Minoufiya University
Faculty of Engineering
Shebin El-Kom
First Semester Examination Date: 22/1/2014
Time allowed: 3 Hours


Department: Electrical Engineering Year: $2^{\text {nd }}$
Academic Year: 2013-2014
Course: Electrical Power Engineering (1)
Course Code: ELE 211
Answer all the following questions
[120 Marks]
Question (1)
[20 Marks]
(a) Drive a formula for the inductance of a fully transposed three phase transmission line with unsymmetrical spaced conductors.
(8 Marks)
(b) A 100 km three-phase bundled conductor line with two sub-conductors per phase the conductors are arranged as shown in Figure. Each phase has its bundled conductors with distance of 15 cm apart and each sub conductor has a diameter of 2 cm . If the specific resistance of the conductor is $1.73 \mu \Omega . \mathrm{cm}, \varepsilon_{0}=8.85 \times 10^{-12} \mathrm{~F} / \mathrm{m}$. For each phase, calculate:

- The total resistance,
- The total inductance,
- The total capacitance.


Question (2)
(12 Marks)
(a) Drive the expressions for the general constants of medium-T line and draw the phasor diagram at lag, lead and unity power factors.
(8 Marks)
(b) A three-phase $150 \mathrm{~km}, 50 \mathrm{~Hz}$ transmission line has the following constants;

$$
A=0.9 \angle 2^{\circ} \text { and } C=0.004 \angle 90^{\circ}
$$

The value of power losses is 11 MW with transmission efficiency of $\mathbf{9 0 \%}$. The load voltage is 110 kV and load power factor is 0.8 lagging. If the line is represented by nominal-T method, calculate:

- The parameters of the line: $R, L$ and $C$.
- The voltage, current and power factor at the sending-end.
- The Voltage regulation.
(12 Marks)


## Question (3)

[20 Marks]
(a) What is the function of the transmission line supports? List different types of transmission line supports and clarify the length of span in each type.
(4 Marks)
(b) What is the function of the cross-arms? Explain with clear drawing the different types of crossarms.
(4 Marks)
(c) An overhead line is erected across a span of 250 m on level supports. The conductor has a diameter of 1.4 cm , and has a dead weight of $1.1 \mathrm{~kg} / \mathrm{m}$. The line is coated with a layer of ice with radial thickness of 1 cm . The line is subjected to wind pressure of $37.8 \mathrm{~kg} / \mathrm{m}^{2}$ of the projected area. Calculate the sag (a) in the inclined direction, (b) in the vertical direction. Assume a maximum working stress $1050 \mathrm{~kg} / \mathrm{cm}^{2}$. One cubic meter weighs 915 kg .
(12 Marks)
(a) Find the ratio of volume of copper required to transmit a certain power over a certain distance by overhead system using (i) 2-wire DC system (ii) 2-phase, 3-wire AC system. Assume the same maximum voltage to earth, same losses, balanced load and the cross-sectional area of the neutral wire is the same as that of the outers.
(6 Marks)
(b) A 100 Km long transmission line supplies a load of 8 MVA at 0.9 power factor lagging, working at maximum load voltage of 33 kV . The efficiency of transmission is $\mathbf{9 0 \%}$. Calculate the volume of conductor (aluminum) required for the line when:

1) Single-phase, 2 -wire system is used.
2) Three-phase, 3 - wire system is used.

Take $\rho$ as $2.85 \times 10^{-8} \Omega . \mathrm{m}$.
(12 Marks)
Question (5) [23 Marks]
(a) Draw the current diagram, and the voltage drop diagram for the 2-wire DC distributer shown in the figure. The conductor resistance is $0.1 \Omega / \mathrm{m}$.

(b) Prove that for a uniformly loaded distributor fed at both ends with an equal voltage, the pout of minimum potential occurs at the middle of the distributor.
(3 Marks)
(c) For the ring DC distributor shown in the Fig. find: 1. The point of minimum potential and its voltage.
2. If an interconnector having a resistance of $0.1 \Omega$ (go and return) be connected between the feeding point $A$ and the point of minimum potential, Find the power losses in the interconnector and the point of the minimum potential in this case.
3. If the interconnector is disconnected and a uniformly distributed load of $1 \mathrm{~A} / \mathrm{m}$ is connected between $E$ and $D$. find the point of minimum potential and its voltage.


Note: The resistance of each conductor for both go and return is $0.8 \Omega$ per 1000 m .
(14 Marks)

## Question (6)

[19 Marks]
(a) Define cable grading and explain its benefits.
(3 Marks)
(b) For a single-core lead sheathed cable derive the expression for (i) capacitance and (ii) maximum dielectric stress.
(4 Marks)
(c) A $33 \mathrm{KV}, 3$-phase, 50 Hz underground line, 3.4 Km long, uses a single-core cable has a conductor diameter of 2.5 cm and the radial thickness of insulation is 1 cm . The relative permittivity of the dielectric is 3.1 . Find (i) the maximum stress and (ii) the total charging KVAR. It is desired to reduce the maximum stress by using two intersheath. Determine their best positions, the maximum stress, and the voltage on each intersheath.
(12 Marks)

