teams will explore a future space conflict scenario.
- *Writing assignments*: a research paper on a topic of the student's choosing.
- *Recordings of class sessions will be available via lecture capture (Echo360) on Blackboard.*

Grading

- The class is a graduate seminar, with an emphasis on reading assignments, problem sets that illustrate key technical concepts, and a final paper. Each week during the term, students will be expected to come to the course meeting familiar with the assigned readings related to that week's topic and able to participate in discussions. Grades will be based on class and exercise participation (15%), completion of problem sets (30%), a student team-based tutorial on a space function assigned by the instructor (15%), and a 12 to 15-page (5,000-6,000 words) research

paper on a topic of the student's choosing, subject to approval of the instructor (40%). Papers should be submitted electronically to space1@gwu.edu no later than five days after the last class.

- Guidelines for tutorials presentation: The tutorial is an opportunity to explain a particular space function in slightly more depth and educate others in the class on its technical, operational, and policy significance. Student will self-organize into teams (of 2-4 persons per team) to present on specific functions. These will include positioning/navigation/timing (PNT), space communications, remote sensing, weather (Earth and space), surveillance and warning, and space launch. Total presentation time cannot exceed 20 minutes (e.g., less than 10 charts, ~15 minutes). The presentation will be graded for accuracy, clarity, objectivity, and completeness.
- Student preparation for the scenario exercise: Teams will prepare position papers for use in the scenario and presentation to the class during each day of the exercise. Students may also prepare background papers to support their positions. The bulk of time required for the exercise will consist of inter-group negotiations outside of the class itself.
- Grading Scale

Excellent	Good	Needs Improvement	Low Pass	Fail
A 96%-100%	B+ 87%-89%	B- 80%-83%	C 74%-76%	F Under 70%
A- 90%-95%	B 84%-86%	C+ 77%-79%	C- 70%-73%	

<i>Assignment Type</i>	<i>Points Per Assignment</i>	<i>Number of Assignments</i>	<i>Percent of Final Grade</i>
Presentation	20	1	15%
Problem Sets	20	6	30%
Class/Exercise Participation	20	1	15%
Research Paper	20	1	40%

Total 100%

Readings – Required Texts:

AU-18 Space Primer. Air University Press, Maxwell AFB, AL, 2023. Available at:
<https://www.airuniversity.af.edu/AUPress/Display/Article/3363308/au-18-space-primer/>

Basics of Space Flight. Jet Propulsion Laboratory, Pasadena, CA, March 19, 2009. JPL D-20120, CL-03-0371. Available at: <https://solarsystem.nasa.gov/basics/>

Central Intelligence Agency. "How your NIOs Can Help," National Intelligence Council, February 16, 1988.

Cheng, Dean. "How China has Integrated its Space Program into its Broader Foreign Policy," China Aerospace Studies Institute, Montgomery, AL, March 2021. Available at:
<https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/CASI%20Articles/2021-03-29%20China%20Space%20and%20Foreign%20policy.pdf?ver=kfO2J-IInVZmNQSjwfM0Yg%3D%3D>

Columbia Accident Investigation Report, Volume 1. August 2003. Available at:
http://www.nasa.gov/columbia/home/CAIB_Vol1.html

Congressional Budget Office. "Large Constellations of Low-Altitude Satellites: A Primer," Washington, D.C., May 2023. Available at <http://www.cbo.gov/publication/58794>

Cooke, Doug. "The CAIB Experience Related to Programs Today," Presentation to the *Columbia+10 Symposium*, George Washington University, Washington, D.C., March 8, 2013

Coonce, Thomas, et al. "NASA Productivity," *Journal of Cost Analysis and Parametrics*, Vol. 3, Issue 1, Winter/Spring 2010, pp. 59-78

William J. Clinton Presidential Library. Letter to Professor Joanne Irene Gabrynowicz, Release of Declassified Material Related PDD-23, February 4, 2010

Daniels, Matthew. *The History and Future of U.S.-China Competition and Cooperation in Space*, Johns Hopkins University Applied Physics Laboratory, 2020. Available at
<https://www.jhuapl.edu/Content/documents/Daniels-Space.pdf>

Defense Intelligence Agency. *Challenges to Security in Space*, January 2019. Available at: https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf

Department of Commerce. *U.S. Export Controls for the Commercial Space Industry*, 2nd Ed. November 2017. Available at: <https://www.space.commerce.gov/wp-content/uploads/2017-export-controls-guidebook.pdf>

Edmondson, Amy C., et. al. "The Recovery Window," in *Organization at the Limit: NASA and the Columbia Disaster*, Oxford: Blackwell, 2005, pp. 220-245

