**Minoufiya University,**

**Faculty of Engineering,**

**Electrical Eng. Dept.,**

**Post Graduate Studies and Research.**

**Minoufiya University**

Faculty of Engineering

**Course Specification**

***Title: High and Extra-High Voltage Engineering***

***Code Symbol: ELE 607***

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

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

***A- COURSE IDENTIFICATION AND IN FORMATION:***

***B - Professional Information***

***B.1 Course Aims:***

The aims of this course are to provide the Student, with the skills of how to perform tests of partial

discharge detection on solid insulation using different techniques. This course will also provide

students with the ability to design EHV cable insulation using statistical procedure. The skill of

applying the general principles of the lightning protection problem in the field is also provided. It

is also aimed that the student will apply the principles of insulation coordination based on lightning

in the field.

***B.2 Course Objectives***

1. Demonstration the aspects of the dielectric breakdown of air

2. Assessing the insulation condition using nondestructive testing.

3. Estimate the insulation thickness of Extra High Voltage (EHV) cable transmission based on a

Weibull Probability Distribution for initial breakdown voltage and stress and Kreuger Volt-

Time characteristics.

4. Realizing different factors affecting on overvoltage protection of EHV cable.

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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) Describe the pre-breakdown corona  and sparkover processes in a rod-rod gap.  a1.2) Recognize the importance of gap  factor    and    Describe the characteristic  profile of the U curve obtained with  impulse voltages of various time-to-crests.  a1.3) Describe the mechanism of lightning  stroke to EHV tower.  a1.4)    Define    the    terms:    temperature  deterioration factor, life expectancy factor,  safety factor, earthing coefficient, earth  fault factor, arrester rating, and insulation  co-ordination. |
| A2. The exchange effect among  the engineering practices  and    reflection    on    the  environment. | a2.1) Explain the influence of the insulator  profile on flashover voltage.  a2.2) Identify the different techniques of  partial discharge detection.  a2.3) Describe the electrical characteristics  of EHV cables and the relation between the  voltage and time to breakdown of solid  insulation. |
| A3. The scientific developments  in electrical power and machines  engineering. | a3.1) State the advantages getting from  using gas insulated EHV lines. |
| Intellectual skills | B1. Analyze and evaluate the  data and use it to solve electrical  power and machines problems. | b1.1) Calculate the parameters of Weibull  Probability     Function     for     breakdown  gradient      from      experimental      values,  graphically and analytically. |
| B5. Evaluate the risks in the  design of specific power and  machines engineering systems. | b5.1) Estimate the gaps sparkover voltages  of    various    geometries    based    on    the  sparkover voltage of a rod-plane gap of the  same length.  b5.2) Compute breakdown and withstand  electrical stresses in solid insulation, the |

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| Field | Academic Reference Standards For Electrical Engineering  Postgraduates (ARSEP-ELE) | | | |
| Knowledge &  Understanding | Intellectual  Skills | Professional  and Practical  Skills | General and  Transferable  Skills |
| Programme Academic  Standards that the course  contribute in achieving | A1, A2 & A3 | B1, B5 &B7 | C1 & C4 | D4, D6 & D8 |



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

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

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|  |  | impulse and AC test voltages of EHV  cable.  b5.3) Calculate the probable number of  strokes contacting 100 km of line per year  anywhere on the line. |
| B7. Take the suitable decision  for        different        professional  situations. | b7.1) Compute the insulation thickness of  the EHV cable. |
| 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) Perform non-destructive testing on  materials and apparatus. |
| C4. Define, plan, analyze, and  solve the power and machines  problems to reach conclusions  and compare the results with  others. | c4.1) Detect and locating a fault in a long  cable using partial discharge technique.  c4.2)     Obtain    breakdown    probability  function for EHV cable sample.  c4.3) Select the rating of overvoltage  protective devices of equipment and EHV  lines    concern    general    principles    of    the  lightning protection problem. |
| 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  high and extra high voltage engineering. |

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| Topic  No. | General Topics | Weeks |
| 1st | Aspects of Air Breakdown | 2-4 |
| 2nd | Non-Destructive Testing of Materials and Electrical Apparatus | 5-7 |
| 3rd | Extra High Voltage Cable Transmission | 8-11 |
| 4th | Lightning and Lightning Protection | 12-15 |

