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Continuing Education Course #531
Electrical Power
Part II: Distribution Systems

1. Consider the following distribution symbol.

What does the symbol represent?
- a. current transformer
- b. ground connection
- c. potential transformer
- d. protective relay

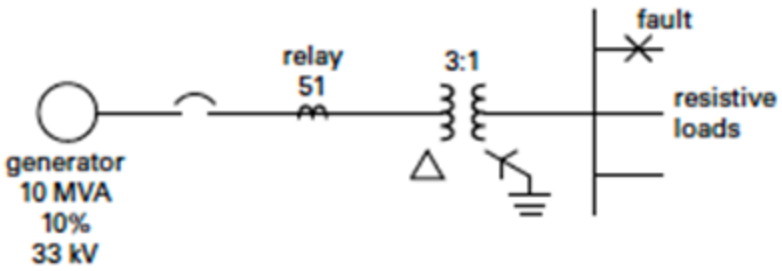
2. What is a common voltage level on subtransmission lines?
- a. 11.5 kV
- b. 69 kV
- c. 250 kV
- d. 480 kV

3. Which of the following represents a distribution system classification?
- a. current
- b. number of conductors
- c. voltage
- d. all of the above

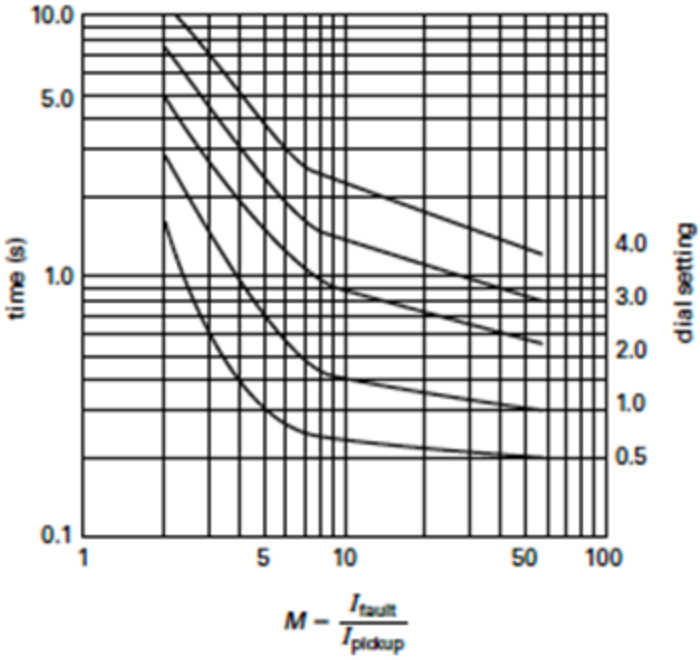
4. What term is applied to the following: current in excess of rated current?
- a. ground fault
- b. overcurrent
- c. overload
- d. short circuit

5. Which device is NOT designed to interrupt a fault current?
- a. automatic single phase sectionalizer
- b. circuit breaker
- c. current-limiting fuse
- d. electronic solid insultation recloser

6. In the diagram shown, relay 51 is an inverse time overcurrent relay per *IEEE Standard Electrical Power System Device Function Numbers, Acronyms, and Contact Designations* (IEEE Std C37.2).



The relay has the characteristics shown on the graph with a *minimum pickup current of 400 A*.



Analysis of a three-phase fault short circuit at the fault location on the 11 kV bus shown in the diagram results in a current on the 33 kV bus of 2300 A. The relay must operate at 2.0 s.

What is the required protective dial setting?

- ○ a. 2
- ○ b. 3
- ○ c. 4
- ○ d. 5

7. A fuse is normally used to protect against the following.

- ○ a. overload
- ○ b. short-circuit
- ○ c. delayed faults
- ○ d. instantaneous faults

8. The flat surface of a large electrical pole is located in Alabama where gust up to 80 km/hr occur.

What is most nearly the expected loading on the pole in such gusts?

- ○ a. 1 psi
- ○ b. 16 psi

○ c. 66 psi
○ d. 86 psi

9. Short spans, less than about _____ feet, of transmission lines may use what type of material?
○ a. 31 ft; copper
○ b. 200 ft; copper
○ c. 100 ft; light aluminum
○ d. 1000 ft; high strength steel

10. A single-conductor cable with an outside diameter of 0.5 cm is to be used in an underground installation. What is most nearly the optimal conductor radius?
○ a. 0.05 cm
○ b. 0.1 cm
○ c. 0.2 cm
○ d. 0.3 cm

11. A single-conductor capacitance-graded cable with an outside diameter of 10 cm can withstand a maximum electric field of 700 kV/m before insulation breakdown occurs.

