Dr Nik Popov
Dr Bill Garland
Dr Laurence Leung

UNENE Thermal-hydraulics course
McMaster Course EP704

Course Schedule

Class Date/ Location	Class Topic	Lecturer Name	Lecture Time
March 19 OUIT - Whitby	1. Course introduction: • Scope and schedule • Introduction	Nik Popov	9:00 – 10:00
March 19 OUIT - Whitby	2. Design Requirements • Heat transfer considerations • Uranium fuel forms • Fuel sheath (cladding) materials • Reactor coolants • Neutron moderators • Moderator arrangements and HTS engineering considerations	Nik Popov	10:00 – 12:00
March 19 OUIT - Whitby	3. Power reactor types and designs 4. Process Design Evolution • Reactor HTS • Steam Generator • Reactor Core • Radiation Exposure • Recent design changes • History of CANDU Design	Nik Popov	13:00 – 15:00
March 19 OUIT - Whitby	5. Heat Transport System Thermal-Hydraulics • Reactor Heat Balance • Steam Generator • Primary Side Flow • Secondary Side Flow • Approximate solution • Heat balance for CANDU 6 • Steam generator with preheater (analytical solution) • Steam generator with preheater (numerical solution)	Bill Garland	15:00 – 18:00
March 20 OUIT - Whitby	6. Flow instabilities	Nik Popov	9:00 – 10:00
March 20 OUIT - Whitby	7. Fuel-coolant heat transfer • General heat conduction equation • Heat transfer in radial direction • General thermal energy equation • Heat transfer in axial direction • Axial quality distribution	Bill Garland	10:00 – 12:00 13:00 – 14:00

Class Date/ Location	Class Topic	Lecturer Name	Lecture Time
March 20 OUIT - Whitby	8. Reactor Thermodynamics • 1st and 2nd Laws • Work, Enthalpy, Energy Equation, Carnot Cycle, Entropy • Reactor power cycle • Efficiency Improvements • Complex Rankine cycle for CANDU	Laurence Leung Nik Popov	14:00 – 18:00
March 21 OUIT - Whitby	9. Two-Phase Flow Fundamentals and impact on the design process • Two-phase flow terminologies • Model assumptions • Flow patterns and transition • Boiling flow • Void fraction	Laurence Leung	9:00 – 11:00
March 21 OUIT - Whitby	10. Critical Heat Flux • CHF terminologies • CHF mechanisms • Experimental techniques • Prediction methods • Applications for design and safety analyses 11. Post dryout heat transfer • Introduction • Transition boiling • Film boiling • Drypatch spreading	Laurence Leung	11:00 – 12:00 13:00 – 16:00
March 21 OUIT - Whitby	12. Pressure drop • Background • Conservation equations • Single-phase pressure gradient • Onset of significant void • Two-phase pressure gradient	Laurence Leung	16:00 – 17:00
March 21 OUIT - Whitby	13. Assignments	Nik Popov	17:00 – 18:00
April 23 OUIT - Whitby	14. Assignments - student presentations	Nik Popov	9:00 – 12:00
April 23 OUIT - Whitby	15. Basic equations for t-h analysis	Nik Popov	13:00 – 15:00
April 23 OUIT - Whitby	16. Equation of state	Bill Garland	15:00 – 17:00
April 24 OUIT - Whitby	17. Nodalization	Bill Garland	9:00 – 11:00
April 24 OUIT - Whitby	18. The rate form of equation of state	Bill Garland	11:00 – 13:00

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April 24 OUIT - Whitby	19. Review of computer programs (CATHENA, TUF, ASSERT, MODTUR-CLAS, etc)	Nik Popov	14:00 – 16:00
April 24 OUIT - Whitby	20. Thermal-hydraulic network calculations	Nik Popov	16:00 – 17:00
April 25 OUIT - Whitby	21. CATHENA t-h models	Nik Popov	9:00 – 12:00 13:00 14:00
April 25 OUIT - Whitby	22. Preparation for the test	Nik Popov Bill Garland	14:00 – 15:00
May 2 OUIT - Whitby	23. Final test	Nik Popov Bill Garland	9:00 – 12:00