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

Artificial Intelligence Techniques in Electrical Power Engineering

College: Engineering

Department: Electrical

First: Course Definition

1- Course Code: EE 651

2- Units: 3 credit hrs

3- Level: 3rd

4- Prerequisite:

5- Co-requisite:

6- Location (if not on main Campus):

Second: Course Objectives

-To acquaint the students the knowledge of fuzzy sets theory and fuzzy sets operations.
-To acquaint the students the knowledge of construction of fuzzy logic controller.
-To make the students familiar with the design framework for a fuzzy logic controller.
-To develop the skills of the students regarding the design of PSS using the fuzzy logic.
-To acquaint the students the knowledge of artificial neural network (ANN).
-To develop the skills of the students regarding the design of PSS using the ANN.
-To develop the knowledge of the students regarding genetic algorithm (GA) and Particle swarm optimization (PSO).
-To give the students an understanding of utilization of GA or PSO to optimize a PSS.

Third: Course Description

1- Topics to be covered

Subject	No of Weeks	Units

Basics of fuzzy sets theory: Fuzzy sets, Fuzzy sets operations, Linguistic variables and fuzzy rules.	2	6
Fuzzy logic controller (FLC) structure: Fuzzifier, Knowledge base, Inference engine, Defuzzifier.	2	6
Application of fuzzy logic to PSS design.	2	6
Artificial neural network (ANN): types, construction, back-propagation learning.	2	6
Application of ANN to PSS design.	2	6
Modern optimization techniques: Genetic algorithm (GA); initial population; reproduction operations; crossover; mutation.	2	6
Particle swarm optimization (PSO) technique. Advantages of GA and PSO. Hybridization of GA or PSO with FLC and ANN	3	9

2- Course components (Total hrs in the Semester: 60

Lectures	Exercises	Other
45	-----	----

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

a. *Knowledge*

i) Description of the knowledge to be acquired:

- Basics of fuzzy sets theory
- Fuzzy logic controller (FLC) structure
- Artificial neural network (ANN) types and construction
- Modern optimization techniques such as GA and PSO
- Hybridization of GA or PSO with FLC and ANN

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 apply fuzzy logic to the design of PSS.
- The ability to apply ANN to the design of PSS.
- The ability to optimize PSS parameters using GA or PSO technique.

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' seminars 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' seminars 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)

- T.J. Ross, "Fuzzy logic with engineering applications", McGrew-Hill, Inc, 1995.
- R.A.F. Saleh, "Superconducting generators control and stability", ISBN 978-3-639-27991-7, VDM Publishing, Germany, 2010.
- Raj Aggarwal, " Artificial intelligence techniques in power systems ", IEE series, 1997.

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

- L. Davis, "Handbook of genetic algorithms", Van Nostrand Reinhold, New York, 1991.

iv) Electronic Books & Web Sites:

- Scientific journals and forums.

v) Periodicals

- IEEE transactions in power systems.

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.