European Space Policy Institute. *Space Spectrum Management*, October 2023. Available at: https://www.espi.or.at/wp-content/uploads/2023/10/ESPI-Space-Spectrum-Policy-Report_v5.pdf

European Space Policy Institute. *ESPI Yearbook 2022 - Space Policies, Issues and Trends*, August 2023. Available at: <https://www.espi.or.at/wp-content/uploads/2023/08/ESPI-Yearbook-2022.pdf>

Fragola Joseph, and Elisabeth Morse. "Application of PRA in Developmental Systems," Valador, 2012, pp. 1-10

Grudo, Gideon. "Technology Readiness Levels, Explained," *Air Force*, August 2016, pp. 22-23

Hale, Wayne. "Lessons from Columbia," Presentation to the *Columbia+10 Symposium*, George Washington University, Washington, D.C., March 8, 2013

Information Office of the State Council of the People's Republic of China. "China's Space Program: A 2021 Perspective," January 2022. Available at: http://www.china.org.cn/china/2022-01/28/content_78016843.htm

International Telecommunications Union. "Overview of ITU History," Geneva, Switzerland, November 2020. Available at: <https://search.itu.int/history/HistoryDigitalCollectionDocLibrary/12.28.71.en.pdf>

International Telecommunications Union. *Structure of ITU-R Study Groups*, <https://www.itu.int/en/mediacentre/backgrounders/Pages/itu-study-groups.aspx>

Kennedy, Fred G. "Space and Risk Analysis Paralysis," in *Aerospace America*, November 2011, pp 29-34

Morse Elisabeth, Joseph Fragola, Blake Putney. "Modeling Launch Vehicle Reliability Growth as Defect Elimination," Conference Paper AIAA 2010-8836, 2010.

NASA. *Aeronautics and Space Report of the President*, FY 2022. Available at: <https://www.nasa.gov/history/history-publications-and-resources/aeronautics-and-space-report-of-the-president/>

NASA. FY2024 Budget Request, Washington, D.C., 2023. Available at: <https://www.nasa.gov/nasa-fiscal-year-2024-budget-request/>

NASA. *NASA Cost Estimating Handbook*, Washington, D.C., 2015. Available at: <https://www.nasa.gov/ocfo/nasa-cost-estimating-handbook-ceh/>

NASA. Columbia Mission STS-107 Mission Management Team meeting transcripts, January 24 and January 27, 2003

NASA Office of the Inspector General. *NASA's Cost Estimating and Reporting Practices for Multi-Mission Programs*, IG-22-011, Washington, D.C., April 7, 2022. Available at <https://oig.nasa.gov/docs/IG-22-011.pdf>

OECD, et. al. *International, North American and European Statistical Classifications for Space Economy Measurement*, OECD Publishing, Paris, 2023. Available at: https://www.bea.gov/system/files/2023-12/international-north-american-european-statistical-classifications-space-economy-measurement_0.pdf

Office of the Director for National Intelligence. *U.S. National Intelligence: An Overview*, Washington, D.C., 2013. Available at: https://www.dni.gov/files/documents/USNI%202013%20Overview_web.pdf

Office of the Director for National Intelligence. *National Intelligence Strategy of the United States*, Washington, D.C., 2023. Available at: https://www.odni.gov/files/ODNI/documents/National_Intelligence_Strategy_2023.pdf

Pettit, Don. "The Tyranny of the Rocket Equation," May 2012. Available at:
<https://www.youtube.com/watch?v=uWjdnvYok4I>

Pollpeter, Kevin and Timothy Ditter, et al. *China's Space Narrative*, China Aerospace Studies Institute, Montgomery, AL, 2019. Available at:
<https://www.airuniversity.af.edu/Portals/10/CASI/Conference-2020/CASI%20Conference%20China%20Space%20Narrative.pdf?ver=FGoQ8Wm2DypB4FaZDWuNTQ%3D%3D>

Reesman, Rebecca and James Wilson. "The Physics of Space War," October 2020. Available at:
<https://csps.aerospace.org/papers/physics-war-space-how-orbital-dynamics-constrain-space-space-engagements>

Secure World Foundation. *Space Sustainability: A Practical Guide*, Washington, D.C. 2018. Available at: https://swfound.org/media/206289/swf_space_sustainability-a_practical_guide_2018_1.pdf

Sgobba, Tommaso. "Safety Design for Space Systems," International Association for the Advancement of Space Safety, 2023.

