



**Answer the following questions**

**Question 1**

(30 marks)

- (a) Discuss the flashover phenomena across insulator surfaces in air including:  
 1) Flashover mechanisms.  
 2) Critical flashover voltage calculations.  
 (b) Explain the sparkover voltage characteristics for rod-plan gaps when impulse voltages are used.  
 (c) Discuss the pre-breakdown discharges phenomena.

**Question 2**

(25 marks)

- (a) Discuss the effect of temperature on breakdown stress in extra high voltage cables.  
 (b) A series of power-frequency tests conducted on samples of 187 kV XLPE cable gave the following breakdown probability figures and corresponding electric stresses:  $P_1=20\%$  at  $E_1 = 35.2$  kV/mm;  $P_2=50\%$  at  $E_2=38$  kV/mm; and  $P_3=90\%$  at  $E_3=43$  kV/mm. Calculate the values of  $E_L$ ,  $b$ , and  $E_0$  and write the Weibull breakdown probability function for this type of voltage.

**Question 3**

(20 marks)

- (a) Classify the cooling types of extra high voltage cables with declaring the laying methods in the soil.  
 (a) Write short notes on: Temperature deterioration coefficient- Life expectancy factor- Safety factors.  
 (a) Discuss how to select cable insulation thickness for a given voltage level.

**Question 4**

(25 marks)

- (a) What are the criteria for selecting surge arrester voltage rating?  
 (b) Compare the performance characteristics of silicon carbide arrester with a zinc oxide arrester. What are the advantages and disadvantages of each?  
 (c) A region has 100 thunderstorm days in a year. A line with a single ground wire has tower height  $h_t=30$  m with ground line height at midspan  $h_g=24$  m. Calculate the probable number of strokes contacting 100 km of line per year ( $N_s$ ) anywhere on the line. If this line is protected by two ground wires with  $s_g= 12$  m, and other dimensions remain same, calculate  $N_s$ .

*With our best wishes*

*Prof. Dr. Mohamed Izzularab and Dr. Amr Abdelhady*

This exam measures the following ILOs

| Skills          | Knowledge&Understanding Skills |      |      |      | Intellectual Skills |      |      | Professional Skills |
|-----------------|--------------------------------|------|------|------|---------------------|------|------|---------------------|
|                 | a1.1                           | a1.2 | a1.5 | a1.3 | b1.2                | b5.1 | b5.3 | c4.3                |
| Question Number | 1b                             | 1a   | 2a,b | 4a,c | 3c                  | 1c   | 4b   | 3                   |