**Minoufiya University,**

**Faculty of Engineering,**

**Electrical Eng. Dept.,**

**Post Graduate Studies and Research.**

**Minoufiya University**

Faculty of Engineering

**Course Specification**

***Title: Protection of Electrical Power Systems***

***Code Symbol: ELE 609***

***Department offering the course: Electrical Eng. Dept***

***Date of specification approval: / /2012***

***A- COURSE IDENTIFICATION AND INFORMATION:***

***B - Professional Information***

***B.1 Course Aims:***

This course aims to the following:- Scientific Developments and evolutions in the protection

relays. Integrate practical knowledge on the digital relays and the digital power system protection.

Gain research talent in the digital protection and also in the AI applied techniques in power system

protection.

***B.2 Course Objectives***

The objective of this course is to attain the following points:

1. Widely demonstrating the advances of digital protection schemes for protecting different

electrical equipment in power systems.

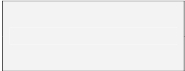
2. Realizing the core of modern protective relays applied for protection improvement.

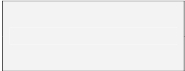
3. Providing practical skills for utilizing modern relaying schemes in power system protection.

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| Field | Programme ILOs that the course  contribute in achieving | Course ILOs |
| Knowledge&  Understanding | A1. Theory, basics and practices of  mathematics, sciences and various  electrical     power      and      machines  engineering technologies. | a1.1) Realize the core of modern  protective relays applied for  protection improvement. |
| A3. The scientific developments in  electrical     power      and      machines  engineering. | a3.1) Understand applications of  digital signal processing and AI in  power system protection. |
| Intellectual skills | B1. Analyze and evaluate the data  and use it to solve electrical power and  machines problems. | b1.1)      Digitally      evaluate      the  protection function. |
| B2. Produce solutions to power and  machines     problems     through     the  application of specific engineering  discipline knowledge based on limited  and possible information. | b2.1) Produce AI techniques for  improving protection systems. |
| Professional and  Practical Skills | C1. Use efficiently the available tools  as computer programs and measuring  instruments as well as building ideas  in the laboratory or through simulation  and apply engineering techniques. | c1.1) Design and perform computer  program for fault feature extraction. |
| C3. Evaluate the available methods  and tools in the power and machines  engineering field. | c3.1) Evaluate the protection relay  performance using AI techniques. |
| General and  Transferable skills | D4. Use different resources to obtain  knowledge and information. | d4.1) Use specialized books and  related internet websites to prepare  reports and presentations. |
| D6. Work with a group and manage  the team. | d6.1) Cooperate with the colleagues  to present collaborative work. |
| D8. Self and continuous learning. | d8.1) Self-learning and evaluation  in the protection engineering. |

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| Field | Academic Reference Standards For Electrical Engineering  Postgraduates (ARSEP-ELE) | | | |
| Knowledge &  Understanding | Intellectual  Skills | Professional  Skills | General Skills |
| Programme Academic  Standards that the course  contribute in achieving | A1 & A3 | B1 & B2 | C1 & C3 | D4, D6 & D8 |



***B.3 Relationship between the course and the programme***

***B.4 Course Intended Learning Outcomes (ILOs)***

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| ***Week***  ***No.*** | ***Sub. Topics*** | ***Total***  ***Hours*** | ***Contact hrs*** | | | ***Course ILOs***  ***Covered (By No.)*** |
| **Lec.** | **Tut.** | **Lab.** |
| *Week-1* | Modern requirements for protection  systems: an introduction | 3 | 3 | - | - | a1.1, b1.1 |
| *Week-2* | Modern requirements for protection  systems: specifications, standards and  performance | 3 | 3 | - | - | a3.1 |
| *Week-3* | Digital relays: Introduction,  Characteristics, typical architecture,  main modules, benefits and  shortcomings. | 3 | 3 | - | - | a1.1, a3.1, b1.1 |
| *Week-4* | Signal processing: Digital concepts of  fault feature extraction. Two-sample  algorithm. Three-sample algorithm.  Mann-Morrison. Prodar 70. Peak-based  Predictive calculation. | 3 | 3 | - | - | a1.1, a3.1, b1.1 |
| *Week-5* | Signal processing: Introduction on DFT.  DFT Basis functions. DFT Analysis and  calculation using correlation. Inverse  DFT. Polar Nuisances. DFT  applications. DFT pitfalls. | 3 | 3 | - | - | a1.1, a3.1, b1.1,  c1.1, d6.1 |
| *Week-6* | Signal processing: Half cycle DFT.  Recursive DFT. Symmetrical  components Discrete Fourier Transform  (SCDFT). Frequency estimation. | 3 | 3 | - | - | a1.1, a3.1, b1.1,  c1.1, d6.1 |
| *Week-7* | Signal processing: Least Square (LSQ)  Technique. KALMAN Filter. | 3 | 3 | - | - | a1.1, a3.1, b1.1,  c1.1, d6.1 |
| *Week-8* | Signal processing: Differential  Equation Algorithm for single-phase  and three-phase transmission system. | 3 | 3 | - | - | a1.1, a3.1, b1.1,  c1.1, d6.1 |
| *Week-9* | Core of Artificial Intelligence: types,  mechanisms, operations | 3 | 3 | - | - | a1.1, a3.1, b2.1,  c3.1 |
| *Week-10* | Developing intelligent relaying schemes  (1) | 3 | 3 | - | - | a1.1, a3.1, b2.1,  c3.1 |
| *Week-11* | Developing intelligent relaying schemes  (2) | 3 | 3 | - | - | a1.1, a3.1, b2.1,  c3.1 |
| *Week-12* | Applications     of      modern      relaying  schemes in power systems (1) | 3 | 3 | - | - | a1.1, a3.1, b2.1,  c3.1 |