Smith, Marcia. *Synopsis of the Report of the Columbia Accident Investigation Board*, Congressional Research Service, 2003. Available at:
<https://history.nasa.gov/columbia/Troxell/Columbia%20Web%20Site/Documents/Congress/CRS%20Summary%20of%20CAIB%20Report.pdf>

Summit Ridge Group. *The Spectrum Handbook*, 2018. Available at
<https://summitridgegroup.com/expertise/the-spectrum-handbook-2018/>

United Nations. *Report of the Committee on the Peaceful Uses of Outer Space to the General Assembly Sixty-Fifth Session, A/78/20*, August 2023. Available at:
https://www.unoosa.org/oosa/en/oosadoc/data/documents/2023/a/a7820_0.html

United Nations. *Letter dated 18 August 2009 from the Permanent Representative of China and the Permanent Representative of the Russian Federation to the Conference on Disarmament addressed to the Secretary-General of the Conference transmitting answers to the principal questions and comments on the draft "Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threats or Use of Force Against Outer Space Objects (PPWT)" introduced by the Russian Federation and China and issued as document CD/1839 dated 29 February 2008, CD/1872, 18*

August 2009. Available at: <https://digitallibrary.un.org/record/670202?ln=en#record-files-collapse-header>

Wright, David, Laura Grego and Lisbeth Gronlund. *The Physics of Space Security*. Cambridge: American Academy of Arts and Sciences, 2005. Available at: https://www.amacad.org/multimedia/pdfs/publications/researchpapersmonographs/Physics_of_Space_Security.pdf

If you get a URL error, check for extra spaces or missing hyphens due to line breaks in the pdf copy of the syllabus. Almost all required readings are available from the Internet or will be available on Blackboard. There are no plans to make a course reading pack.

Readings - Optional Texts:

Besha, Patrick. "Policy making in China's space program: A history and analysis of the Chang'e lunar orbiter project," in *Space Policy*, Vol. 26 (2010) pp. 214-221

Cline, Lynn F.H. "Re-Negotiation of the International Space Station Agreements 1993-1997," in *Acta Astronautica*, Vol. 53 (2003) pp. 917-925

Commission on Planning, Programming, Budgeting, and Execution Reform. *Interim Report*, Washington, D.C., August 2023. Available at: <https://ppbereform.senate.gov/interimreport/>

Congressional Budget Office. "Expired and Expiring Authorizations of Appropriations for Fiscal Year 2023," Washington, D.C., April 27, 2023. Available at: <https://www.cbo.gov/publication/58954>

Congressional Research Service. "Export Controls—International Coordination: Issues for Congress," Washington, D.C., R47684, September 8, 2023. Available at https://www.everycrsreport.com/files/2023-09-08_R47684_e393752923e4476839bd7a4cff3ae069f4f481fc.pdf

Dolman, Everett C. *Astropolitik: Classical Geopolitics in the Space Age*. London: Frank Cass, 2002

Bowen, Bleddyn E. (2020): *War in Space: Strategy, Spacepower, Geopolitics*. Edinburgh: Edinburgh University Press.

Erickson, Sarah and Almudena Azcárate Ortega. "To Space Security and Beyond: Exploring Space Security, Safety, and Sustainability Governance and Implementation Efforts," UN Institute for

Disarmament Research (UNIDIR), Geneva, 2023. Available at: [https://unidir.org/files/2023-08/UNIDIR To Space Security and Beyond Report.pdf](https://unidir.org/files/2023-08/UNIDIR_To_Space_Security_and_Beyond_Report.pdf)

International Space Exploration Coordination Group. *Global Exploration Roadmap* (2018) and *Supplement* (2022). Available at: <https://www.nasa.gov/exploration/about/isecg>

Johnson, Dana J., Scott Pace, and C. Bryan Gabbard. *Space: Emerging Options for National Power*, RAND MR-517. Santa Monica: RAND, 1998. Available at: <http://www.rand.org/publications/MR/MR517/>

Johnson, Dana J., and Ariel E. Levite, Eds. Conference Proceedings, *Toward Fusion of Air and Space: Surveying Developments and Assessing Choices for Small and Middle Powers*, RAND-Fisher Institute for Air and Space Strategic Studies. Santa Monica: RAND, 2001. Available at: <http://www.rand.org/publications/CF/CF177/>

Johnson, Stephen B. "From the Secret of Apollo to the Lessons of Failure: The Uses and Abuses of Systems Engineering and Project Management at NASA," Chapter 12 in *NASA's First 50 Years*, Steven J. Dick, ed., NASA SP-2010-4704, Washington, D.C. 2009

Launius, Roger D., and Howard E. McCurdy, Eds. *Spaceflight and the Myth of Presidential Leadership*. Chicago: The University of Illinois Press, 1997

