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Power System

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CLASS TEST 2019-2020

ELECTRICAL ENGINEERING

Date of Test : 09/08/2019

ANSWER KEY ➤ Power System

1.	(b)	7.	(d)	13.	(a)	19.	(c)	25.	(d)
2.	(b)	8.	(c)	14.	(a)	20.	(b)	26.	(a)
3.	(a)	9.	(a)	15.	(b)	21.	(c)	27.	(d)
4.	(b)	10.	(b)	16.	(b)	22.	(d)	28.	(c)
5.	(d)	11.	(d)	17.	(c)	23.	(a)	29.	(d)
6.	(a)	12.	(b)	18.	(d)	24.	(b)	30.	(a)

DETAILED EXPLANATIONS

1. (b)

$$R_i \propto \frac{1}{l}$$

The insulation resistance of a cable is given by

$$R_i = \frac{R_i}{2\pi l} ln\left(\frac{R}{r}\right)$$

Hence, $$R_i \propto \frac{1}{l}$$

4. (b)

- SF_6 is non-inflammable and chemically stable. Its products of decomposition are not explosive there is no danger of fire or explosion.
- The operation of SF_6 CB is noiseless as there is no exhaust to atmosphere as in case of air blast CB.

5. (d)

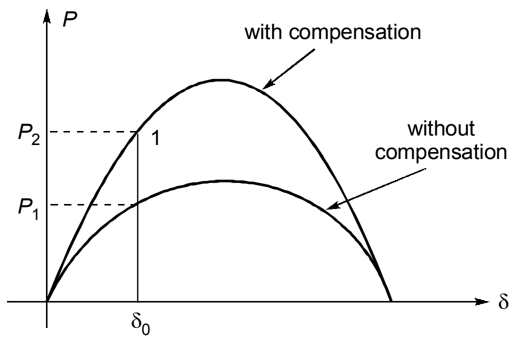
Base load plants are : Thermal, Nuclear, Run off river, Hydro (Rainy Season), Solar, Wind

Peak load Plants are : Pumped Storage, Hydro (Summer), Diesel, Gas

7. (d)

$$\text{Power loss} \propto \frac{1}{V^2}$$

9. (a)



For constant δ, $P_2 > P_1$

∴ Power transfer capacity increases.

11. (d)

$$\text{Plant load factor, } P_f = \frac{P_{avg}}{P_{max}}$$

$$0.8 = \frac{P_{avg}}{100}$$

$$P_{avg} = 80 \text{ MW}$$

$$\text{Hence plant capacity factor} = \frac{P_{avg}}{P_c} = \frac{80}{300} = 0.267$$

12. (b)

$$V_{ph} = \frac{110}{\sqrt{3}} \text{kV}$$

$$f = 50 \text{ Hz}$$

$$C_{Ph} = 125 \text{ nF/km}$$

$$\tan\delta = 2 \times 10^{-4}$$

Hence dielectric power loss, $P_L = V_{ph}^2 \omega c_{ph} (\tan\delta)$ w/km/ph

$$= \left(\frac{110}{\sqrt{3}}\right)^2 \times 10^6 \times 2\pi \times 50 \times 125 \times 10^{-9} \times 2 \times 10^{-4}$$

$$= 31.678 \text{ W/km/ph}$$

13. (a)

$$\text{No. of insulator disc} = \frac{\frac{440 \times 10^3}{\sqrt{3}}}{11 \times 10^3}$$

$$= 23.094 \approx 24$$

14. (a)

Critical disruptive voltage (V_c) $= m\, gr\, \delta \ln(d/r)$ kV/ph (rms)

1. V_c $ln(d)$

   Hence by increasing space between the transmission lines, higher V_c is maintained so that carona is minimised.

2. $V_c \propto$ air density factor (δ)

$$\delta = \frac{3.92b}{273 + T}$$

∴ $\delta \, \alpha$ barometric atmospheric pressure in cm of Hg.

∴ $\delta \propto$ b

b is less in case of hilly areas compared to plane areas. So that corona is more frequent in case of hilly areas.

15. (b)

The restriking voltage is given by

$$V_R = V_m\left(1 - \cos\frac{t}{\sqrt{LC}}\right)$$

The rate of rise of restriking voltage is given by

$$\text{RRRV} = \frac{d}{dt}V_R = \frac{V_m}{\sqrt{LC}}\sin\frac{t}{\sqrt{LC}}$$

this is maximum when, $\frac{t}{\sqrt{LC}} = \frac{\pi}{2}$

$$t = \frac{\pi}{2}\sqrt{LC} \text{ sec.}$$

17. (c)

$$\text{The turns ratio of CT} = \frac{200}{1}$$

Pickup current setting of over current relay = 50%

The operating current of the relay = 1 × 0.5 = 0.5 A

Hence the secondary terminal voltage of CT

$$= \frac{4}{0.5} = 8 \text{ V}$$

18. (d)

$$R = \frac{1}{2}\sqrt{\frac{L}{C}} = \frac{1}{2}\sqrt{\frac{8}{0.02\times10^{-6}}}$$

$$= \frac{1}{2}\sqrt{400\times10^{6}} = 10 \text{ k}\Omega$$

19. (c)

When the characteristic impedance of a transmission line in equal to load impedance then the reflection coefficient will be zero and all the energy sent will be absorbed by the load.

