Miami Dade College

GENERAL INFORMATION	
Course Prefix/Number: ETP1200	Course Title: Power Plant Science
Number of Credits: 3 hr. lecture	
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: 09-14-2010	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): This course is designed to familiarize students who are preparing for careers in Electrical Power Technology with the fundamentals of power plant sciences. Students will learn about basic electrical science, properties of reactor plant materials, basic atomic and nuclear physics, heat transfer and fluid flow, reactor safety design, and plant chemistry. Prerequisites: MAC1105, PHY1025. A.S. degree credit only. (3 hr lecture)	
Prerequisite(s): MAC1105, PHY1025	Co requisite(s):

Course Competencies:

Competency 1: The student will demonstrate an understanding of electrical systems in the power plant by:

1. Describing basic plant electrical design to include sources of electrical power, power distribution (AC and DC), effects of work on grounding systems, and electrical hazards.
2. Explaining basic electron theory and magnetism.
3. Explaining the theory of operation for the following plant components: motors, generators, transformers, voltage regulators, inverters.
4. Describing instrumentation schemes for control circuitry, ground detection, and protective relaying.
5. Explaining the following aspects of transformers: types, functions, and operations including cooling, fault symptoms and hazards, safety and environmental precautions, and fire protection schemes.
6. Defining and explaining basic electronics concepts and components, including: solid state circuitry, amplifiers, and integrated circuits.

Revision Date: 06-23-2011

Approved By Academic Dean Date: _____ Reviewed By Director of Academic Programs Date: _____

Competency 2: The student will demonstrate an understanding of atomic and nuclear physics concepts by:

1. Explaining the following basic concepts of atomic structure:
    a) atomic mass unit
    b) mass defect
    c) binding energy
    d) binding energy per nucleon.
2. Describing the following types of nuclear interactions and reactions, including:
    a) radioactive decay processes -- radioactive decay processes (alpha, beta, gamma, electron capture)
    b) neutron activation; neutron interactions (elastic and inelastic scattering, charged particle emission, fission, radioactive capture)
    c) half-life determination
    d) isotope identification methods
    e) ionization (Bremsstrlaung, ionization and excitation)
    f) radiation interactions with matter (pair production, Compton scattering, photoelectric effect)
    g) radiation interactions with matter (pair production, Compton scattering, photoelectric effect)
3. Identifying elements of the fission process to include:
    a) definition theory of fission process
    b) control of fission process
    c) neutrons associated with fission
    d) neutron flux relationship to reactor power
    e) neutron leakage
    f) neutron sources
    g) sources and effects of decay heat
    h) radiation from fission and fission products
    i) sources and effects of decay heat
4. Explaining the following basic concepts of reactor operation:
    a) general design overview of the station reactor type(s)
    b) basic reactor core parameters
    c) reactivity [including reactivity coefficients: temperature, void, fuel (Doppler)
    d) reactivity control methods
    e) response to control rods/boron/fission product poisons
    f) reactivity events
    g) general reactor startup and shutdown maneuvers and identifying those maneuvers that are supported by maintenance
    h) residual heat/decay heat including sources of decay heat (describe sources of decay and residual heat and its significance)

Competency 3: The student will demonstrate an understanding of heat transfer and fluid flow by:

1. Defining pressure and writing the mathematical expression for pressure using the proper units in the Metric and English systems.
2. Explaining energy as applied to heat, energy, and power.
3. Defining the basic thermodynamics relationships:
    a) first Law of Thermodynamics
    b) second Law of Thermodynamics
    c) properties of water and steam
    d) pressure/temperature relationship
    e) basic steam cycle, including thermal efficiency
4. Explaining the principles of heat transfer including the following:
    a) latent and sensible heat
    b) thermal efficiency
    c) types and typical applications of heat exchangers in power plant operations
    d) indications of heat exchanger fouling
5. Explaining what steam tables are and how they are used.
6. Explaining the principles and phenomena of fluid flow to include:
    a) fluid properties and mechanics, including laminar and turbulent flow
    b) effects of throttling on flow and pressure
    c) filling and venting - understanding the concept of high point vents relating to air binding and water hammer
    d) flow within a closed system to include water hammer, heating, draining, filling and venting and the effects of throttling
    e) pump theory including cavitations
    f) water hammer types and mechanisms
7. Identifying types of temperature measuring systems and explaining how each type is used.

Competency 4: The student will demonstrate a basic understanding of power plant chemistry by:

1. Explaining and applying the basic fundamentals of chemistry including molecules, acids and bases, states of matter, conductivity, pH, and units of measure.
2. Reading and interpreting information from the Periodic Table of elements.
3. Discussing basic principles of ion exchangers and ion exchange theory, including anion and cation resin, mixed bed resin; channeling, break-through and resin bed exhaustion and observation of decontamination factor.
4. Defining mixtures, solutions, and compounds.
5. Explaining properties and analysis methods.
6. Outlining the characteristic properties of gases.
7. Stating the relationship between the temperature of a liquid and its vapor pressure.
8. Explaining corrosion chemistry and monitoring, including types of corrosion, characteristics, and prevention.
9. Explaining primary and secondary water chemistry control, including:
    a) types, sources, and effects of impurities
    b) sampling methods
    c) parameters monitored
    d) principles of water treatment

Competency 5: The student will demonstrate an understanding of properties of reactor plant materials by:

1. Explaining the following properties of metals:
    a) overview of general metals properties including structure basics
    b) changes in structure
    c) expansion/contraction
    d) torque limits

e) embrittlement
f) brittle fracture characteristics, mechanisms and temperature effects such as heatup and cool down alloy definition and application
g) compressive strength material strength
h) yield and tensile strength
i) expansion/contraction associated with temperature changes, heat treating and annealing related to the properties of metals

2. Discussing the following plant material problems:
   a) fatigue failure/work hardening
   b) corrosion, causes and sources
   c) the effects of contaminants and contamination on corrosion and material properties
   d) erosion, including flow-accelerated corrosion and cavitation
   e) radiation-induced embrittlement by neutron exposure
   f) the definition, causes, and effects of thermal shock/stress
   g) vibration-induced cracking
3. Explaining the concepts of and differentiating between stress and strain.
4. Defining the terms stress intensity factor and fracture toughness.
5. Defining and explaining the following elements of corrosion and control, including:
   a) pit and crevice
   b) galvanic
   c) chloride stress caustic
   d) stress corrosion cracking, including intergranular stress corrosion cracking (IGSCC)
   e) microbiologically-induced corrosion (open system sources such as marine growth)

Competency 6: The student will demonstrate an understanding of reactor safety design by:

1. Describing the following reactor plant protection concepts:
   a) defense in-depth
   b) fission product barriers
   c) safety limits
   d) limiting condition for operation
   e) administrative controls and procedural concepts
   f) automatic reactor plant protection
2. Stating the relationship between analyzed accidents and events to:
   a) symptoms and indications
   b) anticipated radiation levels
   c) effect on workplace
3. Describing transient prevention and mitigation, and basic accident management, including:
   a) core cooling mechanisms
   b) core damage
   c) radiation hazards and radiation monitor response