Marshall Institute, *Returning to Fundamentals: Deterrence and U.S. National Security in the 21st Century Roundtable*, Washington, D.C., November 16, 2011. Available at: <https://www.penncerl.org/files/1362-returning-to-fundamentals-deterrence-and-us/>

Maher, Neil M. "Chapter 7. Bringing the Environment Back In: A Transnational History of Landsat." *How Knowledge Moves: Writing the Transnational History of Science and Technology*, edited by John Krige, Chicago: University of Chicago Press, 2019, pp. 201-223. <https://doi.org/10.7208/9780226606040-008>

Mahler, Julianne G. and Maureen H. Casamayou. *Organizational Learning at NASA: The Columbia and Challenger Accidents*. Washington, D.C.: Georgetown University Press, 2009

Moltz, James Clay. *The Politics of Space Security: Strategic Restraint and Pursuit of National Interests – Third Edition*. Palo Alto: Stanford University Press, 2019

Moltz, James Clay. *Toward Cooperation or Conflict on the Moon? Considering Lunar Governance in Historical Perspective*, Strategic Studies Quarterly, Vol. 3, No. 3, Fall 2009. Available at: https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-03_Issue-3/moltz.pdf

NASA. *Governance and Strategic Management Handbook*. NPD 1000.0C, Washington, DC., 2020. Available at: https://nodis3.gsfc.nasa.gov/NPD_attachments/N_PD_1000_000C_.pdf

NASA. *Agency Financial Report for FY 2023*. Washington, D.C., November 15, 2023. Available at: <https://www.nasa.gov/wp-content/uploads/2023/11/fy2023-afr-111323-version5-d-final.pdf>

National Research Council. *Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions*. National Academies Press, Washington, D.C., 2010. Available at: http://www.nap.edu/catalog.php?record_id=13042

Oh, David. "Why Does Psyche Look Like That?" *Medium*, March 2, 2020. Available at: <https://medium.com/the-nasa-psyche-mission-journey-to-a-metal-world/why-does-the-psyche-spacecraft-look-like-that-fc207c0844cc>

Pace, Scott, et al. *The Global Positioning System: Assessing National Policies*, MR-614. Santa Monica: RAND, 1995. Available at: http://www.rand.org/pubs/monograph_reports/MR614/

Pollpeter, Kevin, et al. "China-Russia Space Cooperation," China Aerospace Studies Institute, Montgomery, AL, May 2023. Available at: <https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2023-05-08%20China%20Russia%20Space%20Cooperation.pdf>

Preston, Robert, et al. *Space Weapons Earth Wars*, MR-1209-AF. Santa Monica: RAND, 2002. Available at: <http://www.rand.org/publications/MR/MR1209/>

Secure World Foundation. *Handbook for New Actors in Space*, Washington, D.C. 2016. Available at: <https://swfound.org/handbook/>

Gerstein, Daniel M. and Perry M. Smith. *Assignment Pentagon: How to Excel in a Bureaucracy, Fifth Edition*. Lincoln: Potomac Books Inc., 2020

Temple, L. Parker, III. *Shades of Gray: National Security and the Evolution of Space Reconnaissance*. New York: AIAA, Inc., 2005

Temple, L. Parker, III. *Implosion: Lessons from National Security, High Reliability Spacecraft, Electronics, and the Forces Which Changed Them*. New Jersey: IEEE Press, 2013

U.S. Department of Defense. *Military and Security Developments Involving the People's Republic of China*. Annual Report to Congress, Washington, DC. October 19, 2023. Available at <https://www.defense.gov/Spotlights/2023-China-Military-Power-Report/>

United Nations. Committee on the Peaceful Uses of Outer Space, "Guidelines for the Long-term Sustainability of Outer Space Activities," A/AC.105/2018/CRP.20, 27 June 2018. Available at: https://www.unoosa.org/res/oosadoc/data/documents/2018/aac_1052018crp/aac_1052018crp_20_0.html/AC105_2018_CRP20E.pdf

Weber, Robert A., and Kevin O'Connell. *Alternative Futures: United States Commercial Satellite Imagery in 2020*, Innovative Analytics and Training LLC, Washington, DC, November 2011. Available at: <https://nsarchive2.gwu.edu/NSAEBB/NSAEBB404/docs/37.pdf>

