Course title: Energy economics			
Course code: ENR 165	**No. of credits:** 3	**L-T-P:** 33-12-0	**Learning hours:** 45
Pre-requisite course code and title (if any): NA			
Department: Energy and Environment			
Course coordinator: Dr. Sapan Thapar		**Course instructor:** Dr. Sapan Thapar	
Contact details: sapan.thapar@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 3	

Course Description

This course is designed to provide students with advanced concepts of techno-economic analysis and its role in decision making in renewable energy technology. The course offers the tools needed for rigorous presentation of the effect of the time value of money. The tools introduced include present worth analysis, annual cash flow, rate of return, incremental analysis, futureworth analysis, and payback period. Additionally, the course also covers topics such as energy pricing, and energy modelling.

Course objectives

- To provide students an understanding of the economic fundamentals and principles of decision makinginvolved in energy projects.
- Students learn about cash flows, time value of money and evaluation of investments and projects

Course content

Module	Topic	L	T	P
1	**Basics of engineering economics** Role of engineering economics in the decision making process, Economic decisions versus design decisions, discount rate and economic equivalence, present-worth analysis, annual equivalent- worth analysis, rate-of-return analysis, depreciation, and taxation, developing project cash flows, social cost benefit analysis, Origins of renewable energy project risks, sensitivity analysis, break-even analysis, expected value decisions	8	4	0
2	**Techno-economic Evaluation of Renewable Energy Technologies** Technology dissemination models, volume and learning effects on costs of renewable energy systems, dynamics of fuel substitution by renewable energy systems and quantification of benefits, fiscal, financial and other incentives for promotion of renewable energy systems and their effect on financial viability, case studies on financial feasibility evaluation of renewable energy devices and systems.	8	4	0
3	**Energy Prices and Markets** Basic pricing principles, short run versus long run marginal cost pricing, peak load, seasonal, sectoral pricing of electricity, pricing of natural gas and petroleum products, green power markets	9	2	0
4	**Energy Modelling** Review of various energy sector models, energy demand analysis and forecasting, energy supply assessment and evaluation, energy	8	2	0

	demand – supply balancing, energy modelling in the context of climate change			
		33	**12**	**0**

Evaluation criteria

- Test 1 (Written): 15%
- Test 2 (Written): 15%
- Test 3 (Written/ presentation): 50%
- Assignment/Tutorials: 20%

Learning outcomes

By the end of this course, the student will be able to:

- Evaluate the cost effectiveness of individual renewable energy projects using the methods learned and drawinferences for the investment decisions.
- Compare the life cycle cost of multiple renewable energy technologies using the methods learned and makea quantitative decision between alternate options.
- Utilize spreadsheet functions to perform economic calculations.
- Compare the differences in economic analysis between the private and public sectors. Recognize thelimits of mathematical models for factors hard to quantify.
- Understand of structure of energy markets and methods used for pricing electricity and other forms of energy

Pedagogical approach

The course will be delivered through class room lectures. Relevant case studies shall be discussed in class. Endeavour shall be made to introduce spreadsheet based models in the class through demonstrations.

Materials

Textbooks

Bhattacharyya, S C. (2011), Concepts, Issues, Markets and Governance, Springer
Kandpal T.C. & Garg, H.P. (2003), Financial Evaluation of Renewable Energy Technologies, Macmillan India
Park, C. S., Kim, G., & Choi, S. (2007). Engineering Economics. Pearson Prentice Hall, New Jersey.
Thuesen, G. J., & Fabrycky, W. J., (2002). Engineering economy. Prentice Hall of India.

Suggested readings

Belli, P., Anderson, J., Barnum, H., Dixon, J., & Tan, J. P. (1998). Handbook on economic analysis ofinvestment operations. The World Bank, Washington, DC.
Dahl, C. (2015). International Energy Markets: Understanding Pricing, Policies, & Profits. PennWell Books. Desai, V. (1997). Guidelines for the economic analysis of projects. Asian Development Bank.
Gittinger, J. P.(1973), Economic Analysis of Agricultural Project, The Johns Hopkins University Press.
Jebaraj, S., & Iniyan, S. (2006). A review of energy models. Renewable and Sustainable Energy Reviews, 10(4),281-311.
Kaplan, S. (1983). Energy economics: quantitative methods for energy and environmental decisions.McGraw-Hill College.
Remer, D. S., & Nieto, A. P. (1995). A compendium and comparison of 25 project evaluation techniques. Part 1:Net present value and rate of return methods. International Journal of Production Economics, 42(1), 79-96.

Journals

Energy Policy
Energy Economics
Energy

Additional information (if any)
Student responsibilities The course is highly technical and latest state of the art techniques shall be used, so attendance and class participation will be given utmost importance. All assignments should be submitted as per the timeline. Students will be expected to take up typical energy and power demand problems and use optimization techniques to solve such problems.

Course Reviewers:

1. Dr. Pallav Purohit, International Institute of Applied Systems Analysis (IIASA), Vienna, Austria
2. Ms. Anureet Shahi, Manager (F&A), ONGCL