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Physics 3340

Principles of Environmental Physics

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The course will focus on basic physical principles of light, heat, energy and sound in the natural environment. We will look at the environment of our planet through the understanding provided by physics. We will draw on ideas and concepts from many different areas of physics including mechanics, electricity and magnetism, thermodynamics and particle physics. There will be a bias towards issues that most concern people since we are humans. In particular the issues related to our overabundance on the planet will receive particular attention.

We will cover issues from the small to the largest scale. Issues at the global scale naturally lead to discussions of climate that will be discussed including the physical evolution of the planet and the present role of the atmosphere and ocean. Spectroscopy will be linked to the atmosphere and measurement and observation of the atmosphere both directly and using remote sensing techniques. Fundamental physical principles of energy generation and use will be explored. Pollution transport in the atmosphere and ocean will be discussed, comparing and discussing advective transport and turbulent mixing. The basic physics of acoustics will be applied to observation and noise pollution.

Activity:

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|--------------------|------|
| Assignments | 30 % |
| Test | 10 % |
| Essay/presentation | 20 % |
| Final examination | 40 % |

Assignments will be of two types. There will be 6 of the regular kind, with problems and expectations of working to get solutions. The other will be analysis of a topic. My plan is to have you read a paper and provide a summary for discussion by the class. The summary will include a 2-3 page analysis and a presentation to the group. The grade will be based upon both the paper submitted and the

presentation. There will be 4 of these type of assignments. The regular assignments will be worth 15% and the other group 15% as well.

Dates for assignments and test will be:

15 September – Regular
29 September – Regular & Summary
13 October – Regular & Summary
22 October – Mid-Term
27 October – Regular & Summary
10 November – Regular & Summary
24 November – Regular
3 December – Essay and Presentation Due

Course outline people

(1) Environmental physics

Introduction and background, connections between science and social-science, range of problems, scaling humans on the planet

(2) Atmospheric structure and climate

Solar input, radiation balance, environmental spectroscopy, ozone layers, CO₂ and CH₄ greenhouse effect

(3) Ocean structure and climate

Role of ocean in climate, production in the oceans, modeling dynamics of oceans and atmospheres

(4) Pollutant transport

Diffusion, mixing and transport, in the oceans and the atmosphere, modeling and mitigation

(5) Energy production and use

Fossil fuels, thermodynamics issues, different sources, renewable energy sources, nuclear energy

(6) Information and decision making

Science information in guiding public decision making, role of science and scientists, risk analysis, uncertainty assessment, credibility and responsibility

Text :

E. Boeker and R. van Grondelle. **Environmental Physics 3rd Edition**. Wiley and Sons, 2011. 448 pp