Course Schedule and Readings

Date	Topic	Reading	Assignment Due
Jan 16	Week 1 Space Fundamentals: the environment, orbital mechanics, and functional capabilities	<p><i>Air University Space Primer</i>, Chap. 4, "Basics of Orbital Mechanics"</p> <p>CBO, "Large Constellations of Low-Altitude Satellites: A Primer"</p> <p>Space Flight: The Application of Orbital Mechanics video – copy and paste: http://www.youtube.com/watch?v=Am7EwmxBW8</p> <p><i>Basics of Space Flight</i>, Sec. I, Chap. 1-6, https://www2.jpl.nasa.gov/basics/index.php</p>	<p>Take embedded quizzes in JPL tutorial for each Chapter in Section I</p> <p>Problem Sets released</p>

Jan 23	Week 2 Agency Budgets	<p>NASA. FY2024 Budget Request, Washington, D.C., 2023. Available at: https://www.nasa.gov/nasa-fiscal-year-2024-budget-request/</p> <p>Aeronautics and Space Report of the President, See https://www.nasa.gov/history/history-publications-and-resources/aeronautics-and-space-report-of-the-president/</p> <p>OMB Analytical Perspectives at https://www.whitehouse.gov/omb/budget/analytical-perspectives/ and http://www.usaspending.gov/</p>	None Form teams for tutorial presentations
Jan 30	Week 3 Cost Estimation	<p>NASA Cost Estimating Handbook, Ver. 4.0, February 2015</p> <p>"NASA Productivity" by Coonce, et al. in <i>Journal of Cost Analysis and Parametrics</i>, Winter/Spring 2010</p> <p>NASA Office of the Inspector General. <i>NASA's Cost Estimating and Reporting Practices for Multi-Mission Programs</i>, IG-22-011, Washington, D.C., April 7, 2022.</p>	Problem Set #1 due
Feb 6	Week 4 Spectrum management	<p>European Space Policy Institute. <i>Space Spectrum Management</i>, October 2023.</p> <p>Summit Ridge Group, <i>The Spectrum Handbook</i>, Ch. 1 (pp 24-29), Ch. VII (pp 72-93), Ch. X (pp 135-139), Ch XVII (pp 353-359) Oct 2018</p>	Problem Set #2 due

		<p><i>Structure of ITU-R Study Groups</i>, https://www.itu.int/en/mediacentre/backgrounders/Pages/itu-study-groups.aspx</p> <p>"Overview of ITU History," Geneva, November 2020. Available at: https://search.itu.int/history/HistoryDigitalCollectionDocLibrary/12.28.71.en.pdf</p>	
Feb 13	<p>Week 5 Space Fundamentals: continued. GPS, remote sensing, comm, warning, weather and launch</p>	<p>Reesman and Wilson, "The Physics of Space War," Oct 2020</p> <p><i>Basics of Space Flight</i>, Sections 7, 9, 10, 11, and 13</p> <p><i>Air University Space Primer</i>, Part IV - Mission Sets and Operations</p> <p>Wright, David, et al. <i>The Physics of Space Security</i></p>	Student presentations
Feb 20	<p>Week 6 Export Controls and Remote Sensing Licenses</p> <p>Guest: Janice Starzyk</p>	<p>Export Controls: A Quick Start Guide at: https://beta.bis.gov/videos (Commerce) and https://2009-2017.state.gov/strategictrade/overview/index.htm (State)</p> <p>State Category XV – Spacecraft and Related Articles at: https://www.ecfr.gov/cgi-bin/text-idx?node=pt22.1.121#se22.1.121_11</p> <p>Commerce Department - <i>U.S. Export Controls for the Commercial Space Industry</i>, Nov 2017</p>	Problem Set #3 due

		Declassified PDD-23 materials (Clinton Library) "Licensing of Commercial Remote Sensing Satellite Systems" http://www.nesdis.noaa.gov/CRSRA/licenseHome.html	
Feb 27	Week 7 Commercial Space Launch Licenses; Probabilistic Risk Assessment	Office of Commercial Space Transportation Licensing: https://www.faa.gov/space/ In particular, see discussion of the licensing process Joe Fragola, Elisabeth Morse. Application of PRA in Developmental Systems, Valador, 2012 pp. 1-10 Elisabeth Morse, Joe Fragola, Blake Putney. "Modeling Launch Vehicle Reliability Growth as Defect Elimination," AIAA 2010-8836, 2010 Fred G. Kennedy. "Space and Risk Analysis Paralysis," in <i>Aerospace America</i> , November 2011, pp 29-34	Problem Set #4 due
Mar 5	Week 8 Space Transportation Economics	<i>Air University Space Primer</i> , Ch. 23, "Spacelift" Gideon Grudo. "Technology Readiness Levels, Explained," <i>Air Force</i> , August 2016 Don Pettit, "The Tyranny of the Rocket Equation" https://www.youtube.com/watch?v=uWjdnvYok4I	Problem Set #5 due Get student link to HBS Case Study and