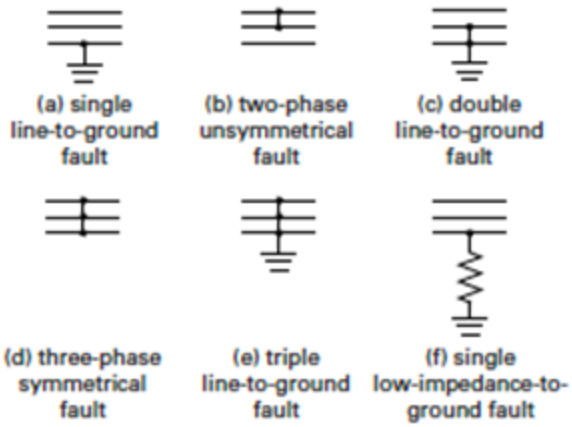
What is most nearly the maximum operating voltage of the conductor?
○ a. 17 kV
○ b. 677 kV
○ c. 700 kV
○ d. 1400kV

12. What is most nearly the total capacitance of 100 m of single-conductor cable with the optimal radii ratio and polyethylene insulation (ε_r = 2.25)?
○ a. 20×10^{-10} F
○ b. 40×10^{-10} F
○ c. 60×10^{-10} F
○ d. 125×10^{-10} F

13. What is most nearly the total inductance of 100 m of single-conductor cable with the optimal radii ratio and polyethylene insulation (μ_r = 2.25)?
○ a. 2.25×10^{-5} H
○ b. 4.50×10^{-5} H
○ c. 4.50×10^{-7} H
○ d. 27×10^{-7} H

14. What is another term for a short-circuit?
○ a. ground fault
○ b. open circuit
○ c. phase-to-phase
○ d. shunt fault

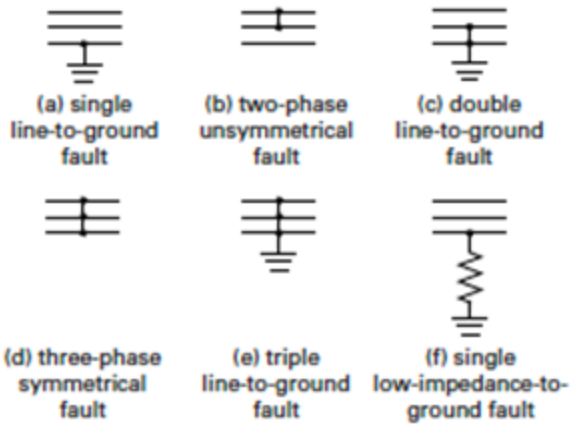
15. Consider the following faults.



What is the most likely fault?

- a. single line-to-ground
- b. three-phase symmetrical
- c. triple line-to-ground
- d. two-phase unsymmetrical

16. Consider the following faults.



What fault is the most severe and determines the rating of the protecting circuit breaker?

- a. triple line-to-ground
- b. two-phase symmetrical
- c. three-phase symmetrical
- d. single low-impedance-to-ground

17. The following formula is used for the _____ voltage period of a transient.

$E_g^{\prime\prime} = Vt + jI_L X_d$

- a. transient
- b. subtransient
- c. final steady state
- d. initial value just prior to the fault

18. A transmission line with 8% reactance on a 200 MW base connects two substations. At the first substation the voltage is 1.03 pu∠5°, and at the second the voltage is 0.98 pu∠-2.5°.

What is the power out of the first substation?

- a. 330 MW
- b. 1811 MW
- c. 1648 MW
- d. 2000 MW

19. A 15 MVA three-phase generator outputs a voltage of 13.9 kV.

What is the magnitude of the base current?

- a. 0.62 kA
- b. 0.68 kA
- c. 1.07 kA
- d. 13.9 kA

20. A given system has a lagging power factor of 0.9.

What is the associated angle?

- a. -0.9
- b. +0.9
- c. +25.94
- d. -25.84

21. The manufacturer's data for two power distribution generators are shown.

generator 1	generator 2
15 MVA	20 MVA
12.5 kV	12.5 kV
pf = 0.8 lagging	pf = 0.8 lagging
$Z_{pu} = 10\%$	$Z_{pu} = 12\%$

What is most nearly the per-unit impedance of generator 1, using generator 2 as the base?

- a. 8%
- b. 11%
- c. 12%
- d. 13%

22. The percent values for a given section of a distribution system are listed as 80%, 20%, 85%, and 125% for voltage, current, impedance, and apparent power, respectively. The base voltage is 12.5 kV. The base current is 50 A. The base impedance is 30 Ω. The base apparent power is 5 MVA.

What is most nearly the actual current?

- a. 10 A
- b. 50 A
- c. 200 A
- d. 400 A

23. A given motor is operating at 12 MVA, 13 kV, with a 0.8 pf lagging. The base voltage is 13.9 kV and the base apparent power is 15 MVA.

What is the base current?

- a. 0.62 kA
- b. 1.07 kA
- c. 10.7 kA
- d. 66 kA

24. What subscript is used for symmetrical phasors rotating clockwise?

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

25. What is the value of the operator "a"?

- a. $1 \times e^{-j120^\circ}$
- b. $1\angle 240^\circ$
- c. $-0.5 - j0.866$
- d. $-0.5 + j0.866$

26. What assumption is made in the MVA Method?

- a. voltage is maintained at 1 pu
- b. maximum resistance to fault current
- c. source limited by internal impedance
- d. source voltage limited by line impedance