A POLYTECHNIC INSTITUTION

Course Outline

School of Manufacturing, Electronics and Industrial Processes
Program: Electrical and Computer Engineering Technology
Option: Automation and Instrumentation

CHSC 3342
Industrial Process Fundamentals

Start Date:	January, 2006					**End Date:**	May, 2006		
Total Hours:	68	**Total Weeks:**	17			**Term/Level:**	3	**Course Credits:**	4.5
Hours/Week:	4	**Lecture:**	3	**Lab:**	1	**Shop:**		**Seminar:**	**Other:**

Prerequisites

Course No.	Course Name
MATH 2431	Calculus for Electronics
PHYS 2143	Physics for Electronics

CHSC 3342 is a Prerequisite for:

Course No.	Course Name
ELEX 4215	Strategies for Industrial Process Control
ELEX 4225	Industrial Control Projects & CAD

■ Course Description

Before suitable measurement and automatic process control strategies can be designed and implemented, a detailed knowledge of the behaviour of that process is required. CHSC 3342 fills that requirement by introducing the student to the static and dynamic properties of common industrial processes. Topics include transportation of fluids and fluid dynamics as well as an introduction to thermodynamics including heat transfer and energy balance equations.

■ Detailed Course Description

1. Be familiar with fluid properties of importance in transport phenomena.

2. Perform elementary calculations using empirical and derived equations to determine rates of momentum, mass, and heat transfer.

■ Evaluation

Final Exam	40%	Comments:
Midterms (2)	30%	
Laboratory	30%	
TOTAL	100%	

■ Course Learning Outcomes/Competencies

Upon successful completion, the student will be able to:

1. Fluid Mechanics (16 hours)

Estimate by calculation the power required to transfer incompressible fluids through a pipeline system.

1.1 Determine static pressure due to a column of liquid.
1.2 Determine buoyant force acting on a body immersed in a fluid.
1.3 Define viscosity and determine its value from standard tables.
1.4 Determine other physical properties of fluids, such as density, heat capacity, and thermal conductivity from standard tables.
1.5 Calculate the Reynolds' number for a given application.
1.6 State the total mechanical energy balance equation (Bernoulli's Equation).
1.7 Determine pipeline friction factors by utilizing a Moody Chart and empirical equations.
1.8 Estimate pressure losses for pipes and fittings and compare to actual measured results.
1.9 Define centrifugal and positive placement pump operational characteristics.
1.10 Define net positive suction head and net positive output pressure.
1.11 Calculate pump brake power required for a typical application.

2. Thermodynamics (16 hours)

Apply thermodynamic formula and/or steam tables to determine the magnitude of change in state properties for compressible fluids.

2.1 Define the basic terms associated with thermodynamics including: energy, work, compressible working substance, open and closed systems.
2.2 Define specific heat capacities at constant pressure and constant volume.
2.3 Define internal energy, enthalpy, and entropy.
2.4 Interpret and utilize thermodynamic diagrams such as pressure vs volume, temperature vs enthalpy.
2.5 List characteristics of, and differentiate between, wet steam, saturated steam, and superheated steam.
2.6 Determine vapour pressure at a given temperature from tables.
2.7 Determine the enthalpy of air/water vapour mixtures utilizing formulae and standard tabulations and charts.
2.8 Apply derived thermodynamic formulae to isobaric, isometric, isothermal, adiabatic, and polytropic processes.
2.9 Apply steam tables to various thermodynamic processes.
2.10 State the gas laws including the specific characteristic equation of a perfect gas and the specific characteristic gas constant.
2.11 Derive the relationship between the specific heat capacities at constant volume and pressure and the specific characteristic gas constant.
2.12 Calculate volume/density, pressure, temperature, or the mass of gases under a variety of conditions.

■ Course Learning Outcomes/Competencies (cont'd.)

3. Heat Transfer (8hours)

Estimate heat transfer rates by conduction, convection, and radiation.

