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|--------------------------------|--|---|---|---|---|
| OGET 8008 | ENERGY AND CLIMATE CHANGE | L | T | P | C |
| Version 1.0 | | 3 | 0 | 0 | 3 |
| Pre-requisites/Exposure | - Graduation/ Bridge Course in Economics | | | | |
| Co-requisites | Knowledge of Environmental Studies at +2 level | | | | |

Course Objectives

The objectives of this course are:

- (a) To familiarize students with basic concept of economics of energy, environment and their interaction with reference to climate change.
- b) To teach the students impact and adaptation of climate change.
- c) To make students understand mitigation strategy of climate change.

Course Outcomes

Upon successful completion of the course a student will be able to:

- CO1: To be able to understand the problem of economics of energy – environmental interaction with respect to global climate change;
- CO2: To be in a position to analysis impact of climate change;
- CO3: To be in a position to understand the adaptation of climate change;
- CO4: To demonstrate in producing research/project report on mitigation strategies of global climate change.

Course Content

Module 1: Introduction to climate change (8 lecture hours)

- Energy–Environment Interaction at Global Level
- Introduction to extreme events
- Gradual changes of the climate

Module 2: Impacts of climate change on different natural systems (8 lecture hours)

- Impact on natural ecosystem, freshwater and regions

Module 3: Impacts of climate change on managed systems (5lecture hours)

- Impact on agricultural, urban infrastructure and society

Module 4: Vulnerability due to climate change (4 lecture hours)

- The concept of vulnerability.
- The vulnerabilities of different ecological and social systems
- Coastal vulnerability

Module 5: Adaptation and Mitigation**(1 lecture hours)**

- Introduction to the concept, indicators of adaptation
- Different adaptation options
- Problems of its operationalization
- Potential adaptation options for issues of energy security and transportation in developing and developed countries
- Low carbon economy
- Deep De-carbonization

Module 6: Factors influencing adaptation and mitigation strategies**(3 lecture hours)**

- Technical factors, Institutional factors, Financial factors
- Constraints to developing strategies; consequences of adaptation strategies.
- Resilience to climate change possibilities.

Module 7: Methods to evaluate vulnerabilities and impacts**(2 lecture hours)**

- Measures of decision support to adaptation
- Connections between adaptation and mitigation: trade-offs

Module 8: Climate Change Mitigation Strategy**(5 lecture hours)**

- Implementing the Paris Climate Agreement-I: The Goal: < 2°C , The Carbon Budget
- Implementing the Paris Climate Agreement-II: Deep Decarbonization; Sources and Sinks: Energy, Land Use, CCS; Uncertainties, Precaution, and Insurance
- Deep Decarbonization: The Three Pillars and National Case Studies
- Low Emissions Electricity & Renewables: The Role of Innovation to Reduce Emissions, Innovative Off-Grid Energy Solutions, Renewables: Solar, Renewables: Wind, Nuclear Power, Transmission, Energy Storage and Grid Integration, Life Cycle Analysis

Text Books

- Portier C.J., et al. (2010). A Human Health Perspective On Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change. p iv-vii; 1-11; 60-64. Research Triangle Park, NC: Environmental Health Perspectives/National Institute of Environmental Health Sciences.
- King, D., et al. (2015). Climate Change: A Risk Assessment. Policy Brief. Cambridge: University of Cambridge Centre for Science and Policy.
- Broecker, W. (2013). Does Air Capture Constitute a Viable Backstop Against a Bad CO₂ Trip? (3 pages) Elementa: Science of the Anthropocene, Commentary, 1, 000009.
- Plumer, B. (2017, Mar 21). 5 Ways to Think About the Remarkable Slowdown in Global CO₂ Emissions. (4 pages).Vox
- Romm, J. (2017, Jun 6). Seven reasons to be alarmed by record-setting levels of CO₂. Think Progress.

