MEC7231: Energy Management

Hours per Semester				Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
45	0	0	45	100	60	40	3

Course Description:

The course Analysis and optimization of energy systems deals mainly with energy conversion; energy management; energy audit; material and energy balance; Energy Monitoring and Targeting; Global Environmental Concerns; thermal energy management; Energy Efficiency on Boilers; Energy Efficiency on Steam System; Energy Efficiency on Insulation and Refractory; FBC Boilers; Waste Heat Recovery; Electric Motors; Compressed Air System; HVAC and Refrigeration System; Fans and Blowers; Pumps and Pumping System; DG Set System.

Course Objectives:

To have the student develop a fundamental understanding of the basic physical principles underlying energy management and audit, energy efficiency in thermal and electrical utilities, energy storage systems and power cogeneration

Learning outcomes:

Upon completion of this course the student will be able to:

- Practice energy efficiency and effective utilization of energy in the application areas
- Develop energy system models
- Use simple simulation tools for energy system specification

Course Outline:

Energy Conservation **(2 Hours)**

- Energy Conservation and its Importance;
- Energy Strategy for the Future; the Energy policy , and its Features

Energy Management **(2 Hours)**

- Definition and Objectives of Energy Management;
- Importance; National need of Energy Management;
- Duties and responsibilities of energy managers

Energy Audit **(4 Hours)**

- Energy Audit types and methodology; Energy Audit Reporting Format;
- Understanding Energy Costs; Benchmarking and Energy Performance; Matching

- Energy Usage to Requirement; Maximizing System Efficiency; Fuel and Energy Substitution; Energy Audit Instruments; Duties and responsibilities of energy auditors.

Material and Energy Balance **(6 Hours)**

- Basic Principles; The Sankey Diagram and its Use;
- Material Balances; Energy Balances;
- Method for Preparing Process Flow Chart; Facility as an Energy System;
- How to Carryout Material and Energy and Balance. Energy Action Planning Key elements; Force field analysis;
- Energy policy purpose, perspective, contents, formulation, ratification;
- Organizing the management: location of energy management, top management support, managerial function, accountability;
- Motivation of employees: Information system designing barriers, strategies; Marketing and communicating: Training and planning.

Energy Monitoring and Targeting **(4 Hours)**

- Definition; Elements of Monitoring and Targeting System;
- A Rationale for Monitoring, Targeting and Reporting; Data and Information Analysis;
- Relating Energy Consumption and Production, Case Study.

Global Environmental Concerns **(4 Hours)**

Global Environmental Issues; Ozone Layer Depletion; Global Warming; Loss of Bio-Diversity; Climate Change Problem and Response; The Conference of the Parties (COP); Prototype Carbon Fund (PCF); Sustainable Development. Electrical Energy Management

Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC, and FACTS. Demand side: conservation in motors, pumps and fan systems; energy efficient motors.

Thermal Energy Management **(3 Hours)**

Energy conservation in boilers, steam turbines and industrial heating systems; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management.

Energy Efficiency on Boilers **(3 Hours)**

Introduction; Boiler Systems; Boiler Types and Classifications; Performance Evaluation of Boilers; Boiler Blow-down; Boiler Water Treatment; Energy Conservation Opportunities; Case Study.

Energy Efficiency on Steam System **(3 Hours)**

Introduction; Properties of Steam; Steam Distribution; Steam Pipe Sizing and Design; Proper Selection, Operation and Maintenance of Steam Traps; Performance Assessment Methods for Steam Traps; Energy Saving Opportunities

Furnaces Types and Classification of Different Furnaces; Performance Evaluation of a Typical Furnace General Fuel Economy Measures in Furnaces; Case Study

Electric Motors (Case Study) **(3 Hours)**

Introduction; Motor Types; Motor Characteristics; Motor Efficiency; Motor Selection; Energy Efficient Motors; Factors Affecting Energy Efficiency and Minimizing Motor Losses in Operation; Rewinding Effects on Energy Efficiency; Speed Control of AC Induction Motors; Motor Load Survey: Methodology.

Compressed Air System (Case Study) **(3 Hours)**

- Introduction; Compressor Types; Compressor Performance;
- Compressed Air System Components;
- Efficient Operation of Compressed Air Systems; Compressor Capacity Assessment; Checklist for Energy Efficiency in Compressed Air System.

HVAC and Refrigeration System (Case Study) **(3 Hours)**

- Introduction; Types of Refrigeration System;
- Common Refrigerants and Properties;
- Compressor Types and Application
- Selection of a Suitable Refrigeration System;
- Performance Assessment of Refrigeration Plants;
- Factors Affecting Performance and Energy Efficiency of Refrigeration Plants;
- Energy Savings Opportunities

Mode of Delivery

Include formal lectures (including those from Visiting Lecturers), case studies, tutorial exercises, practical demonstrations, directed learning and individual work

Method of Assessment

The method of assessment is by written examination and both analytical and experimental work. Examination will carry 60% and assignments 40%.

References

[1] Frank Kreith, D.Yogi Goswami, (2007*) Energy Management and conservation Handbook*,

[2] Albert Thumann, P.E., C.E.M., William J. Younger, C.E.M.,(2008) *Handbook Of Energy Audits*, Sixth Edition

[3] Wayne C. Turner (2001) *Energy management handbook* 4th Edition. Fairmont Press, ISBN0824746163, 9780824746162