3.1 Describe the concept of driving force and resistance as applied to the rate of heat transfer.
3.2 Apply empirical and derived relationships for determining steady state heat transfer rates via conduction through planar solids, cylindrical sections, and other shapes.
3.3 Estimate overall heat transfer coefficients and convective film heat transfer coefficients by the use of standard semi-empirical relationships.
3.4 Calculate the log mean temperature difference driving force for a variety of heat exchangers.
3.5 Determine the heat balance at an insulated pipe surface by considering conduction, convection, and radiation.
3.6 Calculate the heat transfer required to raise or lower the temperature of a substance.
3.7 Produce a piping diagram of a typical heat exchanger process.

4. Mass and Energy Balances (8 hours)

Compute mass and energy balances on selected processes in order to determine unknown flows and/or process capabilities. Topics to be selected from the following:

4.1 Analyze the operation of common boilers.
4.2 Describe the operation of distillation columns and evaporators.
4.3 Describe the unit operations and unit processes encountered in the pulp and paper industry.
4.4 Describe the operation of a cooling tower and the major components and their function for a typical HVAC system.

5. Laboratory Exercises (2 hours sessions)

5.1 Pipeline friction factor as a function of relative roughness and Reynolds' number.
5.2 Equivalent lengths of valve and fittings.
5.3 Characteristic curves for an experimental centrifugal pump.
5.4 Determination of overall and film heat transfer coefficients for liquid/liquid and vapour/liquid heat exchangers.
5.5 Mass and energy balance determinations for an experimental cooling tower.
5.6 Operation of a multiple effect evaporator.
5.7 Operation of a distillation column.

■ Verification

I verify that the content of this course outline is current.

F. Ghaffari — Authoring Instructor
Dec 06/05 — Date

I verify that this course outline has been reviewed.

[signature] — Program Head/Chief Instructor
Dec. 8/05 — Date

I verify that this course outline complies with BCIT policy.

[signature] — Dean/Associate Dean
2005/12/08 — Date

Note: Should changes be required to the content of this course outline, students will be given reasonable notice.

■ Instructor(s)

Farzan Ghaffari Office Location: SW1–1415 Office Phone: 604-451-6847
Office Hrs.: As posted or by appointment E-mail Address: farzan_ghaffari@bcit.ca

■ Learning Resources

Required:

Calculator.

Recommended:

Transport Processes and Unit Operations by C.J. Geankopolis
Thermodynamcis by R. Joel
Applied Thermodynamics for Engineering Technologists by T.D. Eastop and A. McConkey

■ Information for Students

The following statements are in accordance with the BCIT Student Regulations Policy 5002. To review the full policy, please refer to: http://www.bcit.ca/~presoff/5002.pdf.

Attendance/Illness:
In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with his/her instructor or Program Head or Chief Instructor, indicating the reason for the absence. Prolonged illness of three or more consecutive days must have a BCIT medical certificate sent to the department. Excessive absence may result in failure or immediate withdrawal from the course or program.

Academic Misconduct:
Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances are prohibited and will be handled in accordance with the 'Violations of Standards of Conduct' section of Policy 5002.

Attempts:
Students must successfully complete a course within a maximum of three attempts at the course. Students with two attempts in a single course will be allowed to repeat the course only upon special written permission from the Associate Dean. Students who have not successfully completed a course within three attempts will not be eligible to graduate from their respective program.

Course Outline Changes:
The material or schedule specified in this course outline may be changed by the instructor. If changes are required, they will be announced in class.

■ Assignment Details

Assignments:
Late assignments, lab reports, or projects will not be accepted for marking. Assignments must be done on an individual basis unless otherwise specified by the instructor.

Makeup Tests, Exams, or Quizzes:
There will be **no** makeup tests, exams, or quizzes. If you miss a test, exam, or quiz, you will receive zero marks. Exceptions may be made for **documented** medical reasons or extenuating circumstances. In such a case, it is the responsibility of the student to inform the instructor **immediately**.