

**University of Western Ontario**  
**Department of Electrical and Computer Engineering**

**ECE 9505L/ECE9055L: Control, Instrumentation and Electrical Systems in Nuclear Power Plants**

**Course Outline 2017**

**Description:**

To allow students to gain an understanding of instrumentation and control systems for nuclear power plants during in normal operating conditions and as well as under accident conditions. The course will discuss design requirements for process control systems as well as for safety systems. A significant amount of materials will be on instrumentations under severe accident environments in nuclear power plants and issues and methodologies for monitoring a nuclear power plant under a severe accident.

**Instructor:** Dr. Jin Jiang, P.Eng.

TEB 333, 519-661-2111 ext. 88320, [jjiang@eng.uwo.ca](mailto:jjiang@eng.uwo.ca)

Guest lecturers will also teach sections of the course.

**Location:** HSB 240

**Starting date and time:** May 2<sup>nd</sup>, 2017, 9:00AM – 12:00 Noon

**Consultation hours:** By appointments.

**Academic Calendar Copy:**

Nuclear power plants; Instrumentation and control systems; Modeling and control system design; Safety systems and safety analysis; Role of I&C and safety classifications; Safety systems and related standards; Normal and accident conditions; Classification of accidents; LOCA conditions and severe accident progression; Variables and parameters to be considered under accident conditions; Instruments for accident monitoring; Regulations dealing with severe accidents, accident monitoring systems; Examples of severe accidents, monitoring of severe accidents and management of severe accidents; Protection of electronic devices inside the monitoring systems under severe accidents.

**Contact Hours:** 45 lecture hours

**Pre-requisites:** Undergraduate level control systems and power systems

**Restrictions:** Limited to graduate students (M.Eng., MEngSc, PhD.) in Electrical Engineering program.

**Textbooks:**

There are no specific textbooks for this course. However, relevant materials will be provided as the course progresses.

Presentation slides will be posted on the course web site.

## **Topics and Specific Learning Objectives**

### **Topic 1. Overview of Nuclear Power Plants**

At the end of this section, students will be able to:

- a. state the history of atomic energy
- b. explain radioactivity, fission, and fusion based nuclear reactions
- c. describe the principles of operation of nuclear power plants
- d. differentiate various types of nuclear reactors
- e. name different reactor types and key components, their functions

### **Topic 2. Overview of Nuclear Power Instrumentation and Control (I&C)**

At the end of this section, students will be able to:

- a. state the major instrumentation and control systems in nuclear power plants
- b. perform modeling and control system design for reactors and steam generators
- c. describe the difference between safety systems and process control
- d. assess differences between normal and accident conditions

### **Topic 3. Conventional I&C systems and Safety Systems in a Nuclear Power Plant**

At the end of this section, students will be able to:

- a. describe the role of I&C in operation of nuclear power plants
- b. describe safety classifications by different standards
- c. Perform simple analysis of safety systems
- d. provide examples of safety standards used in nuclear industries

### **Topic 4. Accidents in Nuclear Power Plants**

At the end of this section, students will be able to:

- a. describe classification of nuclear accidents
- b. state the definition and describe LOCA conditions
- c. explain the sequence of accident progressions

### **Topic 5. Monitoring of Key parameters after an Accident**

At the end of this section, students will be able to:

- a. describe the Environmental variables and parameters to be monitored

- b. list the instruments for accident monitoring
- c. describe the regulations for mitigating an accident
- d. explain available state-of-art of accident monitoring systems
- e. describe protection mechanisms protecting monitoring systems under an accident condition

**Topic 6. Examples of Severe Accidents Occurred in Nuclear Power Industry**

At the end of this section, students will be able to:

- a. describe most well known severe accidents in nuclear power industry
- b. explain the main causes for such accidents
- c. explain the most important considerations in deal with severe accidents
- c. state accident mitigation strategies and regulations in nuclear industry

**Note:** The above topics may be subject to adjustments and modifications.

**Evaluation**

Course Component	Weights		Maximum Penalties	
	MESc/PhD ECE9505L	M.Eng. ECE9055L	English	Presentation
Project: Report and Presentation	50%	30%	10%	10%
Assignments	20%	10%	10%	10%
Final Examination	30%	60%	10%	10%

To obtain a passing grade in these courses, a mark of 50% or more must be achieved on the final examination as well as on the project report and presentation. Failure to do so will result in a final course grade of 48% or less.

**Project Report and Presentation**

The students are required to work on a team (up to 3 persons) project on a selected topic provided to the class. A list of project topics will be posted on-line in advance. Each group will be required to submit a project report and give an oral presentation. The selection of the topic is on a first come first served basis. The presentations will take place at the end of the term. Exact date and time will be determined after consultation with the class.

**Final Examination:** The date and place of the final exam will be determined after the consultation with the class.

**Submission of Assignments and Report:** Assignments and reports should be deposited into the assigned course locker. A penalty will be applied to late submission.

**Use of English:** In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

**Attendance:** Any student who, in the opinion of the instructor, is absent too frequently from class, will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the final examination in the course.

**Absence Due to Illness or Other Circumstances:** Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook: [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_medical.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf)

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook: [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_religious.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

**Cheating and Plagiarism:** Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook: [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)