Introduction to Power Beaming & Space Solar

ENAE 788T Course Syllabus, Spring 2021

Course Description:

ENAE 788T Introduction to Power Beaming and Space Solar (3) *Engineering majors only, or department permission.* This course covers the fundamentals of power beaming and space solar, including: overview and concepts of space solar; energy collection methods (photovoltaics, thermal engines, sun-pumped lasers); power beaming modalities (microwave, millimeter wave, laser, reflection); space solar implementation architectures; space systems design; large space structures and space robotics; phased array antennas, retrodirective beam control, rectenna theory and design; safety, regulatory, and societal issues; application contexts; and space and energy economics.

Reference Texts (not required, other material to be provided by the instructor):

Recent Wireless Power Transfer Technologies via Radio Waves, by Naoki Shinohara (Editor). Published by River Publishers, © 2018. ISBN 9788793609242

Wireless Power transfer via Radio Waves, by Naoki Shinohara. Published by ISTE & Wiley, © 2014. ISBN 1118862961

The Case for Space Solar Power, by John C. Mankins. Published by Virginia Edition, © 2014. ISBN 978-0991337002

Solar Power Satellites, by Don M. Flournoy. Published by Springer, © 2012. ISBN 978-1461419990

Course Objective:

Students will understand the basics of power beaming and space solar, including the significance and interrelationship of all functional elements, as well as critical system design considerations. They will be fluent in the assessment of power beaming systems, space solar architectural implementations, and the calculation of figures of merit. They will create and utilize software tools appropriate to support the analysis integral to each of the systems' functions.

Logistics

Time & Location	Tu 7:30pm - 10:00pm / Online only
Instructor	Paul Jaffe, pjaffe@yahoo.com, 202-767-6616
Office Hours	Office hours: by appointment
Learning Management System	http://umd.instructure.com/courses/[TBD]

Grading	Grading is based on: class participation (10%), quizzes and homework assignments (20%), interim presentation (15%); interim report (15%); final presentation (15%); final report (25%).

Course Topics Overview:

Topics are not necessarily listed in presentation order, and are subject to change to accommodate time constraints.

- Motivation, current trends, and context for power beaming and space solar
- Historical background for power beaming and space solar
- Energy collection methods: photovoltaics, heat engines, sun-pumped lasers
- Power beaming modalities: microwave, millimeter wave, laser, reflection
- Orbit and constellation design for space solar
- Space solar architectural implementations
- Large space structures, modular satellite components, space operations, and space robotics
- Solar power satellite system design considerations and methods
- Launch, in-space transportation, and in situ resource utilization
- Power beaming and space solar demonstration concepts
- Non-space solar power beaming applications
- Safety, regulatory, societal, and political issues
- Utility grid, remote installation, and space application contexts
- Energy, space, and environmental economics

Grading Policy:

Assignments must be completed and submitted on time unless prior arrangements are made with the instructor.

Expectations for Students:

Students should actively participate in class by arriving on time, asking questions, and engaging with classmates and the instructor. If a student must be absent due to extenuating circumstances, suitable justification and documentation must be provided. A reasonable effort should be made to inform the instructor in advance for any absences.