The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2020/2021

Course:	**Power System Analysis (II) – 0933482 (3 Cr. – Required Course)**
Instructor:	Prof. Eyad A. Feilat Office: E306, Telephone: 06/5355000 ext 22857, Email: e.feilat@ju.edu.jo Office Hours: Will be posted soon
Course website:	http://elearning.ju.edu.jo/
Catalog description:	Power system protection: layout of substations, requirements and elements of protection systems, relays. Directional and non-directional over current and earth fault feeder protection. Differential protection as applied to feeders. Principles of distance protection. Economic operation of power systems: the transmission loss equation, an interpretation of transformation "C", classical economic dispatch, automatic generation control, unit commitment. Power system stability: rotor dynamics and the swing equation, the power angle equation, synchronizing power coefficient, equal-area criterion of stability, introduction to multi-machine stability studies.
Prerequisites by course:	**EE** **0953481** Power System Analysis (I) (pre-requisite)
Prerequisites by topic:	Students are assumed to have a background in the following topics: • Basic principles of power system components and its representation. • Calculations of short-circuit currents. • Principles of synchronous machines.
Textbook:	**Power Systems Analysis by John J. Grainger, William D. Stevenson and Gary W. Chang, McGraw-Hill Education, 2nd edition, 2015.**
References:	1. Power Systems Analysis by Hadi Saadat, PSA Publishing LLC, 3rd edition, 2011. 2. Power System Analysis and Design by J. Duncan Glover, Thomas J. Overbye and Mulukutla S. Sarma, Cengage Learning, 6th edition, 2016. 3. Power System Relaying, S.H. Horowitz, A.G. Phadke, Wiley, 4th edition, 2014. 4. Protective Relaying: Principles and Applications by J. Lewis Blackburn and Thomas J. Domin, CRC Press, 4th edition, 2014. 5. Protection & Control for Power System Paperback by Mohamed A. Ibrahim, CreateSpace Independent Publishing, 1st edition, 2016. 6. Practical Power Systems Protection by Leslie Hewitson, Mark Brown and Ramesh Balakrishnan, Newnes, 1st edition, 2005.

7. Fundamentals of Power System Protection by Y.G. Paithankar and S.R. Bhide, PHI Learning, 2nd edition, 2013.

Schedule: 16 Weeks, 42 lectures (50 minutes each) plus exams.

Course goals: The overall objective is to provide the student with basic knowledge and proficiency in the principles of protecting the different components of a power system during abnormal conditions with emphasis on feeder protection. It also aims to acquaint the student with techniques used for operating power generation systems in an ecomomic manner, and methods used to investigate the stability of synchronous machines running in parallel.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will: **[SO]**

1. Understand the basic principles of power systems protection, identify the protection system components and be familiar with the principle of operation of earth fault, overcurrent directional and nondirectional relays, differential and distance relays. **[1, 2]**
2. Be familiar with classical enconomic operation and automatic control of power stations. **[1, 4]**
3. Know the dynamics of the power system during abnormal conditions. **[1, 4]**

Course topics:

		Hrs
1.	Power System Protection: review of fault calculations, requirements of a successful protection system, current and voltage transformers, electromechanical and static relays.	4
2.	Directional and non-directional over-current and earth-fault protection schemes and relay setting.	9
3.	Transformer Protection: Review of vector groups, Current balance differential schemes. Buchholz relay, Restricted earth fault and unrestricted earth fault schemes.	7
4.	Distance protection: principle of operation, distance-time schemes, methods of distance measurement, setting, acceleration schemes, practical considerations.	9
5.	Economic Operation of Power Systems: Distribution of load between units within a plant and between plants. Classical economic dispatch, automatic generation control, examples.	6
6.	Power System Stability: The stability problem, rotor dynamics and the swing equation, the power angle equation, synchronizing power coefficients, equal area criterion of stability. Classical multi machine stability studies. Step-by-step solution of the swing curve. Factors affecting stability.	7

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

Assignments	0%	Quizzes	0%
First Exam	30%	Projects	0%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021