### Course:
Power System Analysis (2) – 0903482 (3 Cr.)

### Instructor:
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### Course Website:
http://eacademic.ju.edu.jo/E.Feilat/Material/Forms/AllItems.aspx

### Catalog Data:
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, classical economic dispatch, the transmission loss equation, automatic generation control. 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 0903481 – Power System Analysis (1)

### Prerequisites By Topic:
- Basic principles of power system components and its representation
- Calculation of shortcircuit currents.
- Principles of synchronous machines.

### Textbook:

### References:
- Computer – Added power system analysis G. L. Kusic  prentic hall.
- Power system protections volumes 1, 2 & 3 edited by electricity council , mcdonald.
- Electrical power system protection 2013 by A.wright C.Christopoulos.

### Schedule & Duration:
16 Weeks, 45 lectures (50 minutes each) plus exams.

### Minimum Student Material:
Textbook, class handouts, scientific calculator, and an access to personal computer.

### Minimum College Facilities:
Classroom with blackboard and projection display facilities, library, and computational facilities.

### Course Objectives:
The overall objective of this course is to provide the student with basic knowledge and proficiency in the basic principles of protecting the different components of the 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 economic manner, and methods used to investigate the stability of synchronous machines running in parallel.
**Course Outcomes and Relation to ABET Student Outcomes:**

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

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 [a,c,e,k,f]
2. be familiar with classical economic operation and automatic control of power stations [a,e,k]
3. Study the dynamics of the power system during abnormal conditions [a,e]

**Course Topics:**

<table>
<thead>
<tr>
<th>Topic Description</th>
<th>Hrs</th>
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<tbody>
<tr>
<td>1. <strong>Power System Protection:</strong> Layout of electrical substations, requirements</td>
<td>21</td>
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<td>of a successful protection system, current and voltage transformers, electromechanical and static relays.  Directional and non directional over current and earth fault protection schemes and relay setting. Voltage and current balance differential protection schemes for feeders, pilot wire protection, summation circuits. Distance protection: principle of operation, distance-time schemes, methods of distance measurement, setting, acceleration schemes, practical considerations.</td>
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<td>2. <strong>Economic Operation of Power Systems:</strong> Distribution of load between units</td>
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<td>within a plant and between plants. Classical economic dispatch, automatic</td>
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<td>generation control, examples.</td>
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<td>3. <strong>Power System Stability:</strong> The stability problem, rotor dynamics and the</td>
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<td>swing equation, the power angle equation, synchronizing power coefficients,</td>
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**Ground Rules:** Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. 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.

**Assessments:** Exams and Quizzes

**Grading policy:**

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<tr>
<th>Assessment</th>
<th>Percentage</th>
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<tr>
<td>First Exam</td>
<td>20%</td>
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<tr>
<td>Midterm Exam</td>
<td>30%</td>
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<tr>
<td>Final Exam</td>
<td>50%</td>
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<td><strong>Total</strong></td>
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**Last Updated:** October 2014