		If Rockets were Transparent https://www.youtube.com/watch?v=su9EVeHqizY	character key codes
Mar 12	Spring Break	No Class	
Mar 19	Week 9 Organizational Behavior	<i>Columbia's Final Mission</i> – the Mission Management Team MMT Transcripts – January 24, January 27, 2003 Edmondson, Amy C., et al, "The Recovery Window," in <i>Organization at the Limit</i> , 2005, pp. 220-245 Marcia Smith, <i>Synopsis of the Report of the Columbia Accident Investigation Board</i> , Congressional Research Service, 2003	Use key codes to review HBS Case Study of the Columbia MMT on-line (TBD)
Mar 26	Week 10 Organizational Behavior Guest: John Logsdon	<i>Columbia's Final Mission</i> – the aftermath Columbia Accident Investigation Board (CAIB) Report – Volume 1 Columbia+10 briefings by Wayne Hale and Doug Cooke Sgobba, Tommaso. "Safety Design for Space Systems," International Association for the Advancement of Space Safety, 2023	
Apr 2	Week 11 Small and Medium Space Powers	OECD, et. al. <i>International, North American and European Statistical Classifications for Space Economy Measurement</i>	Problem Set #6 due

	<p>Guest: Peter Marquez</p>	<p><i>Space Sustainability: A Practical Guide</i>, Secure World Foundation, 2018</p> <p><i>Space Policies, Issues and Trends in 2022</i>, European Space Policy Institute, August 2023.</p> <p>United Nations. <i>Report of the Committee on the Peaceful Uses of Outer Space to the General Assembly Sixty-Fifth Session</i>, A/78/20, August 2023.</p> <p>Manber, Jeff. December 2009 podcast interview on The Space Show http://www.thespaceshow.com/show/15-dec-2009/broadcast-1276-special-edition - from 07:00 to 93:00</p>	
Apr 9	<p>Week 12 China as a Space Power</p> <p>Guest: Dean Cheng</p>	<p>Information Office of the State Council, PRC, "China's Space Program: A 2021 Perspective," January 2022</p> <p>Matthew Daniels, <i>The History and Future of U.S.-China Competition and Cooperation in Space</i>, JHUAPL, 2020</p> <p>Pollpeter, Kevin et al. <i>China's Space Narrative</i>, 2019</p> <p>Cheng, Dean. <i>How China has Integrated its Space Program into its Broader Foreign Policy</i>, 2021</p> <p>Letter from China and Russia to the Conference on Disarmament, 18 August 2009, CD/1872</p>	

Apr 16	Week 13 Space Intelligence	<p><i>U.S. National Intelligence: An Overview, 2013</i></p> <p><i>National Intelligence Strategy of the United States, 2019</i></p> <p>Defense Intelligence Agency, <i>Challenges to Security in Space</i>, January 2019</p> <p>Central Intelligence Agency. "How your NIOs Can Help," National Intelligence Council, February 16, 1988.</p>	<p>Form teams for scenario exercise</p> <p>Game prep</p>
Apr 23	Week 14 Scenario Exercise – Move 1	Use Zoom and Zoom Breakout Rooms	Team Position Papers
Apr 30	Week 15 Scenario Exercise – Move 2	Use Zoom and Zoom Breakout Rooms	Team Position Papers and "Lessons Learned" List

Credit Hour Policy

Over 15 weeks, students will spend about 2 hours per week in class. Required readings, problems sets, and projects are expected to take up, on average, 6 hours per week (time required for problem sets can vary). Over the course of the semester, students will spend 30 hours in instructional time and 90 hours preparing for class. Late work will receive grade deductions based on the number of days the item is late. The amount of the deduction is at the instructor's discretion.

Prerequisites

Academic - No academic prerequisites. Knowledge of basic algebra is assumed.

Technological - If you have questions or problems with technology for this course, please consult the Technology Help link in the left navigation menu in our course in Blackboard.

You should be able to:

- Use a personal computer and its peripherals.
- Use word processing and other productivity software (e.g., Excel)
- Use the webcam and microphone on your device.

- Use your computer to upload recordings and images to your computer.
- Seek technology help by contacting [GW Information Technology](#) (202-994-4948).

If you have any problems with the software in this course, please reference the Technology Help link in the left navigation menu in our course on Blackboard.