- Bhattacharyya, S. C. (2012). Energy Economics. Springer

Reference Book

- United Nations / Framework Convention on Climate Change (2015). Adoption of the Paris Agreement. Articles 2, 4, 5, and 14. p22-23; 29 (3 pages). 21st Conference of the Parties, Paris: United Nations.
- United Nations Intergovernmental Panel on Climate Change (2014). Climate Change 2014: Synthesis Report, Summary for Policymakers. p2-3; 17-31. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland.
- IRENA (2017). Rethinking Energy 2017: Accelerating the global energy transformation. p3; 9-15. International Renewable Energy Agency (IRENA).
- United Nations General Assembly (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. p1-6; 14-27. (21 pages) Seventieth Session of the General Assembly, New York: United Nations Sustainable Development Summit.
- Deep Decarbonization Pathways Project (2015). Pathways to Deep Decarbonization 2015 Report: Executive Summary. p3-16. (14 pages) Sustainable Development Solutions Network (SDSN) — Institute for Sustainable Development and International Relations (IDDRI).
- Deep Decarbonization Pathways Project. Russia: Economic Diversification. (2 pages) DDPP Country Case Study.
- The White House. (2016). United States Mid-Century Strategy for Deep Decarbonization. Executive Summary.p5-20. (16 pages) The White House. (2016).
- Bataille, C. et al. (2015). Pathways to Deep Decarbonization in Canada. A report of the Deep Decarbonization Pathways Project (DDPP) of the Sustainable Development Solutions Network (SDSN) p3-6. (4 pages) Institute for Sustainable Development and International Relations (IDDRI).
- Denis, A., et al. (2014) Pathways to Deep Decarbonization in 2050 – How Australia Can Prosper in a Low Carbon World. A report of the Deep Decarbonization Pathways Project (DDPP) of the Sustainable Development Solutions Network (SDSN) — p2-5. (4 pages) Institute for Sustainable Development and International Relations (IDDRI).
- McKibben, B. (2016, Aug 15). A World at War. (14 pages) New Republic.
- Shankleman, J. (2017, Mar 22). Big Oil Replaces Rigs With Wind Turbines. (4 pages) Bloomberg Markets.
- IPCC (2011). Summary for Policymakers. In: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation. Sections 5-6, p18-24. (7 pages). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

| Components | Class Test | Assignment | Project Report | Presentation | ESE |
|---------------|------------|------------|----------------|--------------|-----|
| Weightage (%) | 10 | 10 | 20 | 10 | 50 |

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

| Mapping between COs and POs | | |
|-----------------------------|--|---------------------------------|
| | Course Outcomes (COs) | Mapped Programme Outcomes |
| CO1 | To be able to understand the problem of economics of energy – environmental interaction with respect to global climate change; | PO 1,2, 3,4,7,8,9,10, 11,13, 14 |
| CO2 | To be in a position to analysis impact of climate change; | PO 1,2, 3, 7,8,9,10, 11,14 |
| CO3 | To be in a position to understand the adaptation of climate change; | PO 1,2, 3,6 8,9,10, |
| CO4 | To demonstrate in producing research/project report on mitigation strategies of global climate change. | 11, 13,14 |

Program Outcome / Course Outcome mapping

| CO | CO 1 | CO 2 | CO 3 | CO 4 |
|--------|------|------|------|------|
| PO 1 | 3 | 3 | 3 | |
| PO 2 | 3 | 3 | 3 | |
| PO 3 | 3 | 3 | 3 | |
| PO 4 | 3 | 1 | 1 | |
| PO 5 | 2 | 1 | 1 | |
| PO 6 | 2 | 1 | 3 | |
| PO 7 | 3 | 3 | 1 | |
| PO 8 | 3 | 3 | 3 | |
| PSO 9 | 3 | 3 | 3 | |
| PSO 10 | 3 | 3 | 3 | |
| PSO 11 | 3 | 3 | | 3 |
| PSO 12 | 2 | 2 | 2 | 2 |
| PSO 13 | 3 | | | 3 |

