University of Waterloo

Department of Electrical and Computer Engineering

E&CE 360 Power Systems and Smart Grids
Winter Term 2021

TEACHING TEAM

Instructor			
Name	**Office &Ext**		**E-mail**
Ramadan El-Shatshat	EIT 4021 @ 37063		raelshat@uwaterloo.ca
Teaching Assistants			
Name	**Duty**	**Office**	**E-mail**
Yasser Obaidallah Assolami	Tut TA		yoassola@uwaterloo.ca
Lab Instructor			
Gannayya Bommali	CPH 1333 @ 33815		GBommali@uwaterloo.ca

COURSE TIMETABLE

Type	**Day**				
	Mon.	**Tues.**	**Wed.**	**Thurs.**	**Fri.**
Lecture	3:00-4:20 pm				3:00-4:20 pm
Office Hour	TBA				
Tutorials		8:00-8:50 am			
Labs		8:30AM (3 h) Or 1:30 PM (3h) CPH 1333	8:30AM (3 h) Or 1:30 PM (3h) CPH 1333	8:30AM (3 h) Or 1:30 PM (3h) CPH 1333	

RESOURCES

Texts:

1. Power Systems Analysis and Design, Glover , Sarma and Overbye, SI version, 5th Edition, Cengage Learning, 2012
2. Ramadan El-Shatshat, E&CE 360 Lecture Notes (will be posted in UW-LEARN)

KEY DATES

Week		M	T	W	T	F	Event	LAB (T) COMP
1		11	12	13	14	15	Lectures begin **Jan 11, 2020**	
2	**Jan**	18	19	20	21	22	Tutorials begin week 2, Lab begins Tuesday **Jan 19, 2020**	Lab0-INTRO
3		25	26	27	28	29		
4		1	2	3	4	**5**	**Quiz 1**	Lab-1
5	**Feb**	8	9	10	11	12	Post lab-1 report -Feb 12	
6		15	16	17	18	19	**Reading Week**	
7		22	23	24	25	26	**Midterm Week**	
8		1	2	3	4	**5**	**Quiz 2**	Lab-2
9	**March**	8	9	10	11	12	Post lab-2 Report -March 12	
10		**15**	**16**	17	18	19	**March Break March 13 - 16, 2020**	Lab-3
11		22	23	24	25	26	Post lab-3 Report -March 26	Lab-4
12		29	30	31	1	2		Lab-5
13	**April**	5	6	7	8	9	Post lab-4 Report -April 9	
14		12	13	14	15	16	Post lab-5 Report -April 14**/ Final-April 16**	

COURSE CONTENT

Module	Detailed Description	No. of Lectures
1	**Power Systems:** Power system structure: generation, transmission and distribution system, load profiles and characteristics; Deregulation; Smart grids.	**3**
2	**Power System Components:** Generators: models and analysis, synchronization, infinite bus; Transformers: three-phase connections, equivalent circuits; Transmission lines: models- short, medium and long lines, efficiency and regulation; Loads: types, models.	**9**
3	**Per Unit System**	2
4	**Power Flow Analysis:** One line diagram, power flow analysis: concepts, problem formulation, power flow solutions; Control of active and reactive power.	**7**
5	**Fault Analysis and Protection:** Three-phase symmetrical faults; Basic concepts of protection, elements of protection systems. Protection zones, Primary and backup protection, Protection system requirements, Protective relays, Application of protection systems.	**5**
6	**Distribution Systems:** Distribution system configurations; Voltage drop and loss calculations; Shunt capacitors in distribution systems; Distribution automation	**6**
7	**Smart Grids:** Philosophy and concept of smart grids, Smart homes and smart meters; requirements; concept of smart loads and customer engagement; self healing and restoration paths.	**4**

LABORATORY WORK

- Lab. work is done online or at CPH 1333. Lab experiments will be performed in groups of two students.
- You need to submit one report per group.
- Lab schedules and Lab handouts are posted on UW-LEARN
- Pre-lab questions must be answered and submitted before the beginning of the respective lab sessions by individual student. Please note that it is necessary to do pre-lab work before attending each lab session. You will save much time if you thoroughly study the relevant sections of the lab before attempting the experiments in the lab. Come to the lab with a clear understanding of what you are meant to accomplish, or with clear questions, so that the teaching team can help you.
- All the submissions must be done through UW-LEARN
- Labs are essential components of the course, and hence, they are MANDATORY.
- **Lab Experiments**
  Lab Study – 0: Lab Safety & Equipment Introduction
  Lab Study – 1: Three- Phase Transformers
  Lab Study – 2: AC Synchronous Machines
  Lab Study – 3: AC Transmission Lines
  Lab Study – 4: Power Systems Load Flow Studies
  Lab Study – 5: Short Circuit Analysis and Protection Simulations

LABORATORY SCHEDULE

Experiments	Online-Lab	Post-lab Report	Post-lab Quiz
Lab0: Power Lab Safety & Equipment Introduction Review	Jan 19 - 21	No Report	Friday, Jan 22, 11:59pm
Lab1: 3-Φ Transformer	Feb 2 - 4	Friday, Feb 12, 11:59pm	Friday, Feb 12, 11:59pm
Lab2: Synchronous Machines	Mar 2 - 4	Friday, Mar 12, 11:59pm	Friday, Mar 12, 11:59pm
Lab3: 3- Φ AC Transmission Lines	Mar 17 - 19[1]	Friday, Mar 26, 11:59pm	Friday, Mar 26, 11:59pm
Lab4: Power System Load Flow Studies Simulation with ETAP	Open	Friday, Apr 9, 11:59pm	No Quiz
Lab5: Short Circuit Analysis and Protection Simulation using ETAP	Open	Wednesday, Apr 14, 11:59pm	No Quiz

TUTORIALS

Problems have been assigned based on the scheduled lectures for each week. A set of problems will be given at the end of each chapter. **Teaching Assistants** will help students during the tutorial hours to solve the problems. Additional assistance will be provided during office hours. The solutions for the assigned problems will be made available in the course account on LEARN, at the end of the week of each tutorial session.

NOTE: Quizes and final exam will be based on the assignment problems, so it is definitely in your interest to seriously attempt to do them all

EXAMINATIONS

The following examinations will be held:

- **Quizes:** Friday Feb 5, 2021, and Friday March 5, 2021
- **Final Exam:** Scheduled for the period April 16 - April 24, 2020. Do not make plans to be absent from campus during this period until your final examination dates are known!

OVERALL COURSE GRADE

The course will have two marking schemes. The overall course grade will be calculated as follows:

Test	Percentage
Final Exam	40%
LAbs	20%
2 Quizzes	40%
Total	100%

Note:

- A Student must attend all lab's. If the student fails to attend any of the five labs, he will automatically be receiving an NCR (no credit generated) for his final grade.

ACADEMIC INTEGRITY, GRIEVANCE, DISCIPLINE, APPEALS AND NOTE FOR STUDENTS WITH DISABILITIES

See www.uwaterloo.ca/accountability/documents/courseoutlinestmts.pdf . The text for this web site is listed below:

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for Students with Disabilities: The Office for persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.