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# Final Exam

Continuing Education Course #533
Electrical Power
Part IV: Transmission Lines

1. What type of cable or guide is used for frequencies up to about 1 GHz?
- a. coaxial cable
- b. merlin cable
- c. optical guides
- d. waveguides

2. What type of cable or guide is used for frequencies up to about 100 GHz?
- a. coaxial cable
- b. waxing cable
- c. optical guides
- d. waveguides

3. The wavelength transmitted by a power transmission line is _____ than the length of the line itself.
- a. larger
- b. smaller
- c. approximately the same
- d. depends on the line length

4. A transmission lines designed to carry wavelengths comparable to, or shorter than, the length of the line are called what?
- a. high frequency transmission lines
- b. low-frequency transmission lines
- c. TEM lines
- d. waveguides

5. To avoid using field theory to analyze transmission lines, _____ _____ are used along with currents and voltages associated with the electric and magnetic fields
- a. ABCD parameters
- b. combined parameters
- c. distributed parameters
- d. software parameters

6. Consider the following: internal inductance, external inductance, shunt conductance, skin effect.
- a. internal inductance
- b. external inductance
- c. shunt conductance
- d. skin effect

7. As frequency increases, which of the following also increases due to the skin effect?

- a. AC resistance
- b. internal inductance
- c. external inductance
- d. DC resistance

8. What is most nearly the magnitude characteristic impedance of a 200 km line with the given parameters?

$Z_l = 0.80\Omega/\text{mi}\angle 70^\circ$
$Yl = 7 \times 10^{-6}\text{S}/\text{mi}\angle 90^\circ$
- a. $2.96 \times 10^{-3}\Omega$
- b. $114 \times 10^{-3}\Omega$
- c. $114\Omega$
- d. $340\Omega$

9. What is the reflection coefficient if the SWR is 1.5?
- a. 0.2
- b. 0.5
- c. 1.0
- d. 1.5

10. Consider a waxwing conductor with the following properties.

$L_l = 1.26 \times 10^{-3}\,\frac{\text{H}}{\text{mi}}$
$C_l = 2.43 \times 10^{-8}\,\frac{\text{F}}{\text{mi}}$

The "velocity factor" is defined as the ratio of the velocity of propagation to the speed of light.

What is the velocity factor for this conductor?
- a. 0.29
- b. 0.81
- c. 0.97
- d. 1.0

11. A transmission line with a characteristic impedance of 50 Ω and a termination resistance of 70 Ω has an electrical angle of $\beta l = \pi/2$.

What is the reflection coefficient?
- a. 0.500
- b. 0.700
- c. 0.167
- d. 6.00

12. A transmission line with a characteristic impedance of 50 Ω and a termination resistance of 70 Ω has an electrical angle of $\beta l = \pi/2$.

What is the SWR?
- a. 0.16
- b. 0.18
- c. 0.28
- d. 1.40

13. What is the approximate length of a short transmission line?

- a. 50 mi
- b. 75 mi
- c. 100 mi
- d. 150 mi

14. A 50 kW facility is located 0.5 mi from its connection to the substation with an output of 600 VDC. The lowest voltage allowed is 580 V.

A partial table of conductors follows.

| conductor size (AWG) | | |
|---|---|---|
| copper | approximately equivalent aluminum | voltage dropper 100,000 A-m |
| 6 | 4 | 31.3 |
| 4 | 2 | 19.7 |
| 2 | 1/0 | 12.4 |
| 1/0 | 3/0 | 7.80 |
| 2/0 | 4/0 | 6.19 |

*Values are calculated for 82°C (90°F) conductors.

What is the minimum aluminum conductor size required?

- a. 1/0
- b. 2/0
- c. 3/0
- d. 4/0

15. What is the skin depth for round copper conductors at 400 Hz?

- a. 0.066 cm
- b. 0.033 cm
- c. 0.33 cm
- d. 3.3 cm

16. The skin depth for a certain design is calculated as 25 mil. The wire to be used has a radius of 250 mil.

What is the effective area being utilized for the conduction of electricity?

- a. 0.037 $in^2$
- b. 0.100 $in^2$
- c. 0.159 $in^2$
- d. 0.196 $in^2$

17. A single-phase system uses a wire with a radius of 106 mil with the wires spaced 6 inches apart.

What is most nearly the inductance per unit length?

- a. 1 μH/m
- b. 2 μH/m
- c. 4 μH/m
- d. 5 μH/m

18. What is the equivalent spacing, $D_e$, of a symmetrically spaced three-phase transmission line with equal values of $D$ of 20 ft?

- a. 0.40 ft
- b. 0.80 ft
- c. 10 ft
- d. 20 ft

19. Which of these is NOT a purpose of transposing commercial transmission lines?
- a. reduce interference
- b. reduce power losses
- c. reduces fault current
- d. minimize line length

20. What is parameter $A$ of a 220 km falcon line with $Zl$ = 0.85 Ω/mi∠70° and $Yl$ = $7 \times 10^{-6}$ S/mi∠90°?
- a. $1.0\angle 20^{\circ}$
- b. $0.948\angle 1.2^{\circ}$
- c. $0.996\angle 0.008^{\circ}$
- d. $4.0 \times 10^{-4}\angle 160^{\circ}$

21. A three-phase, 215 kV transmission line supplies a 100 MW wye-connected load at 0.8 pf lagging. The ABCD parameters are A = 0.9∠2.0°, B = 150∠80°, C = 0.001∠90°, and D = 0.9∠2°.

What is the receiving end voltage?
- a. 124 kV
- b. 152 kV
- c. 215 kV
- d. 220 kV

22. A three-phase, 215 kV transmission line supplies a 100 MW wye-connected load at 0.8 pf lagging. The ABCD parameters are A = 0.9∠2.0°, B = 150∠80°, C = 0.001∠90°, and D = 0.9∠2°.

What is the magnitude of the receiving end current?
- a. 269 A
- b. 336 A
- c. 440 A
- d. 582 A

23. A three-phase, 215 kV transmission line supplies a 100 MW wye-connected load at 0.8 pf lagging. The ABCD parameters are A = 0.9∠2.0°, B = 150∠80°, C = 0.001∠90°, and D = 0.9∠2°.

What is the sending end voltage? [Hint: Use the values from the previous two questions. Use the receiving end voltage as the reference since the power factor of the load is given.]
- a. 11.1 kV∠36.8°
- b. 124 kV∠14.5°
- c. 153 kV∠14.5°
- d. 504 kV∠0°

24. A transmission line with a characteristic impedance of 50 Ω and a termination resistance of 70 Ω has an electrical angle of βl = π/2.

What is most nearly the input impedance?
- a. 0.7 Ω
- b. 1.4 Ω

○ c. 4.0 Ω
○ d. 36 Ω

25. A certain transmission line has a characteristic impedance of 25 Ω and a terminating resistance of 100 Ω.

What is the reflection coefficient?
○ a. 0.6
○ b. 1.0
○ c. 1.7
○ d. 6.0