Kingdom of Saudi Arabia Ministry of Higher Education **Qassim University** College of Engineering	Qassim University جامعة القصيم	المملكة العربية السعودية وزارة التعليم العالي **جامعة القصيم** **كليه الهندسه**

Control of Power Systems

College: Engineering

Department: Electrical

First: Course Definition

1- Course Code: EE 652

2- Units: 3 credit hrs

3- Level: 3rd

4- Prerequisite:

5- Co-requisite:

6- Location (if not on main Campus):

Second: Course Objectives

- To make the students familiar with power system stability modes.
- To develop the knowledge of the students in power system model at steady-state.
- To develop the knowledge of the students regarding Park's transformation.
- To give the students an understanding of the swing equation of a synchronous generator.
- To develop the skills of the students regarding derivation of a linearized model and state space model of power systems.
- To develop the skills of the students regarding the design of an automatic voltage regulator (AVR) of a power system.
- To acquaint the students the knowledge of the concept of damping torque analysis in power system stability studies.
- To acquaint the students with the necessary information and skills for designing a Power System Stabilizer (PSS) using phase compensation method.

Third: Course Description

1- Topics to be covered

Subject	No of Weeks	Units

Classifications of power system stability modes	2	6
Power system modelling: Rotor movement equation of synchronous generator; Park's transformation	2	6
Steady-state model; simplified dynamic model of a single-machine infinite-bus power system; linearized model; state space model	3	9
Power system control analysis: Power system small-signal stability analysis	2	6
Damping torque analysis; transient stability analysis and improvement.	2	6
Power system control design: AVR design	2	6
PSS design and analysis	2	6

2- Course components (Total hrs in the Semester): 45

Lectures	Exercises	Other
45	---	----

3- Intended Learning Outcomes of the Course (ILO's)

a. *Knowledge*

i) Description of the knowledge to be acquired:

- Power system stability modes
- Power system model at steady-state
- Park's transformation and the swing equation of a synchronous generator
- The linearized model and state space model of power systems
- The role of AVR in power system performance.
- The role of PSS in power system performance
- The concept of damping and synchronizing torques in power system analysis

ii) Teaching strategies to be used to develop that knowledge

- Class lectures.
- Students' presentations
- Group discussion in the Class
- Assignments
- Case study Report (data collection, internet search, and reporting

iii) Methods of assessment of knowledge acquired

- Exams.
- Quizzes.
- Homework assignments.

- Term projects.

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed

- The ability to obtain a linearized model of a power system and perform a small signal analysis for the linearized system.
- The ability to obtain the dynamic model of a power system and analyze the system performance under transient condition.
- The ability to design a proper PSS for a certain power system.

ii) Teaching strategies to be used to develop these cognitive skills

- Class lectures.
- Case studies analysis.
- Term projects.

iii) Methods of assessment of students' cognitive skills

- Students' **s**eminars and presentations.
- Term projects.
- Written reports.

c. Interpersonal Skills and Responsibility

i) Description of the interpersonal skills and capacity to carry responsibility to be developed

- Decision making based on engineering analysis.
- Communication skills.
- Team work.

ii) Teaching strategies to be used to develop these skills

- Reports.
- Term team projects.
- Presentations and seminars

iii) Methods of assessment of students' interpersonal skills and capacity to carry responsibility

- *Evaluation of the team* projects.
- Written reports.
- Students' **s**eminars and presentations.

d. Communication, Information Technology and Numerical Skills

i) Description of the skills to be developed in this domain

- Literature search.
- Problems numerical modelling.
- Utilization of computer applications in analysis and design.

ii) Teaching strategies to be used to develop these skills

- Class lectures.
- Case studies analysis.
- Computer lab sessions.
- Term projects.

iii) Methods of assessment of students numerical and communication skills

- Term projects.
- Written reports.
- Students' seminars and presentations.

e. Psychomotor (if applicable) & Other Non-cognitive Skills

i) Description of the psychomotor or other skills to be developed and the level of performance required

- NA

ii) Teaching strategies to be used to develop these skills-

- NA

iii) Methods of assessment of student's psychomotor skills

- NA

4- Student Assessment Schedule

Serial	*Assessment tool (test, group project, examination etc.)*	*Week due*	*Weight*
1	Term Project – 1	3rd	15 %
2	Mid Term Exam -1	7th	15 %
3	Term Project – 2	10th	15 %
4	Term Project – 3	13th	15 %
5	Final Exam	16th	40 %

5- Student Support

- Providing electronic library for references and scientific periodicals.
- Providing the necessary computer applications for the course.

6- Learning Resources

i) Essential Books (References)

- P.M. Anderson, and A.A. Fouad, "Power system control and stability", IEEE Press, New York, 2nd edn., 1994.
- B.W. Hogg, "Representation and control of turbo-generators in electric power systems", Chapter 5 in 'Modelling of dynamical systems', V.2, Peter Peregrinus Ltd., 1981.

ii) Course Notes Course materials are uploaded on the College Web-Site (www.qec.edu.sa) to be available for the students.

iii) Recommended Books

- M. Pavella, and P.G. Murthy, "Transient stability of power systems: theory and practice", John Wiley & Sons, 1st edition, 1994.
- Antonio G.Exposito,- Antonio J. Conejo, Claudo Canizares, "Electric Energy Systems: Analysis and Operation", First Edition, CRC Press, USA, 2008.

iv) Electronic Books & Web Sites:

- Scientific journals and forums.

v) Periodicals

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7- Course Evaluation and Improvement Processes

i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- Students' Questionnaires,
- Observing the students opinions recorded in the college student site
- Appeal box
- Carrying out extensive questioners by a sample of the distinguished students just after the graduation from the college.-

ii) Other Strategies for Evaluation of Teaching by the Instructor or by the Department

- Instructor report
- Public faculty seminars.
- Periodical review of the teaching methods by both the department council and the education affairs vice dean.-

iii) Processes for Improvement of Teaching

- Assessment of students' work by external examiners.
- Analysis of students' evaluation of course and instructor.
- Seminars by industry professionals.

- Evaluation of the course outlines and student works by external staff member,
- Periodical contact with different engineering authorities and industries for evaluating and getting their feedback and suggestions concerning the course outlines.

iv) Processes for verifying standards of student achievement

- Check marking by an independent faculty member of a sample of student work.
- Periodic exchange and remarking of a sample of assignments/exams with a external evaluator.

v) Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

- Assessment and evaluation of the level of achieving the course outcomes through a continuous improvement process (part of a quality assurance system established by the university),
- Consequently, actions are to be taken to improve the course delivery when necessary.
- Review of the course objectives, outcomes and curriculum every 2 years.