Miami Dade College

Course Competencies Template - Form 112

GENERAL INFORMATION	
Name: Diane King	Phone #: 77021
Course Prefix/Number: ETP2202	Course Title: Fundamentals of Reactor Energy Principles
Number of Credits: 3	
Degree Type	☐ B.A. ☐ B.S. ☐ B.A.S ☐ A.A. ☒ A.S. ☐ A.A.S. ☐ C.C.C. ☐ A.T.C. ☐ V.C.C
Date Submitted/Revised: 12-10-2010	Effective Year/Term: 2011-1
☒ New Course Competency ☐ Revised Course Competency	
Course to be designated as a General Education course (part of the 36 hours of A.A. Gen. Ed. coursework): ☐ Yes ☒ No	

The above course links to the following Learning Outcomes:

- ☐ Communication
- ☒ Numbers / Data
- ☒ Critical thinking
- ☐ Information Literacy
- ☐ Cultural / Global Perspective
- ☐ Social Responsibility
- ☐ Ethical Issues
- ☒ Computer / Technology Usage
- ☐ Aesthetic / Creative Activities
- ☐ Environmental Responsibility

Course Description (limit to 50 words or less, must correspond with course description on Form 102):

This course is for students preparing for nuclear power plant systems operations. Students will learn concepts related to energy principles and their applications in the power plant environment, including basic energy concepts, thermodynamics and thermal processes in the nuclear power plant, heat transfer, heat exchangers, and steam. Prerequisites: ETP1200; PHY1025. A.S. degree credit only. (3 hr. lecture)

Prerequisite(s): ETP1200; PHY1025	Corequisite(s):

Course Competencies: (for further instruction/guidelines go to: http://www.mdc.edu/asa/curriculum.asp)

Competency 1: The student will demonstrate an understanding of basic energy concepts by:

1. Explaining the following terms, including their relationship to each other:
   - energy
   - heat (Q)
   - work (W)
   - power
2. Explaining the four forms of energy possessed by a working fluid in an energy transfer system.
3. Explaining the following terms including symbols, units, and equations when appropriate:
   - stored energy and transient energy
   - potential energy (PE)
   - kinetic energy (KE)
   - internal energy (U)
   - flow energy (Pn)
4. Performing calculations involving work, energy and power, including conversions to the equivalent amount of heat.
5. Explaining the difference between mechanical work and flow work.
6. Defining the following terms:
   - enthalpy (H)

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- entropy (S)

7. Explaining the Law of Conservation of Energy.
8. Explaining the terms in the General Energy Equation.

Competency 2: The student will demonstrate an understanding of basic thermodynamic concepts and processes by:

1. Stating the Second Law of Thermodynamics.
2. Explaining entropy as it relates to a thermodynamic process.
3. Explaining the relationship between real and ideal processes.
4. Explaining thermodynamic process concepts, including:
   - vacuum formation in a condenser
   - the principles of operation of an air ejector
   - the concept of condensate depression and its effect on plant operation
   - the function of fixed and moving blading in the turbine
   - the reason turbines are multi-staged
   - the throttling process
5. Performing calculations and interpreting results using h-s (Mollier) diagrams and steam tables.
6. Applying the General Energy Equation to:
   - solve condensing process problems
   - solve turbine process problems
   - describe the function of convergent and divergent nozzles
   - describe the pumping process
   - solve typical pumping process problems

Competency 3: The student will demonstrate an understanding of fundamental heat transfer concepts by:

1. Distinguishing between boiling processes and other heat transfer mechanisms.
2. Drawing a simple pool boiling curve and explaining the characteristics and properties illustrated in the curve.
3. Describing sub cooled nucleate boiling and bulk boiling.
4. Defining departure from nucleate boiling (DNB) and departure from nucleate boiling ratio (DNBR), describing the parameters that affect DNB and DNBR, and explaining their effects.
5. Defining and describing sub cooling margin.
6. Classifying the following regions along a hypothetical fuel channel experiencing two-phase flow:
   - slug flow region
   - annular flow region
   - dry out region or mist flow region
   - OTB point

Competency 4: The student will demonstrate an understanding of the principles associated with heat exchangers by:

1. Identifying the types and purposes of heat exchangers used in a power plant, such as heating, cooling, condensing, steam generators.
2. Describing the following:
   - classification by flow (such as cross-flow, counter-flow and parallel flow)
   - classification by heat transfer process
   - principles of operation
3. Listing and describing the function of heat exchanger components such as shells, tubes, relief valves, vacuum breakers, etc.
4. Explaining failure mechanisms and symptoms (such as air binding, tube leaks, and heat transfer reduction), common defects, indicators of wear, and malfunctions of heat exchangers.
5. Explaining the following concepts:
   - the overall heat transfer coefficient (U_O)

- heat flux
- the manner in which fluid films affect heat transfer

6. Solving heat flux and heat transfer rate problems and problems applying the overall heat transfer coefficient.
7. Describing the relationship between heat transfer rate in a heat exchanger and the factors which affect it.
8. Listing functions of the main condenser in a power plant.
9. Defining condensate depression and discussing its operational implications.

Competency 5: The student will demonstrate an understanding of fundamental nuclear process specific thermal concepts by:

1. Differentiating between radial and axial temperature profiles.
2. Drawing the radial temperature profile from the centerline of a fuel pellet to the centerline of the channel.
3. Explaining the following concepts:
   - necessity of determining core coolant flow
   - the need for adequate core bypass flow
   - the causes of natural circulation
   - core bypass flow
4. Explaining factors affecting natural circulation, including:
   - how to determine if natural circulation flow exists
   - how to enhance natural circulation
   - how gas binding affects natural circulation
5. Calculating core flow rate, core thermal power, or core temperature differences based on changing natural circulation flow conditions

Competency 6: The student will demonstrate an understanding of thermodynamic cycles by:

1. Describing the thermodynamic cycle.
2. Differentiating between a thermodynamic process and a thermodynamic cycle.
3. Defining thermodynamic cycle efficiency (η) in terms of net work produced, heat supplied, and heat rejected.
4. Describing the Carnot cycle and the relevance of the Carnot cycle efficiency to power plant design and operation.
5. Calculating the Carnot efficiency of a thermodynamic cycle when given heat source and heat sink temperature.
6. Describing the Rankine steam cycle and its relationship to actual power plant components.

Competency 7: The student will demonstrate an understanding of steam by:

1. Identifying the advantages of using steam as a working fluid.
2. Explaining the difference between *state* and *phase* of a working substance.
3. Distinguishing between liquids, vapors, gases, and fluid.
4. Stating, explaining, and applying Boyle's Law, Charles's Law, and the Combined Ideal Gas Law in solving gas or mixture problems.
5. Explaining the uses of steam tables, including the information that can be found within them, and how the information is arranged.
6. Identifying regions and lines on typical water property diagrams, i.e., P-T, P-v, T-s, H-s.
7. Defining the following terms and explaining how they are applied:
    - sensible heat
    - latent heat of vaporization/ condensation
    - saturated liquid
    - saturated vapor
    - vapor pressure
    - wet vapor
    - sub cooled (compressed) liquids
    - degrees of sub cooling/sub cooling margin
    - superheated vapor
    - degrees of superheat
    - supersaturated vapor
    - moisture content
    - steam quality
    - vaporization line
    - critical point
    - vapor dome
    - isotherm
    - specific heat (Capacity) (C_p)