**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 coursecontribute in achieving | Course ILOs |
| Knowledge&Understanding | A1. Theory, basics and practices ofmathematics, sciences and variouselectrical     power      and      machinesengineering technologies. | a1.1) Realize the core of modernprotective relays applied forprotection improvement. |
| A3. The scientific developments inelectrical     power      and      machinesengineering. | a3.1) Understand applications ofdigital signal processing and AI inpower system protection. |
| Intellectual skills | B1. Analyze and evaluate the dataand use it to solve electrical power andmachines problems. | b1.1)      Digitally      evaluate      theprotection function. |
| B2. Produce solutions to power andmachines     problems     through     theapplication of specific engineeringdiscipline knowledge based on limitedand possible information. | b2.1) Produce AI techniques forimproving protection systems. |
| Professional andPractical Skills | C1. Use efficiently the available toolsas computer programs and measuringinstruments as well as building ideasin the laboratory or through simulationand apply engineering techniques. | c1.1) Design and perform computerprogram for fault feature extraction. |
| C3. Evaluate the available methodsand tools in the power and machinesengineering field. | c3.1) Evaluate the protection relayperformance using AI techniques. |
| General andTransferable skills | D4. Use different resources to obtainknowledge and information. | d4.1) Use specialized books andrelated internet websites to preparereports and presentations. |
| D6. Work with a group and managethe team. | d6.1) Cooperate with the colleaguesto present collaborative work. |
| D8. Self and continuous learning. | d8.1) Self-learning and evaluationin the protection engineering. |

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| Field | Academic Reference Standards For Electrical EngineeringPostgraduates (ARSEP-ELE) |
| Knowledge &Understanding | IntellectualSkills | ProfessionalSkills | General Skills |
| Programme AcademicStandards that the coursecontribute 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 protectionsystems: an introduction | 3 | 3 | - | - | a1.1, b1.1 |
| *Week-2* | Modern requirements for protectionsystems: specifications, standards andperformance | 3 | 3 | - | - | a3.1 |
| *Week-3* | Digital relays: Introduction,Characteristics, typical architecture,main modules, benefits andshortcomings. | 3 | 3 | - | - | a1.1, a3.1, b1.1 |
| *Week-4* | Signal processing: Digital concepts offault feature extraction. Two-samplealgorithm. Three-sample algorithm.Mann-Morrison. Prodar 70. Peak-basedPredictive calculation. | 3 | 3 | - | - | a1.1, a3.1, b1.1 |
| *Week-5* | Signal processing: Introduction on DFT.DFT Basis functions. DFT Analysis andcalculation using correlation. InverseDFT. Polar Nuisances. DFTapplications. DFT pitfalls. | 3 | 3 | - | - | a1.1, a3.1, b1.1,c1.1, d6.1 |
| *Week-6* | Signal processing: Half cycle DFT.Recursive DFT. Symmetricalcomponents 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: DifferentialEquation Algorithm for single-phaseand 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      relayingschemes in power systems (1) | 3 | 3 | - | - | a1.1, a3.1, b2.1,c3.1 |

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| TopicNo. | 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      relayingschemes 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 relayingsystems | 3 | 3 | - | - | a1.1, a3.1, b2.1,c3.1, d4.1, d8.1 |
| *Week-15* | Applications of Artificial Intellegence inrelaying 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**

**Prof. Dr. Abdel-Maksoud I. Taalab** **Prof. Dr. Gamal Morsi**

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**Date:**