Center for Curriculum and Transfer Articulation

Reactor Theory

Course: **PPT221**	Lecture **3.0** Credit(s) **3.0** Period(s) **3.0** Load
	Course Type: **Occupational**
First Term: **2014 Fall**	Load Formula:
Final Term: **Current**	

Description: Basic nuclear reactor theory to include atomic and nuclear physics, thermodynamics, and heat transfer and fluid flow.

Requisites: Prerequisites: PPT120 and GTC108.

MCCCD Official Course Competencies

1. Interpret Systems International (SI) and English units, including measuring pressure, temperature, flow, volume, mass, weight, distance, and time. (I)
2. Perform basic calculations and apply physics concepts.. (II)
3. Explain the principles of mechanical concepts. (III)
4. Explain basic atomic structure. (IV)
5. Explain basic nuclear interactions and reactions, including radioactive decay processes. (V)
6. Explain the basic fission process, including the theory of fission process. (VI)
7. Explain residual heat/decay heat, including the sources of decay heat. (VII)
8. Categorize major sources of natural background radiation, manmade sources of background radiation, and radioactive sources routinely found in a nuclear plant. (VIII)
9. Explain basic reactor operation to include basic reactor types. (IX)
10. Explain principles and concepts related to heat. (X)
11. Explain the concepts and principles of steam. (XI)
12. Explain principles of heat transfer. (XII)
13. Explain principles of fluid flow. (XIII)

MCCCD Official Course Outline

I. Systems International (SI) and English units
   A. Measuring Pressure
   B. Temperature
   C. Flow
   D. Volume
   E. Mass
   F. Weight
   G. Distance
   H. Time
II. Physics Concepts

A. Density, height, and temperature effects on process fluids, mass, fluid mechanics, weight, and heat
B. Temperature system conversions such as Rankine, Fahrenheit, Kelvin, Celsius
C. Temperature measuring systems
D. Acceleration, distance, and velocity
E. Energy, force, momentum, power, work

III. Principles of Mechanical Concepts
A. Lubrication principles (such as coefficient of friction, viscosity, heat dissipation)
B. Mechanical principles (such as simple machines, including functions of individual components such as levers, gears, cams, and pulleys)

IV. Basic Atomic Structure
A. Atomic mass unit, protons, neutrons, electrons
B. Isotopes, mass-energy equivalence, mass defect
C. binding energy, and binding energy per nucleon
D. Embrittlement
E. Changes in Structure
F. Temperature Effects
G. Plant Material Problems

V. Basic Nuclear Interactions and Reactions
A. Radioactive decay processes
B. Half-life determination
C. Isotope identification methods
D. Radiation interactions with matter
E. Ionization
F. Neutron interactions

VI. Fission Process
A. Delayed and prompt neutrons
B. Thermal and fast neutrons
C. Control of fission process
D. Neutron flux effects on reactor power
E. Neutron leakage
F. Fission products
G. Neutron sources
H. Radiation from fission and from fission products

VII. Residual heat/Decay heat

VIII. Background Radiation
A. Natural sources
B. Manmade sources
C. Sources routinely found in a nuclear plant

IX. Basic Reactor Operation
A. Reactor types
B. Reactor parameters
C. Reactivity
D. Response to control rods/boron/fission
E. Reactor startup and shutdown
F. Reactivity events
G. Reactor core parameters
H. Reactivity control methods

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X. Principles and Concepts of Heat
- A. Heat transfer mechanisms
- B. Heat exchanger construction and types
- C. Temperature

XI. Principles and Concepts of Steam
- A. Basic steam-water cycle
- B. Boiling and saturation
- C. Pressure-temperature relationship
- D. Properties of steam and water, including pressure-temperature relationship,
- E. Basic steam-water cycle, steam tables, boiling, saturation
- F. Temperature/pressure, and thermal efficiency
- G. Steam tables

XII. Principles of Heat Transfer
- A. Conduction, convection, and radiation
- B. Heat exchangers
- C. Latent and sensible heat
- D. Thermal efficiency

XIII. Principles of Fluid Flow
- A. Effects of throttling on flow and pressure
- B. Filling and venting
- C. Fluid properties and mechanics, including laminar and turbulent flow
- D. Flow within a closed system
- E. Pump theory, including cavitation
- F. Water hammer types and mechanisms

Last MCCCD Governing Board Approval Date: **June 24, 2014**