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***B.5  Course Topics.***

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| ***Week***  ***No.*** | ***Sub. Topics*** | ***Total***  ***Hours*** | ***Contact hrs*** | | | ***Course ILOs***  ***Covered (By No.)*** |
| **Lec.** | **Tut.** | **Lab.** |
| *Week-1* | General Introduction. | 3 | 3 | - | - | - |
| *Week-2* | Aspects of air breakdown: introduction, pre-  breakdown discharges. | 3 | 3 | - | - | a1.1, d4.1 |
| *Week-3* | Aspects of air breakdown cont.: The ‘U-  curve’, the gap factor. | 3 | 3 | - | - | a1.2, d4.1 |
| *Week-4* | Aspects of air breakdown cont.: Sparkover  characteristics under AC, DC and impulse  voltages, atmospheric effects. | 3 | 3 | - | - | a2.1, b5.1, d4.1,  d6.1, d8.1 |
| *Week-5* | Non-Destructive Testing of Materials and  Electrical Apparatus: introduction, partial  discharge measurements (introduction,  discharge detection using straight detectors,  balanced detection method, discharge  detection in power cables). | 3 | 3 | - | - | a2.2, c1.1, c6.1,  d4.1, d6.1, d8.1 |
| *Week-6* | Non-Destructive Testing of Materials and  Electrical Apparatus cont.: measurement of  DC resistivity. | 3 | 3 | - | - | c1.1, d4.1, d6.1,  d8.1 |
| *Week-7* | Non-Destructive Testing of Materials and  Electrical Apparatus cont.: measurement of  dielectric constant and loss factor | 3 | 3 | - | - | c1.1, d4.1, d6.1,  d8.1 |
| *Week-8* | Extra High Voltage Cable Transmission:  introduction, electrical characteristics of  e.h.v. cables, breakdown and withstand  electrical stresses in solid insulation | 3 | 3 | - | - | a2.3, b1.1, b5.2,  c6.2, d4.1, d6.1,  d8.1 |
| *Week-9* | Extra High Voltage Cable Transmission  Cont.: breakdown and withstand electrical  stresses in solid insulation cont., volt-time  characteristics of solid insulation. | 3 | 3 | - | - | a2.3, b5.2, c6.2,  d4.1, d6.1, d8.1 |
| *Week-*  *10* | Extra High Voltage Cable Transmission  Cont.: effect of temperature on breakdown  stress, selection of insulation thickness. | 3 | 3 | - | - | a1.4, b7.1, d4.1,  d6.1, d8.1 |
| *Week-*  *11* | Extra      High Voltage Cable Transmission  Cont.: design basis of cable insulation, tests  on cable characteristics, gas insulated EHV  lines. | 3 | 3 | - | - | a1.4,a3.1, c1.1,  d4.1, d6.1, d8.1 |
| *Week-*  *12* | Lightning      and      lightning      protection:  lightning strokes to lines, lightning-stroke  mechanism. | 3 | 3 | - | - | a1.2, b5.3, d4.1,  d6.1, d8.1 |
| *Week-*  *13* | Lightning and lightning protection Cont.:  general      principles      of     the     lightning  protection          problem,          tower-footing  resistance, insulator flashover and withstand  voltages. | 3 | 3 | - | - | C4.3, d4.1, d6.1 |
| *Week-*  *14* | Lightning and lightning protection Cont.:  probability of occurrence of lightning stroke  currents, lightning arresters and protective  characteristics | 3 | 3 | - | - | a1.4, c4.3, d4.1 |
| *Week-*  *15* | Lightning and lightning protection Cont.:  dynamic voltage rise and arrester rating,  insulation coordination based on lightning. | 3 | 3 | - | - | a1.4,c4.3, d4.1 |



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***B.6  Course Topics/hours/ILOS***

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| **Course Intended**  **learning outcomes**  **(ILOs)** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Knowledge &**  **understanding** | **a1.1** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **a1.2** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **a1.3** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **a1.4** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **a2.1** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **a2.2** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **a2.3** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **a3.1** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **Intellectual**  **Skills** | **b1.1** | **x** |  | **x** |  | **x** |  |  |  | **x** |  |  |  |  |
| **b5.1** |  |  | **x** |  |  |  |  |  | **x** | **x** |  |  |  |
| **b5.2** | **x** |  | **x** |  | **x** |  |  |  | **x** |  |  |  |  |
| **b5.3** | **x** |  | **x** |  | **x** |  |  |  | **x** |  |  |  |  |
| **b7.1** | **x** |  | **x** |  | **x** |  |  |  | **x** |  |  |  |  |
| **Professional**  **and Practical**  **Skills** | **c1.1** |  | **x** | **x** |  |  |  |  |  | **x** | **x** |  |  |  |
| **c4.1** |  | **x** | **x** |  |  |  |  |  | **x** | **x** |  |  |  |
| **c4.2** | **x** |  | **x** |  | **x** |  |  |  | **x** |  |  |  |  |
| **c4.3** | **x** |  | **x** |  |  |  |  |  |  |  |  |  |  |
| **General and**  **Transferable**  **Skills** | **d4.1** | **x** |  | **x** |  |  |  |  |  | **x** |  |  |  |  |
| **d6.1** | **x** |  | **x** |  |  |  |  |  | **x** |  |  |  |  |
| **d8.1** |  | **x** | **x** |  |  |  |  |  | **x** |  |  |  |  |

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



**B. 8*Assessments:***

**Selflearning**

**Presentation**

**andMovies**

**Cooperative**

**Discovering**

**Discussion**

**Modelling**

**Sitevisits**

**Problem**

**solving**

**Brain**

**storming**

**Tutorial**

**Projects**

**Lecture**

**Playing**

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

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

***Weighting of assessments:***

1.**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.

2.**Class room** facilitated by computer, white board and datashow.

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***B.10 List of references:***

1. R. D. Begamudre, “Extra high voltage AC transmission engineering”, 3rd edition, New Age

International (P) Ltd., Publishers ,2006.

2. M S. Naidu, V. Kamaraju, ”High Voltage Engineering ”, 2nd edition, MCGraw Hill, 1996.

3. Hugh M. Ryan, “High voltage engineering and testing”, 2nd edition 2001.

4. Recent published journal and international conference papers.

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

**Prof. Dr. Mohamed A. Izzularab** **Prof. Dr. Gamal Morsi**

**Dr. Nehmdoh A. Sabiha**

**Date:**