



ECET 247 Power Systems
Winter 2021

COURSE OUTLINE

The calendar description is available on the web @ _____

Ω Please note: This outline will not be kept indefinitely. It is recommended students keep this outline for their records, especially to assist in transfer credit to post-secondary institutions.

1. Instructor Information

- (a) **Instructor** Godfried Pimlott

(b) **Office hours** _____
(c) **Location** TEC 209

(d) **Phone** 250 370 4430 **Alternative:** _____
(e) **E-mail** pimlott@camosun.bc.ca

(f) **Website** _____

2. Intended Learning Outcomes

(If any changes are made to this part, then the Approved Course Description must also be changed and sent through the approval process.)

Upon successful completion of this course a student will be able to:

- Explain the operation of an electric power system.
- Analyze power systems and power system networks using single line representations, per unit techniques, power flow equations, and symmetrical component techniques.
- Discuss different methods to improve efficiency and power factor of electrical systems and equipment.
- Analyze a power system by combining models of power transformers, generators and distribution/transmission lines, using engineering software as applicable.
- Predict load sharing between paralleled generators, transformers and transmission lines.
- Explain transient behaviour of power systems under different conditions such as switching and start-up.
- Discuss methods to maintain power system stability and reliability such as frequency and voltage control.
- Synchronize a generator with the grid.
- Describe the main concepts of smart grids and micro grids.

3. Required Materials

- (a) Texts
Glover et al, Power System Analysis and Design, 6th edition, 2017 CENGAGE Learning

(b) Other

- Various on-line resources as required

4. Course Content and Schedule

(Can include: Class hours, Lab hours, Out of Class Requirements and/or Dates for quizzes, exams, lecture, labs, seminars, practicums, etc.)

Lectures: 3 hours/Week

Labs: 2.5 hours/week

1. Overview of a Large Scale Power System (1 hr)
 - 1.1 Generation
 - 1.2 Transmission
 - 1.3 Distribution
 - 1.4 Load
 - 1.5 Example: The North American Grid

2. Generation and Loading (5 hrs)
 - 2.1 Energy Sources
 - 2.1.1 Fossil Fuel
 - 2.1.2 Solar
 - 2.1.3 Wind
 - 2.1.4 Hydro
 - 2.1.5 Other
 - 2.2 Generators
 - 2.2.1 Synchronous
 - 2.2.2 Asynchronous (induction)
 - 2.3 Loads
 - 2.3.1 Resistive
 - 2.3.2 Reactive
 - 2.3.3 Electronic
 - 2.4 The Load from the system perspective
 - 2.5 Multiple generators
 - 2.5.1 Real and Reactive Power
 - 2.5.2 Circulating Current
 - 2.6 Load sharing

3. Transmission and Distribution (7 hrs)
 - 3.1 System Structure
 - 3.1.1 One-line diagrams
 - 3.1.2 Loop flow
 - 3.1.3 Stations and substations
 - 3.1.4 Types of distribution systems
 - 3.1.4.1 Radial Networks
 - 3.1.4.2 Ring Networks
 - 3.1.4.3 Mesh Networks
 - 3.2 Three phase Transmission
 - 3.2.1 Balancing loads
 - 3.2.2 Delta and Wye connections
 - 3.2.3 Three phase power

- 3.3 DC Transmission
- 3.4 Transformers
- 3.5 Transmission lines
 - 3.5.1 Conductors
 - 3.5.2 Transmission line model
 - 3.5.3 Towers and other components
- 3.6 Loading
 - 3.6.1 Thermal limits
 - 3.6.2 Stability limits
- 3.7 Voltage Control
- 3.8 Protection

