



Answer the following questions and assume any missing data

Question 1

(25 marks)

- (1-a) Discuss the pre-breakdown discharges phenomena.
 (1-b) Explain the characteristics of mean breakdown gradient of rod-plane gaps under impulse, alternating and D.C voltages as a function of gap length.
 (1-c) Discuss briefly the effect of atmospheric conditions, density of air, and humidity on flashover voltage of high voltage insulators.

Question 2

(15 marks)

- (2-a) Explain the flashover mechanism of high voltage insulators considering Obenaus model. What are the methods that can be used in the decreasing of insulator flashover?
 (2-b) Mention the different overvoltage tests that can carried out on the insulators and bushings.

Question 3

(30 marks)

- (3-a) Write short notes on: shielding failure - backflashover- spark gap
 (3-b) Discuss how to select surge arrester rating considering a high voltage system of 66 kV.
 (3-c) Compare between lightning overvoltages protection considering spark gap and surge arresters.
 (3-d) A tower has a 10-ohm footing resistance and two ground wires each with $Z_g = 400$ ohms. The lightning stroke surge impedance is $Z_s = 400$ ohm. For $I_s = 70$ kA, crest, calculate the tower top potential (i) considering all impedances, (ii) neglecting the ground wire and stroke surge impedances, and (iii) considering only one ground wire and stroke surge impedance.

Question 4

(30 marks)

- (4-a) Compare between the different extra high voltage cable types considering their constructions and insulation properties.
 (4-b) Discuss how to select cable insulation thickness for a given voltage level.
 (4-c) Classify the cooling types of extra high voltage cables with declaring the laying methods in the soil.
 (4-d) 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 $E_1 = 40$ kV/mm; $P_2=50\%$ at $E_2=40$ kV/mm; and $P_3=90\%$ at $E_3=50$ kV/mm. Calculate the values of E_L , b , and E_0 and write the Weibull breakdown probability function for this type of voltage.

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,c	4a,c	3c	1c	4b	3a,b,d