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| Topic  No. | General Topics | Weeks |
| 1st | Reviewing the recent requirements for protection systems | 2 |
| 2nd | Core of digital relays in power system protection | 6 |
| 3rd | Core of Artificial Intelligence in power system protection | 4 |
| 4th | Applications of mdoern relaying schemes in power system protection | 3 |



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***B.5 Course Topics.***

***B.6 Course Topics/hours/ILOS***

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| **Course Intended**  **learning outcomes**  **(ILOs)** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Knowledge &**  **understanding** | **a1.1** | **x** | **x** |  |  |  |  |  |  | **x** |  |  |  |  |
| **a3.1** | **x** | **x** | **x** |  |  |  |  |  | **x** |  |  |  |  |
| **Intellectual Skills** | **b1.1** | **x** | **x** |  |  |  |  |  |  | **x** |  |  |  |  |
| **b2.1** | **x** | **x** |  |  |  |  |  |  | **x** |  |  |  |  |
| **Professional and**  **Practical Skills** | **c1.1** | **x** | **x** |  |  |  |  |  |  | **x** | **x** |  |  |  |
| **c3.1** | **x** | **x** | **x** |  |  |  |  |  | **x** |  |  |  |  |
| **General and**  **Transferable Skills** | **d4.1** |  |  |  |  |  |  |  |  | **x** |  |  |  |  |
| **d6.1** |  |  |  |  |  |  |  |  | **x** | **x** |  |  |  |
| **d8.1** |  |  |  |  |  |  |  |  | **x** |  |  |  |  |

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| *Week-13* | Applications     of      modern      relaying  schemes in power systems (2) | 3 | 3 | - | - | a1.1, a3.1, b2.1,  c3.1, d4.1, d8.1 |
| *Week-14* | Applications of digital relays in relaying  systems | 3 | 3 | - | - | a1.1, a3.1, b2.1,  c3.1, d4.1, d8.1 |
| *Week-15* | Applications of Artificial Intellegence in  relaying systems | 3 | 3 | - | - | a1.1, a3.1, b2.1,  c3.1, d4.1, d8.1 |

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| **Assessment Method** | **Mark** | **Percentage** |
| **Final Examination (*written*)** | **100** | **100%** |
| **Total** | **100** | **100%** |



**B.7*Teaching and Learning Method:***

**Selflearning**

**Presentation**

**andMovies**

**Cooperative**

**Discovering**

**Discussion**

**Modelling**

**Sitevisits**

**Problem**

**solving**

**Brain**

**storming**

**Projects**

**Tutorial**

**Lecture**

**Playing**

**B. 8*Assessments:***

***Student assessment methods:***

***B.9 Facilities required for teaching and learning:***

***Weighting of assessments:***

**A. Library Usage:** Students should be encouraged to use library technical resources in the

preparation of reports. So, the computers with sufficient electronic resources should be

available.

**B. Classrooms:** The lecturer and students are going to prepare presentations including research

knowledge and therefore computer and data show (hanged LED) is required.

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***B.10 List of references:***

1- A.G. Phadke and J. S. Thorp "Computer Relaying for Power Systems", A John Wiley and

Sons, Ltd., 2009,

2- A. Johns and S. Salman, “Digital Protection for Power Systems”, 1995.

3- K. Warwick, R. Aggarwal, and A. Ekwue, "Artificial Intelligence Techniques in Power

Systems (Power & Energy Series)", Institution of Engineering and Technology, 1997.

4- Yong-Hua Song, Allan Johns and Raj Aggarwal, "Computational Intelligence Applications to

Power Systems (Intelligent Systems, Control and Automation: Science and Engineering)",

Institution of Engineering and Technology, 1997

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**Course Coordinators:** **Head of Department**

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**Dr. Nagy I. Elkalashy**

**Date:**