- 4 Power Flow Analysis (8 hrs)
 - 4.1 Network representation
 - 4.1.1 Node voltage magnitude and phase
 - 4.1.2 Branch current magnitude and phase
 - 4.1.3 Real and Reactive power generated and consumed
 - 4.2 Bus Types
 - 4.2.1 Load buses
 - 4.2.2 Generator buses
 - 4.2.3 Slack buses
 - 4.3 Balancing Real and Reactive Power
 - 4.4 Per Unit calculations
 - 4.5 A Six Bus Example
 - 4.6 The Power Flow Equations and Solution Methods
 - 4.6.1 The equations
 - 4.6.2 Iterative solutions
 - 4.6.3 Newton-Raphson
 - 4.6.4 Gauss
 - 4.6.5 Gauss-Siedel
 - 4.6.6 In reality use a computer
 - 4.7 Applications and Optimal Power Flow

- 5 Faults (3 hrs)
 - 5.1 Symmetrical Components
 - 5.2 Symmetrical Faults
 - 5.3 Unsymmetrical Faults
 - 5.4 Short Circuit Current Analysis

- 6 System Performance (3 hrs)
 - 6.1 Reliability
 - 6.2 Security
 - 6.3 Stability
 - 6.4 Power Quality

- 7 System Operation and Management (3 hrs)
 - 7.1 Operation and Control
 - 7.1.1 Per Cycle
 - 7.1.2 Real-time
 - 7.1.3 Scheduling
 - 7.1.4 Planning
 - 7.2 New Technology
 - 7.2.1 Storage
 - 7.2.2 Distributed generation
 - 7.2.3 Automation

7.2.4 Flexible AC Transmission Systems

- 8 The Smart Grid (2 hrs)
- 9 Micro Grids (2 hrs)
9.1 Marine power systems

5. Basis of Student Assessment (Weighting)

(Should be directly linked to learning outcomes.)

(a) Assignments

10%

(b) Quizzes

10%

(c) Exams

Term Tests (2): 35%

Final Exam: 35%

(d) Other (e.g. Project, Attendance, Group Work)

Labs: 10%

6. Grading System

(If any changes are made to this part, then the Approved Course description must also be changed and sent through the approval process.)

(Mark with "X" in box below to show appropriate approved grading system – see last page of this template.)

Standard Grading System (GPA)

Competency Based Grading System

7. Recommended Materials to Assist Students to Succeed Throughout the Course

8. College Supports, Services and Policies



Immediate, Urgent, or Emergency Support

If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), **SEEK HELP**. Resource contacts @

<http://camosun.ca/about/mental-health/emergency.html> or <http://camosun.ca/services/sexual-violence/get-support.html#urgent>

College Services

Camosun offers a variety of health and academic support services, including counselling, dental, disability resource centre, help centre, learning skills, sexual violence support & education, library, and writing centre. For more information on each of these services, visit the **STUDENT SERVICES** link on the College website at <http://camosun.ca/>

College Policies

Camosun strives to provide clear, transparent, and easily accessible policies that exemplify the college's commitment to life-changing learning. It is the student's responsibility to become familiar with the content of College policies. Policies are available on the College website at <http://camosun.ca/about/policies/>. Education and academic policies include, but are not limited to, Academic Progress, Admission, Course Withdrawals, Standards for Awarding Credentials, Involuntary Health and Safety Leave of Absence, Prior Learning Assessment, Medical/Compassionate Withdrawal, Sexual Violence and Misconduct, Student Ancillary Fees, Student Appeals, Student Conduct, and Student Penalties and Fines.

A. GRADING SYSTEMS <http://camosun.ca/about/policies/index.html>

The following two grading systems are used at Camosun College:

1. Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D		1
0-49	F	Minimum level has not been achieved.	0

2. Competency Based Grading System (Non GPA)

This grading system is based on satisfactory acquisition of defined skills or successful completion of the course learning outcomes

Grade	Description
COM	The student has met the goals, criteria, or competencies established for this course, practicum or field placement.
DST	The student has met and exceeded, above and beyond expectation, the goals, criteria, or competencies established for this course, practicum or field placement.
NC	The student has not met the goals, criteria or competencies established for this course, practicum or field placement.

B. Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy at <http://camosun.ca/about/policies/index.html> for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	<i>Incomplete:</i> A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	<i>In progress:</i> A temporary grade assigned for courses that are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
CW	<i>Compulsory Withdrawal:</i> A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.