

The Science of Global Challenges

BSU107 2nd Semester Credit Hours 03

COURSE DESCRIPTION:

Our world has seen a massive transformation in the past 200 years. The progress that we see around ourselves is largely owed to the advancement in scientific knowledge that has enabled us to harness Nature's resources in a multitude of ways. This progress however has come at a great cost, including a threat to our own existence. Through this course, we will discuss some of the core challenges mankind is facing, the scientific reasoning behind all these challenges and the actions that must be taken to create a future free of these problems. The three main areas we will focus on include Climate Change, The Energy Crisis and the survival of humanity in the wake of deadly viruses and infectious diseases.

Towards the end the students will get to see the complex relationship between Science, Technology and our Society and some future directions that promise a safer future for all of us.

COURSE OUTCOMES:

Through successful completion of this course, students will be able to:

1. Explain the scientific principles that help understand the key challenges we are facing today
2. Describe natural systems modulating the Earth's climate, articulate causes and consequences of anthropogenic climate change, and discuss measures to curb global greenhouse gas emissions.
3. Differentiate between renewable and nonrenewable systems
4. Explain the working principles of various renewable systems and devices including solar photovoltaics, wind mills, hydro power, geo thermal and bio energy
5. Explain the working principle of key biological ideas including viruses and diseases, evolution by natural and artificial selection
6. Demonstrate an understanding of the deep connection between science, technology and society

Outline

1. Overview and Framing of the course

Introduction to some key advancements we have made in the last 200 years and the associated challenges that are manifesting themselves in the form of Climate Crisis, the over reliance on fossil fuels and mass extinction of various species.

2. Challenge 1: Climate Change

- Intro and Framing
- What's the greenhouse effect
- Challenges and risks of climate change
- Geologic History and Planetary Processes
- Oceans: How do ocean currents regulate global climate
- Atmosphere: How do large scale wind patterns affect global climate
- Ecosystems: Climate constrain ecosystems and ecosystems impact global climate
- Projections of future climate
- Measuring anthropogenic climate change
- What are GCMs? Carbon emission scenarios
- Sustainability

3. Challenge 2: Energy

- Science of Energy: Forms of Energy, Energy Conversion
- Sustainability of Energy Systems
- Working of renewable devices. How do solar cells operate? Photoelectric effect, intro to

- semiconductors and band gaps, Wind energy, Wind mills, Physics of a generator
- Energy quantification - Energy needs, available resources, renewable vs nonrenewable, challenges of current practices.
- • Future of Energy
- 4. Challenge 3: Human survival and infectious disease**
- • What are infectious diseases
- • Types of infectious diseases
- • History of Germs, Vaccines and Diseases
- • Evolution by Natural and Artificial Selection
- • Why are viruses crossing species barrier?
- • Anti-biotic resistance
- • Human physiological limits
- • Changing interactions and new diseases
- 5. Science, Technology, and Society**
- • Complex web of science, politics and social systems
- • Development of Science in certain areas, Role of Wars
- • Scientific Funding
- • Technological Progress and Ethical Constraints
- • Human experiences as Data
- 6. The Future of Science: Nanotechnology & Biotechnology**
- Nanotechnology and its future applications in Medicine, Food, Computational Systems, Energy
- • Biotechnology
- • Future of foods: Agricultural production, consumption and nutrition
- • Genetic Modification: CRISPR, Gene Therapy
- • Exobiology – Life and humans outside of Earth