Course Code ESE-810	Credit Hours (Th-Pr) 3-0	**Computer Applications in Energy Systems (Elective)**	Contact Hrs/Week (Th-Pr) 3-0	Total Contact Hrs (Th-Pr) 45-0

Course Outline:

Simulation and Modeling on Energy costs and energy resource availability, Optimization and sensitivity analysis, models include: solar photovoltaics (PV), wind turbines, run-of-river hydro power, diesel, gasoline, biogas, alternative, co-fired and custom-fueled generators, electric utility grids, micro-turbines, and fuel cells

Eligibility Criteria: B.E (Chemical, Mechanical, Electrical, Environmental and Materials)

Recommended Books:

S. No.	Title	Author(s)	Assigned Code	Remarks
1.	Economy-Energy-Environment Simulation Beyond the Kyoto Protocol.	Kimio Uno	EC	Text
2.	Energy,simulation-training, ocean engineering, and instrumentation	Brain J. Thomson	YC	Reference
3.	Handbook of Energy Audits	Albert Thumann, William J. Younger, Terry Niehus	RM	Reference

Course Objectives:

The primary objectives of this course are to familiarize students with practical applications of soft wares used to model various aspects of energy systems ranging from energy planning strategies, carbon mitigation technologies, energy production & life cycle cost, grid design, evaluate supply & demand, depicting all possible flows to energy from resource extraction, through energy transformation and end-use devices, to demand for useful energy services.

Learning outcome:

The students will appreciate a multiple of software platforms leading to first order estimates to critical questions arising in the production and use of energy. This is considered universally as the preface to fabrication of experimental energy gadgets, which provides saving of time and costs

Topics Covered:

No.	Topics	Text Book	Contact Hours
1.	**HOMER** HOMER models a wide range of conventional and renewable energy technologies. Power sources that can be modeled include: solar photovoltaics (PV), wind turbines, run-of-river hydro power, diesel, gasoline, biogas, alternative, co-fired and custom-fueled generators, electric utility grids, microturbines, and fuel cells. Storage options include: battery banks and hydrogen.	YC	4
2.	**LEAP** LEAP is a comprehensive integrated scenario-based energy-environment modeling tool. Its scenarios account for how energy is consumed, converted and produced in a given energy system under a range of alternative assumptions on population, economic development, technology, price and so on. It is notable for its flexibility, transparency and user-friendliness.	YC	4
3.	**GEMIS** GEMIS is the acronym for the **G**lobal **E**mission **M**odel for **I**ntegrated **S**ystems. GEMIS performs full life-cycle computations for a variety of fuel chains, calculating emissions, resource use and costs.	YC	4

4.	**Energy Costing Tool** In recognition of the critical role that energy plays in reaching the MDGs, UNDP's Sustainable Energy Programme has developed a set of tools for helping mainstream energy considerations into MDG-based national development strategies. A crucial part of developing MDG-based national development strategies is MDG costing, which quantifies the specific financial and human resources needed, as well as infrastructure required, to meet the MDGs.	YC	4
5.	**EnergyPLAN** EnergyPLAN is a Windows-based tool created to assist in the design of national or regional energy planning strategies. It is a deterministic input/output model. General inputs are demands, renewable energy sources, energy station capacities, costs and a number of optional different regulation strategies emphasizing import/export and excess electricity production	YC	4
6.	**CO2DB** CO2DB is a database containing detailed data on carbon mitigation technologies. The database currently contains approximately 3000 technologies, including detailed technical, economic and environmental characteristics as well as data on innovation, commercialization and diffusion.	EC	4
	RETSCREEN RETScreen International Clean Energy Project Analysis Software can be used world-wide to evaluate the energy production, life-cycle costs and greenhouse gas emission reductions for various types of energy efficient and renewable energy technologies (RETs). The software also		4

	includes product, cost and weather databases, and a detailed online user manual.		
	ENPEP The Energy and Power Evaluation Program (ENPEP) is a set of ten energy, environmental, and economic analysis tools. ENPEP is developed by the U.S. Argonne National Laboratory with support from the U.S. Department of Energy. Several ENPEP modules are developed by and are the property of the International Atomic Energy Agency (IAEA). ENPEP can be used to evaluate the entire energy system (supply and demand side), perform a detailed analysis of the electric power system, and evaluate environmental implications of different energy strategies. Each module has automated linkages to other ENPEP modules as well as stand-alone capabilities. ENPEP consists of the following modules: • MACRO-E: A macro-economic tool that helps analyze the feedbacks between the energy sector and the economy as a whole. • MAED:: An MS-Excel-based bottom-up energy demand analysis model. • LOAD: which analyzes hourly electric loads and generates load duration curves for use in other ENPEP modules. • PC-VALORAGUA: used to determine the optimal generating mix of hydro and thermal electric power systems. • WASP-IV: used to determine least-cost generating system expansion paths subject to user-defined constraints. • GTMax: used to study marketing and system operational issues deregulated energy markets. • ICARUS: used to assess the reliability and economic		4

	performance of alternative expansion plans for electric utility generating systems. • IMPACTS: estimates physical and economic damages from air pollution. • BALANCE: uses a market-based simulation approach to examine how various segments of the energy system will respond to changes in energy prices and demands.		
	TIMES/MARKAL (Recommended by Planning Commission) • MARKAL (MARket ALlocation) is a technology-rich energy/economic/environmental model. It was developed in a collaborative effort under the auspices of the International Energy Agency Energy Technology Systems Analysis Programme (ETSAP). MARKAL is a generic model tailored by the input data to represent the evolution over a period of usually 20 to 50 years of a specific energy-environment system at the national, regional, state or province, or community level.		13