ESS 102: SPACE AND SPACE TRAVEL

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Course Description:

Space and Space Travel is a conceptual course for liberal arts and beginning science and engineering students interested in the space environment around the Earth, its control by solar activity, and potential opportunities for the exploration of the solar system. In this course we will describe the filling of space with hot ionized gases called plasmas that are ejected from the Sun, the formation of electron beams and guns, the occurrence of storms and aurora on the Earth and planets as they interact with solar plasma, and the monitoring of space weather and other radiation hazards on long and short time scales. We will also cover issues related to our exploration of this space environment, including scientific targets, orbital mechanics, terrestrial and space based observations, advanced spacecraft propulsion concepts including plasma propulsion, and the complications and difficulties posed by manned vs. unmanned missions.

Prerequisites: None


Class Room Clickers (required): TurningPoint

Class Web Site:

http://www.ess.washington.edu/Space/ESS102/
COURSE TOPICS

Week 1: Introduction and Review of Scientific Notation
  - Light, Energy, & Distance
  - Vital Statistics - how big and how hot
  - Composition - thick or thin
  - Properties of Light - Something radiant and absorbing

Week 2-3: Powering the Sun
  - Coal Burning vs Nuclear reaction
  - Fission or Fusion
  - Solar Neutrinos - Do they have mass?
  - Solar Quakes

Week 3-4: Hot Stuff - Plasmas
  - Charged Particles - something to get hot about
  - Magnetic Effects
  - Creation of plasmas - the fourth state of matter

Week 4-5: The Dynamic Solar Atmosphere
  - Sunspots, Filaments
  - Plages/Spicules
  - Prominences, Loops
  - Flares, Ejections
  - The Sun in X-rays

Week 5: The Solar Wind and the Solar System
  - Orbital Mechanics
  - Composition of the solar system
  - Kuiper Belt Objects - A 10th planet?

Final Project: Stage 1

Week 6: Space Travel
  - what have we done so far
  - Chemical Propulsion
  - Orbital Transfers
  - What to carry and for how long
  - Radiation Hazards

Week 7: Advanced Systems
  - Interstellar Travel - how fast do you have to go
  - Plasma Propulsion - what we might need
  - Advanced Concepts

Final Project: Stage 2 due

Week 8-9: Interactions with the Earth
- Solar Particle Radiation
- Earth's Magnetic Cocoon (the magnetosphere)
- Radiation Belts
- Solar UV and Vanishing Ozone
- The Northern Lights/ Global Aurora
- Ionospheric/Communication Effects
- Cosmic Rays

Week 9-10: The Other Planets
- Mars or the Galilean moons of Jupiter
- Water or not
- Atmospheric Structures
- Kuiper Belt Objects –is Pluto a planet
- Extra-Solar Planets
- Terrestrial Worlds
- Habitability

GRADING

There are five factors in the grade:

1. Weekly Assignments (problems, lab., computer) [30%]
3. 3 Tests – key concepts [total of 30%]
4. Writing Project - write a scientifically correct science fiction article [25%]
5. Classroom Participation [5%]

Grading Policies

Written Assignment Due Dates:
All weekly homework that needs to turned into the TAs will be due in the following computer lab section on either Monday or Tuesday. No assignments will be accepted electronically (by email). You must physically hand them in, except for the on-line components which will also has a one-week duration.

Late Policy:
Without PRIOR approval of your TA, no assignments of any kind will be accepted after the due date.

Missed-lab Policy:
There will be NO make-up labs. If you need to miss your lab section, plan to attend another section instead. Attendance will be taken in each section and will affect your participation grade. TAs will drop the lowest demonstration lab and the lowest computer lab scores at the end of the term.

Missed-test Policy:
The three tests will be in either computer lab or lecture. Make up tests are only available to those who are travel on exam day and who MAKE PRIOR arrangements with their TAs or documented extenuating circumstances.
LABORATORY WORK (Order subject to change due to weather restrictions on outside projects)

Week 1: Properties of Light
- Radiation Spectrum from Hot Objects
- Inverse Square Law
- Infrared Spectrum
- Ultraviolet Spectrum

Week 2: The Colors of Light
- Emission Spectra from the elements
- Line absorption - effects from hot stuff

Week 3: Radiation: in the air and from the ground
- Geiger Counter
- Alpha, beta, and gamma radiation
- Ionization/Absorption
- Radio waves propagation

Weather Permitting Lab
- Telescope observations of the Sun

Week 4: Power of Sound - solar quakes in the lab.
- Strings seen through a stroboscope
- Drumhead - patterns of oscillations
- Standing Wave in Room

Week 5: Magnetic Fields - an invisible force
- Field around a magnet
- Magnetized Fluid
- Dynamo - Faraday Disk ; Motor/Generator

Week 6: Discussion of Final Project

Week 7: Propulsion - how fast can you go
- CO2 Rocket - One hot one cold
- Rocket Wagon
- Ring Launcher
- Water Rocket flight Demo

Week 8: Student Test Flight and Competition

Week 9: Charged Particle Dynamics - glowing motion
- Fine Beam Tube in Helmholtz Coil
- Millikan Oil Drop Analog

Week 10: Remote Sensing Lab
- Surface imaging
- Plausible Interpretations