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|---------------|---|---|--|---|
| PSO 14 | 3 | 3 | | 3 |
|---------------|---|---|--|---|

| Energy and Climate Change | OGET 8008 | Course Code and Course Title |
|---------------------------|---------------|--|
| 2 | PO 1 | Students will be able to develop and evaluate alternate managerial choices and identify optimal solutions. |
| 2 | PO 2 | Students will demonstrate effective application capabilities of their theoretical understanding of economics theories – Microeconomics, Macroeconomics and trade theories to the renewable and non-renewable energy sectors. |
| 2 | PO 3 | Students will exhibit effective decision-making skills, employing analytical and critical thinking ability. |
| 1 | PO 4 | Students will demonstrate effective oral and written communication skills in presenting frameworks, models and regulations of the energy sectors. |
| | PO 5 | Students will be able to work effectively in teams and demonstrate team-working capabilities. |
| 1 | PO 6 | Students will exhibit leadership and networking skills. |
| 2 | PO 7 | Students will demonstrate sensitivity towards ethical and moral issues and have ability to address them in energy economics. |
| 2 | PO 8 | Students will demonstrate employability traits in line with the needs of changing dynamics of renewable and non-renewable energy sectors. |
| 2 | PSO 9 | Students will demonstrate strong conceptual knowledge of economic theory in the context of renewable and non-renewable energy sectors. |
| 2 | PSO 10 | Students will demonstrate effective understanding of economics as it is applicable to energy markets, energy pricing, energy trading and risk management. |
| 2 | PSO 11 | Students will demonstrate analytical skills in designing solutions for energy efficiency. |
| | PSO 12 | Students will exhibit the ability to evaluate working of energy policies. |
| 2 | PSO 13 | Students will have domestic and global perspective towards legal frameworks and environmental regulations with respect to energy sectors. |
| 2 | PSO 14 | Students will exhibit deployable skills pertinent to the renewable and non-renewable energy sectors. |

1 – Weakly mapped

2 – Moderately mapped

3 – Strongly mapped

Model Question Paper



Name:

Enrolment No:

End Semester Examination-Dec. 2016

Program/course: MA Economics (Energy Economics)

Semester : IV

Subject: Energy and Climate Change

Max. Marks : 100

Code : OGET 8008

Duration : 3 Hrs

Section A (attempt all)

Q1. Define the following in one sentence.

| | | | |
|------------------|----------------------------------|----------|-----|
| i. | Global warming | [2] | CO1 |
| ii. | Environmental Kuznet Curve | [2] | CO1 |
| iii. | Solar Energy | [2] | CO1 |
| iv. | Adaptation to Climate Change | [2] | CO1 |
| v. | Climate Change Mitigation | [2] | CO1 |
| vi. | Abatement technology | [2] | CO1 |
| vii. | Decarbonization | [2] | CO1 |
| viii. | GHG | [2] | CO1 |
| ix. | Emission charge | [2] | CO1 |
| x. | Energy consumption | [2] | CO1 |
| SECTION B | | | |
| | Answer any four questions | 5 X4= 20 | |

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|---------------------------------|---|-------------|---------------------|
| Q2. | Explain critically energy environmental interaction at global level. | [5] | CO3, CO4 |
| Q3. | Explain the impact of climate change on natural ecosystems. | [5] | CO3, CO4 |
| Q4. | What do you mean by COP 21? | [5] | CO3, CO4 |
| Q5. | State and explain SDG 13. | [5] | CO3, CO4 |
| Q6. | Examine CO2 emission of developed and developing countries. | [5] | CO3, CO4 |
| SECTION C | | | |
| Answer any two questions | | 2 X 15 = 30 | |
| Q7. | “Climate change is a global phenomenon”. Examine and illustrate the statement from the study of energy-environmental interaction at global level. | [15] | CO1, CO4 |
| Q8. | Critically examine impact of climate change on agriculture and food security. | [15] | CO3, CO4 |
| Q9. | Explain and illustrate SDG 1 to SDG 5. | [15] | CO3, CO4 |
| Section D | | | |
| Answer the question | | 1 X 30 = 30 | |
| Q10. | Describe various strategies of mitigation of climate change. | [30] | CO1, CO3, CO4 |