Policies

Incomplete Grades

At the option of the instructor, an Incomplete may be given for a course if a student, for reasons beyond the student's control, is unable to complete the work of the course, and if the instructor is informed of, and approves, such reasons before the date when grades must be reported. An Incomplete can only be granted if the student's prior performance and class attendance in the course have been satisfactory. Any failure to complete the work of a course that is not satisfactorily explained to the instructor before the date when grades must be turned in will be graded F, Failure.

If acceptable reasons are later presented to the instructor, the instructor may initiate a grade change to the symbol I, Incomplete. The work must be completed within the designated time period agreed upon by the instructor, student, and school, but no more than one calendar year from the end of the semester in which the course was taken. To record the exact expectations, conditions, and deadlines of the Incomplete please use the Elliott School's Incomplete Grade Contract:

[Incomplete Grade Contract for Graduate Courses](#)

The completed and signed contract is to be submitted to the Academic Affairs and Student Services Office. All students who receive an Incomplete must maintain active student status during the subsequent semester(s) in which the work of the course is being completed. If not registered in other classes during this period, the student must register for continuous enrollment status. For more information regarding Incompletes, please visit the [University Bulletin](#).

Instructor Response Time

I will respond to emails within a day on weekdays and on the next business day over weekends and holidays. I will return assignments within a week that includes a weekend.

Statement on Inclusive Teaching

In support of inclusive excellence, the Elliott School is committed to supporting our faculty and students in exercising inclusive teaching throughout our curriculum. All faculty members are expected to practice inclusive teaching as outlined in [ESIA's inclusive teaching statement](#) and to include a stated commitment in the syllabus. For more information, please visit [ESIA's resource page for inclusive teaching](#).

Inclement Weather

Please note that online courses at the George Washington University will continue to be held even when the University is closed for inclement weather.

Late Work

Late work will be subject to penalties but submission of all work is strongly encouraged regardless. Penalties may be waived for students who get approval in advance for a delay, or in the case of unexpected events such as an illness, injury, or death in the family, etc.

GW Acceptable Use for Computing Systems and Services

All members of the George Washington University must read and comply with the Acceptable Use Policy when accessing and using computing systems and services, including email and Blackboard. Please read [the Acceptable Use Policy](#) to familiarize yourself with how GW information systems are to be used ethically.

Netiquette

Please observe the following rules of netiquette for communicating online:

- Remain professional, respectful, and courteous at all times.
- Remember that a real human being wrote each post and will read what you write in response. It is easy to misinterpret discussion posts. Let's give the benefit of the doubt.
- If you have a strong opinion on a topic, it is acceptable to express it as long as it is not phrased as an attack. Please be gracious with differing opinions.
- When upset, wait a day or two prior to posting. Messages posted (or emailed) in anger are often regretted later.
- Proofread and use the spell check tool when you type a post. It makes the post easier to read and helps your readers understand what you are saying.

I reserve the right to delete any post that is deemed inappropriate for the discussion forum, blog, or wiki without prior notification to the student. This includes any post containing language that is offensive, rude, profane, racist, or hateful. Posts that are seriously off-topic or serve no purpose other than to vent frustration will also be removed.

Academic Integrity

Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information. Please review [GW's Policy on Academic Integrity](#). All graded work must be completed in accordance with the George Washington University Code of Academic Integrity. For more information, see [Promoting Academic Integrity](#).

Artificial Intelligence

The wide availability of Generative Artificial Intelligence (GAI) tools, such as ChatGPT, is driving an ongoing conversation about their academic uses. For this course, GAI tools may be used for study purposes or

specifically authorized assignments. In general, GAI tools should not be used to create text for class papers. In the case of problem sets, students are required to show their work and not use the product of a GAI tool. Work submitted for evaluation is represented as the student's own intellectual product. Students may not submit content (e.g., ideas, text, code, images) for evaluation that was generated, in whole or in part, by Generative Artificial Intelligence tools (such as ChatGPT and other large language models). Doing so without instructor's explicit permission constitutes cheating under the Code of Academic Integrity and is therefore prohibited. Students are permitted to use GAI tools to generate content that is not submitted to an instructor for evaluation. For example, using GAI tools to study for examinations, tests, and quizzes is permitted.

Sharing of Course Content

Unauthorized downloading, distributing, or sharing of any part of a recorded lecture or course materials, as well as using provided information for purposes other than the student's own learning may be deemed a violation of GW's Student Conduct Code.

Use of Student Work (FERPA)

The professor will use academic work that you complete during this semester for educational purposes in this course during this semester. Your registration and continued enrollment constitute your consent.