20. (b)

$$\Delta P_d = 20 \text{ MW}$$

$$H = 5 \text{ MW-sec/MVA}$$

$$t_d = 0.5 \text{ sec}$$

$$f_n = f_i\left[\frac{HS+(\Delta p_d)t_d}{HS}\right]^{1/2} = 50\left[\frac{(5\times200)+(20\times0.5)}{5\times200}\right]^{1/2}$$

$$= 50.249 \text{ HZ}$$

$$\Delta f = 0.249 \text{ Hz}$$

21. (c)

$$\text{SIL}_2 = SIL\sqrt{1+k_{sh}}$$

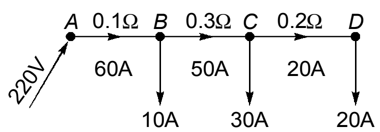
$$= SIL\sqrt{1+0.2}$$

$$= 1.0954 \text{ SIL}$$

$$\text{Hence \% increment in SIl} = \frac{1.0954SIL - SIL}{SIL}\times100$$

$$= 9.54\%$$

22. (d)



Voltage node D = 220 – [(0.1 × 60) + (0.3 × 50) + (0.2 × 20)]

= 195 V

24. (b)

The voltage transmitted into the overhead line is

$$V'' = \frac{2VZ_L}{Z_L + Z_C} = \frac{2 \times 8 \times 450}{450 + 50} = 14.4 \text{ kV}$$

25. (d)

For unity power factor load,

$$Q_R = 0$$
$$V_S = V_R = 132 \text{ kV}$$
$$Q_R = 0$$
$$0 = \frac{|V_S||V_R|}{B}\sin(\beta - \delta) - \frac{|A||V_R^2|}{|B|}\sin(\beta - \alpha)$$
$$0 = \frac{(132)^2}{110}\sin(75 - \delta) - \frac{0.98 \times 132^2}{110}\sin(75 - 3) \text{ MVAR}$$
$$0 = \sin(75 - \delta) - 0.98 \sin 72°$$
$$\sin(75 - \delta) = 0.98 \sin 72°$$
$$\delta = 6.25°$$
$$P_R = \frac{|V_S||V_R|}{|B|}\cos(\beta - \delta) - \frac{|A||V_R|^2}{|B|}\cos(\beta - \alpha)$$
$$= \frac{132^2}{110}\cos(75 - 6.25) - \frac{0.98 \times 132^2}{110}\cos(75 - 3) \text{MW}$$
$$= 57.41 - 47.97 \text{ MW} = 9.44 \text{ MW}$$

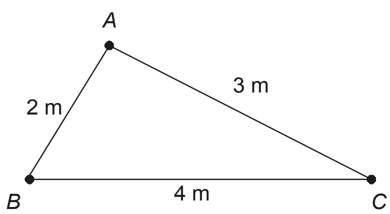
26. (a)

$$L = 0.4 \ln\left(\frac{2 \times 100}{0.7788 \times 1}\right) \text{ mH/km}$$
$$= 2.22 \text{ mH/km}$$
$$X_L = 2\pi \times 50 \times 10 \times 2.22 \times 10^{-3}$$
$$= 6.97 \ \Omega$$

27. (d)

$$\text{GMR} = \sqrt[4]{0.7788 \times r \times 2r \times 2r \times 2\sqrt{2}r} = 1.723\, r$$

28. (c)



$$r = \frac{2}{2} = 1 \text{ cm}$$

$$D_m = \sqrt[3]{D_{AB} \times D_{BC} \times D_{CA}} = \sqrt[3]{2 \times 3 \times 4} = 2.884 \text{ m}$$

$$D_S = \text{GMR} = 0.7788 \text{ r} = 0.7788 \text{ cm}$$

$$\text{Inductance/phase/meter} = 2 \times 10^{-7} ln\left(\frac{D_m}{D_s}\right) = 2 \times 10^{-7} ln\left(\frac{D_m}{D_s}\right)$$

$$= 2\times10^{-7} ln\left(\frac{288.4}{0.7788}\right) = 1.18\ \mu\text{H/m}$$

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