**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 coursecontribute in achieving | Course ILOs |
| Knowledge&Understanding | A1. Theory, basics and practicesof    mathematics,    sciencesand various           electricalpower        and        machinesengineering technologies. | a1.1) Describe the pre-breakdown coronaand sparkover processes in a rod-rod gap.a1.2) Recognize the importance of gapfactor    and    Describe the characteristicprofile of the U curve obtained withimpulse voltages of various time-to-crests.a1.3) Describe the mechanism of lightningstroke to EHV tower.a1.4)    Define    the    terms:    temperaturedeterioration factor, life expectancy factor,safety factor, earthing coefficient, earthfault factor, arrester rating, and insulationco-ordination. |
| A2. The exchange effect amongthe engineering practicesand    reflection    on    theenvironment. | a2.1) Explain the influence of the insulatorprofile on flashover voltage.a2.2) Identify the different techniques ofpartial discharge detection.a2.3) Describe the electrical characteristicsof EHV cables and the relation between thevoltage and time to breakdown of solidinsulation. |
| A3. The scientific developmentsin electrical power and machinesengineering. | a3.1) State the advantages getting fromusing gas insulated EHV lines. |
| Intellectual skills | B1. Analyze and evaluate thedata and use it to solve electricalpower and machines problems. | b1.1) Calculate the parameters of WeibullProbability     Function     for     breakdowngradient      from      experimental      values,graphically and analytically. |
| B5. Evaluate the risks in thedesign of specific power andmachines engineering systems. | b5.1) Estimate the gaps sparkover voltagesof    various    geometries    based    on    thesparkover voltage of a rod-plane gap of thesame length.b5.2) Compute breakdown and withstandelectrical stresses in solid insulation, the |

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| Field | Academic Reference Standards For Electrical EngineeringPostgraduates (ARSEP-ELE) |
| Knowledge &Understanding | IntellectualSkills | Professionaland PracticalSkills | General andTransferableSkills |
| Programme AcademicStandards that the coursecontribute 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 EHVcable.b5.3) Calculate the probable number ofstrokes contacting 100 km of line per yearanywhere on the line. |
| B7. Take the suitable decisionfor        different        professionalsituations. | b7.1) Compute the insulation thickness ofthe EHV cable. |
| Professional andPractical Skills | C1. Use efficiently the availabletools as computer programs andmeasuring instruments as well asbuilding ideas in the laboratoryor through simulation and applyengineering techniques. | c1.1) Perform non-destructive testing onmaterials and apparatus. |
| C4. Define, plan, analyze, andsolve the power and machinesproblems to reach conclusionsand compare the results withothers. | c4.1) Detect and locating a fault in a longcable using partial discharge technique.c4.2)     Obtain    breakdown    probabilityfunction for EHV cable sample.c4.3) Select the rating of overvoltageprotective devices of equipment and EHVlines    concern    general    principles    of    thelightning protection problem. |
| General andTransferableSkills | D4. Use different resources toobtain          knowledge          andinformation. | d4.1) Use specialized books and relatedinternet websites to prepare reports andpresentations. |
| D6. Work with a group andmanage the team. | d6.1) Cooperate with the colleagues topresent collaborative work. |
| D8.      Self      and      continuouslearning. | d8.1) Self-learning and evaluation in thehigh and extra high voltage engineering. |

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| TopicNo. | 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.: Sparkovercharacteristics under AC, DC and impulsevoltages, atmospheric effects. | 3 | 3 | - | - | a2.1, b5.1, d4.1,d6.1, d8.1 |
| *Week-5* | Non-Destructive Testing of Materials andElectrical Apparatus: introduction, partialdischarge measurements (introduction,discharge detection using straight detectors,balanced detection method, dischargedetection in power cables). | 3 | 3 | - | - | a2.2, c1.1, c6.1,d4.1, d6.1, d8.1 |
| *Week-6* | Non-Destructive Testing of Materials andElectrical Apparatus cont.: measurement ofDC resistivity. | 3 | 3 | - | - | c1.1, d4.1, d6.1,d8.1 |
| *Week-7* | Non-Destructive Testing of Materials andElectrical Apparatus cont.: measurement ofdielectric constant and loss factor | 3 | 3 | - | - | c1.1, d4.1, d6.1,d8.1 |
| *Week-8* | Extra High Voltage Cable Transmission:introduction, electrical characteristics ofe.h.v. cables, breakdown and withstandelectrical 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 TransmissionCont.: breakdown and withstand electricalstresses in solid insulation cont., volt-timecharacteristics of solid insulation. | 3 | 3 | - | - | a2.3, b5.2, c6.2,d4.1, d6.1, d8.1 |
| *Week-**10* | Extra High Voltage Cable TransmissionCont.: effect of temperature on breakdownstress, selection of insulation thickness. | 3 | 3 | - | - | a1.4, b7.1, d4.1,d6.1, d8.1 |
| *Week-**11* | Extra      High Voltage Cable TransmissionCont.: design basis of cable insulation, testson cable characteristics, gas insulated EHVlines. | 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-strokemechanism. | 3 | 3 | - | - | a1.2, b5.3, d4.1,d6.1, d8.1 |
| *Week-**13* | Lightning and lightning protection Cont.:general      principles      of     the     lightningprotection          problem,          tower-footingresistance, insulator flashover and withstandvoltages. | 3 | 3 | - | - | C4.3, d4.1, d6.1 |
| *Week-**14* | Lightning and lightning protection Cont.:probability of occurrence of lightning strokecurrents, lightning arresters and protectivecharacteristics | 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:**