Form No. T611

Philadelphia University
Faculty of Engineering

Student Name:
Student Number:

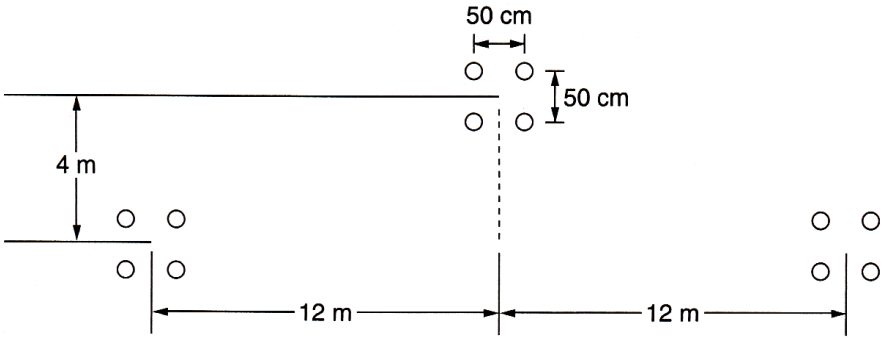
Dept. of Electrical Engineering
Second Exam, Second Semester: 2016/2017

Course Title: Power Systems I	**Date: 7/5/2017**
Course No: (610411)	**Time Allowed: 50 Minutes**
Lecturer: Dr. Mohammad Abu-Naser	**No. of Pages: 1**

Question 1: ***(8Mark)***

Objectives: This question is related to capacitance of transmission line

Determine the capacitance per phase per meter for the overhead line configuration shown in the following figure. Assume the line is uniformly transposed and the conductors have a 1 cm radius. (ε_o =8.85x10^{-12} F/m)



Question 2: ***(12Mark)***

Objectives: This question is related to performance of transmission line

A 200-km three phase line has a series impedance z = 0.05 + j0.5 Ω/km and a shunt admittance y = j6.4 x 10^{-6} S/km. At full load, the line delivers 350 MVA at 0.9 PF lagging and at 400 kV. Assuming the line is medium, calculate the:

1) ABCD parameters
2) Sending end voltage and current (V_s and I_s)
3) Percent voltage regulation
4) Identical shunt inductors are connected at both ends of the line during light load providing 80% compensation (the inductors are removed during heavy loads), calculate the percent voltage regulation of the compensated line.

Good luck

Power System (1)

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Model Answers

Question 1

$$D_s = 1.091 (r \times d^3)^{1/4} = 1.091 (.01 \times .5^3)^{1/4} = 0.205 \text{ m}$$

$$D_{eq} = \sqrt[3]{d_{12} d_{13} d_{23}}$$

$$d_{12} = d_{23} = \sqrt{4^2 + 12^2} = 12.65 \text{ m}$$

$$d_{13} = 24 \text{ m}$$

$$D_{eq} = \sqrt[3]{12.65^2 \times 24} = 15.66 \text{ m}$$

$$C = \frac{2\pi\varepsilon}{\ln \frac{D_{eq}}{D_s}} = \frac{2\pi \times 8.85 \times 10^{-12}}{\ln \frac{15.66}{.205}}$$

$$= 1.28 \times 10^{-11} \text{ F/m}$$

Question 2

1) $Z = zL = (.05 + j.5) \times 200 = 10 + j100 \ \Omega$

$Y = yL = j 6.4 \times 10^{-6} \times 200 = j 1.28 \times 10^{-3} \ S$

$$A = 1 + \frac{YZ}{2} = .936 + j.0064 = .936 \angle .392^\circ = D$$

$$B = Z = 10 + j100 \ \Omega = 100.5 \angle 84.3^\circ \ \Omega$$

$$C = Y + \frac{Y^2 Z}{4} = -4.1 \times 10^{-6} + j\, 1.24 \times 10^{-3} \ S$$

2) $V_R = \frac{400}{\sqrt{3}} = 230.94\,kV$

$I_R = \frac{350(.9 - j.436)}{\sqrt{3} \times 400} = .505\angle -25.84^\circ\ kA$

$V_S = AV_R + BI_R$

$= .936\angle .392^\circ \times 230.94\angle 0 + 100.5\angle 84.3^\circ \times .505\angle -25.84^\circ$

$= 246.8\angle 10.44^\circ\ kV$

$I_S = CV_R + DI_R$

$= (-4.1\times10^{-6} + j1.24\times10^{-3}) \times 230.94\angle 0 + .936\angle .392^\circ \times .505\angle -25.84^\circ$

$= .434\angle 11^\circ\ kA$

3) $VR\% = \frac{V_S/A - V_R}{V_R} \times 100\%$

$= \frac{246.8\angle .936 - 230.94}{230.94} \times 100\% = 14.18\%$

4) $Y_{eq} = j1.28\times10^{-3} \times \left(1 - \frac{80}{100}\right) = j2.56\times10^{-4}$

$A_{eq} = 1 + \frac{Y_{eq}Z}{2} = .987\angle .074^\circ$

$VR\% = \frac{V_S/A - V_R}{V_R} \times 100\%$

$= \frac{246.8\angle .987 - 230.94}{230.94} \times 100\% = 8.26\%$