

UNIVERSITY NETWORK OF EXCELLENCE IN NUCLEAR ENGINEERING

UN0601 - Control, Instrumentation and Electrical Systems in CANDU based Nuclear Power Plants

COURSE OUTLINE – 2007

OBJECTIVE:

The objective of this course is to provide students with essential knowledge of control systems, measurement techniques, and instrumentation in nuclear power plants. At the end of the course, the student should be able to perform simple analysis of control systems, design feedback controllers. The student will also be able to understand basic principles of measurements and instrumentations used in a nuclear power plant.

CONTACT HOURS: 36 hours

ANTIREQUISITE: None

PREREQUISITES: Undergraduate course in Control Systems or equivalent

COURSE CONTENT:

1. Feedback Control System Analysis and Design (12 hours)

- 1.1 Basic concepts in dynamic systems and their controls
- 1.2 Modeling of physical systems
- 1.3 Review of Laplace Transforms
- 1.4 Performance specifications and limitations of control loops
- 1.5 Transient vs steady-state performance
- 1.6 Frequency domain analysis
- 1.7 Time domain response and root locus analysis
- 1.8 Stability of systems
- 1.9 Controller design and tuning

2. Measurement Techniques and Instrumentation (12 hours)

- 2.1 Reactivity measurement and control
- 2.2 Temperature measurement and control
- 2.3 Pressure measurement and control
- 2.4 Flow measurement and control
- 2.5 Turbine-generator speed and power monitoring and control
- 2.6 Overall plant operational modes (normal and alternate) and their controls

3. Instrumentation and Control in Nuclear Power Plants (8 hours)

- 3.1 Reactor regulating systems
- 3.2 Reactor safety systems
- 3.3 Main heat transport system
- 3.4 Computer control systems
- 3.5 Control of turbine and electric generator

4. Advanced Control Systems for Nuclear Power Plants (4 hours)

- 4.1 Distributed Control Systems (DCS)
- 4.2 Network based control
- 4.3 Intelligent sensors/transducers

PROJECT:

The students in the course will be required to do a project on a topic related to the course and submit the project report.

REFERENCES:

- [1] R. C. Dorf and R. H. Bishop, *Modern Control Systems*, 10th Edition, Prentice Hall, 2004
- [2] N. S. Nise, *Control Systems Engineering*, 4th Edition, John Wiley & Sons, 2004
- [3] K. Dutton, S. Thompson, B. Barraclough, *The Art of Control Engineering*, Addison-Wesley, 1997.
- [4] N. E. Battikha, *The Condensed Handbook of Measurement and Control*, ISA, 2004.

EVALUATION:

For the purpose of evaluation, the course is divided into three components, namely

- a) Project
- b) Homework
- c) Final examination

The final course grade will be determined from students' performance in all three areas. The examination shall be semi-open book; calculators and formula sheets will be allowed. The weighting of each of these components will be as follows:

Component	Value	Maximum Penalties*	
		English	Presentation
Project: and Report	30%	10%	10%
Homework	30%	10%	10%
Final Examination	40%	10%	10%

*In accordance with the policy of the University, the grade assigned to all written and oral work presented in English shall take into account syntax, diction, grammar and spelling. In the professional life of an engineer, the manner in which oral and written communications are presented is extremely important. An engineering student must develop these skills as an integral part of the graduate program. To encourage the student to do so, the grades assigned to all written and oral work will take into account all aspects of presentation including conciseness, organization, neatness, use of headings, and the preparation and use of tables and figures.

All work will be marked first for content after which a penalty not to exceed the maximum shown above may be applied for lack of proficiency in English and/or presentation.

ATTENDANCE:

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

CHEATING:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

PLAGIARISM:

Students must write their report and assignments in their own words. Whenever students take an idea, or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

COURSE INSTRUCTOR:

Jin Jiang, Ph.D., P.Eng.
Professor
Department of Electrical & Computer Engineering
University of Western Ontario
London, Ont.
N6A 5B9

Tel: (519) 661-2111 Ext. 88320
Fax: (519) 850-2436
E-mail: jjiang@eng.uwo.ca