EP718
Reactor Heat Transport System Simulation and Analysis
Winter 2020
Course Outline

CALENDAR/COURSE DESCRIPTION

Reactor Heat Transport System Simulation and Analysis covers the thermal-hydraulics analysis od reactor heat transport systems. The course presents the underlying physics, thermodynamics, fluid flow and energy transfer applied in analysis of nuclear reactor primary heat transport system design.

The topics include:

1) Conservation equations in thermal-hydraulic system analysis
2) Numerical solution techniques
3) Nodalization diagrams and thermal-hydraulic loop nodalization
4) Equation of state
5) The rate form of the equation of state
6) Thermal-hydraulic network modelling
7) Overview of computer codes for thermal-hydraulic analysis (CATHENA, TUF, RELAP, TRACE)
8) R&D related to thermal-hydraulic code development
9) Computer code validation, accuracy assessment, and applicability assessment

The course will be taught by means of lectures and assignments. ***Attendance at the lectures is mandatory***.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): None.
Antirequisite(s): None.

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

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Office Hours:
TBD
Or by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

None

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://engphys.mcmaster.ca/undergrad-studies/ug-courses/eng-phys-2ne3/
http://avenue.mcmaster.ca/

COURSE OBJECTIVES

By the end of this course, students should be able to:

- Understand and apply methods for development of thermal-hydraulic models in reactor heat transport system analysis.
- Understand and critically review thermal-hydraulic computer codes and numerical solution techniques
- Use thermal-hydraulic computer models for analysis of thermal-hydraulics networks.
- Develop processes and procedures for computer code R&D support.
- Develop and use processes for computer code accuracy assessment and applicability assessment.

MATERIALS AND FEES

Required Texts:

"The Essential CANDU: A Textbook on the CANDU Nuclear Power Plant Technology", "Chapter 7: Thermalhydraulic Analysis", UNENE/COG, 2017.
CATHENA, RELAP and TRACE Computer Code Manuals.

Calculator:

Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.

Other Materials:

None.

COURSE OVERVIEW

Module	Topic	Readings
1	Introduction, concepts, assignments	
2	Basic equations for thermal-hydraulic system analysis	Chapter 2
3	Nodalization principles, rules and techniques	Chapter 3
4	Equation of state	Chapter 4
5	The rate form of the equation of state	Chapter 5
6	Thermalhydraulic network simulation	Chapter 6
7	Modern thermal-hydraulic computer codes (CATHENA, TUF, RELAP, TRACE	Computer manuals
8	Computer code development process and phenomena identification and ranking	Journal papers
9	R&D activities in support of computer code development and validation and the process of computer code validation	COG information and
10	Computer code accuracy assessment and applicability assessment	

ASSIGNMENTS

The following assignments are part of the course:

1. Assignment 1:
   - Using a computer code FORTRAN listing for a PWR downcomer analysis, make appropriate changes, develop and executable and test the code
   - Use the developed code for performing required analysis
2. Assignment 2:
   - Perform critical review and comparison of selected system thermal-hydraulics computer programs (CATHENA, TUF, RELAP and TRACE)
3. Assignment 3:
   - Perform assessment of selected models in a thermal-hydraulic code, such as flow regime model, critical heat flux models, two-flow friction model, etc.

MARKING

Component	Weight
Assignment 1	30
Assignment 2	20
Assignment 3	20
Final Exam (must achieve 20 points minimum)	30
Total	100%