Course: ME-50103: **Industrial Energy Assessment: Tools and Applications**

Catalog Description: Credit 3, class 3

Course synthesizes advanced energy efficiency, energy auditing methods, tools, and practices. The fundamentals of several types of industrial audits will be analyzed with respect to the methods, tools (hand and software), and industrial applications. Topics include energy audit process, energy bill analysis, economic analysis, measurement instrumentation, building envelop, electrical system, HVAC system, waste heat recovery, lighting, cogeneration, and other prevalent industrial systems. Evaluation of economic, environmental, and productivity are integral components of the course.

Pre- requisites: Graduate or consent of instructor

Co-requisites: None

Text book: Handbook of Energy Audits, 8th Ed., Albert Thumann, P.E., C.E.M., William J. Younger, C.E.M. and Terry Niehus, P.E., C.E.M. ISBN 0-88173-621-X, CRC press.

Reference Book: Guide to Energy Management, 7th Edition, Barney L. Capehart, Wayne C. Turner, William J. Kennedy. ISBN 0-88173-605-8, CRC press.

Coordinator: Ali Razban

Goals: The objective of this course is to acquaint the students with various forms of available energy assessment tools in order to analysis energy system and how improve energy consumption.

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

1. Synthesize the concepts, terminology, and industrial applications of various energy sources [d, e].
2. Identify key parameters representing the energy usage for energy efficiency assessment [e, h].

3. Demonstrate appropriate and accurate measurements using portable metrology equipment [e, k].
4. Compute energy from different measurement systems and convert or translate the values of different forms of energy (ex. 1MMBtu of Heat versus 1MMBtu of Electricity) [e, k].
5. Justify calculations using engineering principles [e].
6. Understand the need for safety in the workplace [f].
7. Utilize statistical methods and/or software packages to determine/predict inefficient energy use and to design/develop energy/environment/cost efficient solutions [e, k].

Note: The letters within the brackets indicate the Program Outcomes of Mechanical Engineering.

Topics:

1. **The need for energy assessment**
   a) Building energy cost control
   b) Utility DSM programs and deregulation
   c) Energy efficiency and peak demand reduction, and commercial business energy cost control Industrial plant operation improvement by:
      – Reducing energy costs
      – Reducing environmental emissions
      – Improving product quality
      – Improving plant productivity

2. **Safety and conducting an energy audit & energy audit instrumentation**
   a) Purpose of the energy audit
   b) Facility description and data needs
   c) Major systems in the facility
   d) Data forms for recording information
   e) Collecting the actual data, and identification of preliminary energy management opportunities.
   f) Need for instrumentation, light level meters, electric meters – voltages, current, power, energy, power factor, temperature-measuring instruments, combustion efficiency measurement, air flow and air leak measurement, thermography and data logging.

3. **Energy and electric rate structures**
   a) Identifying types of energy used electric rates, gas rates, oil, coal, and other rates, steam and hot water rates, factors in controlling fuel costs and utility incentive programs.
   b) Short history of electric rates

c) Difference between power and energy,
d) Electric meters, components of electric rates, example rate structures, factors in controlling electric costs, electric utility incentive programs, and special schedules (interruptible, TOU, real-time pricing)

4. **Energy accounting and economic analysis**
   a) Fuel types and costs
   b) Energy content of fuels, energy conversion factors
   c) Energy use index, energy cost index, where energy is used in facilities,
   d) Economic decisions, simple economic measures, and cost and benefit analysis.

5. **Audit system mechanics**
   Determine instrumentation, measurement strategy, appropriate software and mathematical analysis for the following;

   a) Lighting systems
   b) Electrical energy systems & controls
   c) Motors and adjustable speed drives
   d) Industrial systems
   e) Building envelop
   f) HVAC system
   g) Boilers and steam generation and waste heat recovery
   h) Cogeneration (CHP)
   i) Maintenance

6. **Energy codes and standards, green buildings, leed® & energy star**
   a) building codes, ASHRAE standards (62, 15, 3, 90.1, 189), ASME, IEEE, and other standards, Federal legislation – NECPA, PURPA, NGPA, CAAA, NEPA of 1992, CFC replacements – Montreal Protocol, Global Climate Change, National Energy Policy Act of 2005, Proposed tax incentives 2002, and ISO-50001.
   b) Green buildings and sustainable design, U.S. Green Buildings Council and LEED, LEED certification: LEED -- NC, EB, CI, CS.
   c) ASHRAE 90.1 energy cost budget method, Energy and atmosphere, indoor environmental quality, water efficiency, EPA and the ENERGY STAR program, ENERGY STAR building label and Energy performance ratings and profile manager.

Evaluation Methods: homework assignments, midterm exam, quizzes, team project and final exam.

Professional

Components: Energy Engineering Management

Prepared by: David Goodman

ABET Category: Engineering Science

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