Copyright Policy Statement

Materials used in connection with this course may be subject to copyright protection under Title 17 of the United States Code. Under certain Fair Use circumstances specified by law, copies may be made for private study, scholarship, or research. Electronic copies should not be shared with unauthorized users. If a user fails to comply with Fair Use restrictions, he/she may be liable for copyright infringement. For more information, including Fair Use guidelines, see [Libraries and Academic Innovations Copyright page](#).

Bias-Related Reporting

At the George Washington University, we believe that diversity and inclusion are crucial to an educational institution's pursuit of excellence in learning, research, and service. Acts of bias, hate, or discrimination are anathema to the university's commitment to educating citizen leaders equipped to thrive and to serve in our increasingly diverse and global society. We strongly encourage students to report possible bias incidents. For additional information, please visit [Bias Incident Response](#).

Disability Support Services & Accessibility

If you may need disability accommodations based on the potential impact of a disability, please [register with Disability Support Services \(DSS\)](#). If you have questions about disability accommodations, contact DSS at 202-994-8250 or dss@gwu.edu or visit them in person in Rome Hall, Suite 102. For additional information, please visit [GW Disability Support Services](#).

For information about how the course technology is accessible to all learners, see the following resources:

[Blackboard accessibility](#)

[Kaltura \(video platform\) accessibility](#)

[Voicethread accessibility](#)

[Microsoft Office accessibility](#)

[Adobe accessibility](#)

Religious Observances

In accordance with University policy, students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance. For details and policy, please see [GW's Policy on Religious Observances](#).

Counseling and Psychological Services

The University's Counseling and Psychological Services office offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include: crisis and emergency mental health consultations confidential assessment, counseling services (individual and small group), and referrals. For additional information, call 202-994-5300 or visit [GW's Counseling and Psychological Services office](#).

Emergency Preparedness and Response Procedures

The University has asked all faculty to inform students of these procedures, prepared by the GW Office of Public Safety and Emergency Management in collaboration with the Office of the Executive Vice President for Academic Affairs.

To Report an Emergency or Suspicious Activity

Call the University Police Department at 202-994-6111 (Foggy Bottom) or 202-242-6111 (Mount Vernon).

Shelter in Place – General Guidance

- Although it is unlikely that we will ever need to shelter in place, it is helpful to know what to do just in case. No matter where you are, the basic steps of shelter in place will generally remain the same.
- If you are inside, stay where you are unless the building you are in is affected. If it is affected, you should evacuate. If you are outdoors, proceed into the closest building or follow instructions from emergency personnel on the scene.
- Locate an interior room to shelter inside. If possible, it should be above ground level and have the fewest number of windows. If sheltering in a room with windows, move away from the windows. If there is a large group of people inside a particular building, several rooms may be necessary.
- Shut and lock all windows (for a tighter seal) and close exterior doors.
- Turn off air conditioners, heaters, and fans. Close vents to ventilation systems as you are able. (University staff will turn off ventilation systems as quickly as possible).
- Make a list of the people with you and ask someone to call the list in to UPD so they know where you are sheltering and who is with you. If only students are present, one of the students should call in the list.
- Await further instructions. If possible, visit [GW Campus Advisories](#) for incident updates or call the GW Information Line 202-994-5050.
- Make yourself comfortable and look after one other. You will get word as soon as it is safe to come out.

Evacuation

An evacuation will be considered if the building we are in is affected or we must move to a location of greater safety. We will always evacuate if the fire alarm sounds. In the event of an evacuation, please gather your personal belongings quickly (purse, keys, GWorld card, etc.) and proceed to the nearest exit. Every classroom has a map at the door designating both the shortest egress and an alternate egress. Anyone who is physically unable to walk down the stairs should wait in the stairwell, behind the closed doors. Firemen will check the stairwells upon entering the building.

Once you have evacuated the building, proceed to our primary rendezvous location: the court yard area between the GW Hospital and Ross Hall. In the event that this location is unavailable, we will meet on the ground level of the Visitors Parking Garage (I Street entrance, at 22nd Street). From our rendezvous location, we will await instructions to re-enter the School.

Alert DC

Alert DC provides free notification by e-mail or text message during an emergency. Visit [GW Campus Advisories](#) for a link and instructions on how to sign up for alerts pertaining to GW. If you receive an Alert DC notification during class, you are encouraged to share the information immediately.

GW Alert

GW Alert provides popup notification to desktop and laptop computers during an emergency. In the event that we receive an alert to the computer in our classroom, we will follow the instructions given. You are also encouraged to download this application to your personal computer. Visit [GW Campus Advisories](#) to learn how.

Additional Information

Additional information about emergency preparedness and response at GW or the University's operating status can be found on [GW Campus Advisories](#) or by calling the GW Information Line at 202-994-5050.