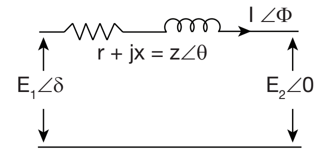
Power Systems Test 2

Number of Questions: 35 **Section Marks: 90**

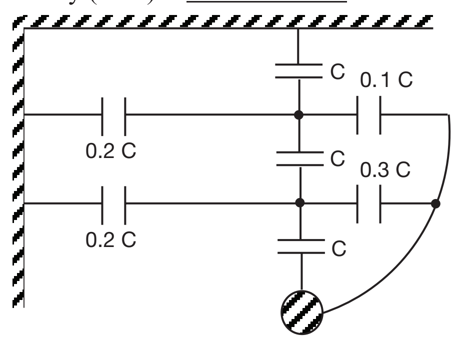
Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The voltage appears across the contacts of the circuit breaker during the arcing period is
   (A) Arc voltage (B) Restriking voltage
   (C) Recovery Voltage (D) None of the above
2. In low oil circuit breakers the conducting parts are insulated by
   (1) Oil
   (2) Air
   (3) Porcelain
   (4) Organic insulating material
   (A) 1, 2 and 3 (B) 1, 2 and 4
   (C) 2, 3 and 4 (D) all of the above
3. If the length of arc increases the arc resistance
   (A) Increases (B) decreases
   (C) remains same (D) None of the above
4. In a 3-ϕ system the sum of line currents is equal to
   (A) neutral current
   (B) fault current
   (C) zero sequence current
   (D) $\sqrt{3}$ times of any phase current
5. All phase sequence currents are equal in
   (A) shunt faults (B) L-G fault
   (C) LLL fault (D) series faults
6. A conductor consists of seven identical strands each having a radius of 0.4cm. The self GMD of the conductor is
   (A) 2.8 cm (B) 0.87 cm
   (C) 1.2 cm (D) 0.8 cm
7. The conductor material properties are
   (1) high electrical conductivity
   (2) high tensile strength
   (3) low specific gravity
   (A) 1 and 2 (B) 2 and 3
   (C) 1 and 3 (D) 1, 2 and 3
8. The number of wires are present in four layer stranded conductor is
   (A) 60 (B) 61
   (C) 36 (D) 37
9. In D.C distribution system the value of $\dfrac{\text{volume of copper for 3 – wire system}}{\text{volume of copper for 2 – wire system}}$ is
   (A) 0.31 (B) 3.2
   (C) 0.8 (D) 1.2
10. In the following single line diagram the maximum power received at load end is



figure

   (A) $\alpha + \delta = 90^o$ (B) $\theta + \phi = 90^o$
   (C) $\alpha - \delta = 90^o$ (D) $\theta - \phi = 90^o$
11. An alternator is connected to an infinite bus bar and delivers 1.0 p.u current at 1.0 p.u voltage and 0.9 p.f lagging. The real power is
   ($\because$ reactance of the alternator X_d = 1.0 p.u)
   (A) 1.0 p.u (B) 0.9 p.u
   (C) 0.435 p.u (D) 0.897 p.u
12. For the figure shown below, the value of string efficiency (in %) is ____________



13. A generator is connected through a 3-cycle *C.B* to a transformer is rated 20 MVA, 11kV with reactance's of $X_d^{11} = 15\%$, $X_d^1 = 20\%$, and X_d = 80%. It is operating at no load and rated voltage when a 3-phase short circuit occurs between the breaker and transformer. The initial symmetrical rms current in the breaker is
   (A) 7 kA (B) 1.04 kA
   (C) 1.81 kA (D) 12.12 kA
14. A system of 220kV, the line to ground capacitance is 0.05 μF and the inductance is 5H. Calculate the voltage appearing across the pole in a *C.B* if a magnetizing current of 10A.
   (A) 100 kV (B) 10 kV
   (C) 220 kV (D) 127 kV
15. The string efficiency can be improved by using
   (A) longer cross arm
   (B) guard rings
   (C) Grading of insulator discs
   (D) All of the above
16. A 3-phase, 50Hz, 20km long overhead line supplies 2000kw at 11kV, 0.9 p.f lagging. The line resistance is 0.04Ω per phase per km and line inductance is 0.8mH

per phase per km. The voltage regulation of the transmission system is

(A) 5.32% (B) 2.46%
(C) 4.36% (D) 8.26%

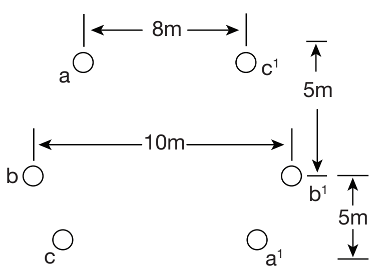
17. An insulator string consists of three units, each having a safe working voltage of 15kV. The ratio of self capacitance to shunt capacitance of each unit is 6:1. The string efficiency is

(A) 76.96% (B) 80.44%
(C) 72.55% (D) 86.54%

18. The A and B parameters of a 3-phase overhead transmission line are $0.95\angle 0$ and $150\angle 90$ respectively. To maintain the receiving end voltage equal to the sending end by connecting a shunt inductive reactor the value of shunt reactor should be

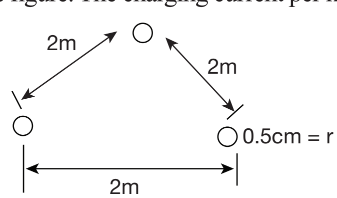
(A) $3000\angle 90$ (B) $157.89\angle 90$
(C) $6.34 \times 10^{-3}\angle -90$ (D) $3.34 \times 10^{-4}\angle -90$

19. The inductance per km of a transposed double circuit 3-ϕ line as shown in the figure is (diameter of each conductor is 3 cm)



(A) 0.608 mH/km/phase (B) 0.264 mH/km/phase
(C) 0.608 H/km/phase (D) 0.264 H/km/phase

20. A 3-ϕ, 132kV, 50Hz overhead transmission line as shown in the figure. The charging current per km is



(A) 0.2 A/km (B) 0.2 mA/km
(C) 0.2 kA/m (D) 0.2 kA/km

21. A conductor with 3cm diameter is passed centrally through a porcelain bushing $\in_r = 5$ having internal and external diameters of 4 cm and 10 cm respectively. Calculate the maximum gradient on the surface of the conductor, if 20kV r.m.s voltage applied between the conductor and earth.

(A) 34.32 kV/cm (B) 37.48 kV/cm
(C) 32.42 kV/cm (D) 28.32 kV/cm

22. A 50Hz overhead line has line to earth capacitance of 2μF. It is decided to use an earth fault neutralizer. Calculate the reactance to neutralize the capacitance of 85% length of the line.

(A) 624.45 ohms (B) 1873.36 ohms
(C) 936.68 ohms (D) 1248.90 ohms

23. Two overhead lines are connected in parallel to supply a load of 20 MW at 0.8 pf (lag) and 30 kV. The reactance's of line A and B are 15 Ω and 20 Ω respectively. The power carried by transmission line B is _________ kW.

24. A 3-phase, 400kV, 50Hz transmission line consists of 2cm radius conductor spaced 4 meters apart in equilateral triangular formation, if the temperature is 40°*c* and atmospheric pressure is 76cm. The corona loss per km of the line is _____ ($m_o = 0.85$)

(A) 2 kw/km (B) 4 kw/km
(C) 1 kw/km (D) 0.5 kw/km

25. A 3-phase, 20 MVA, 11kV alternator has internal reactance of 6% and negligible resistance. Calculate the external percentage reactance per phase to be connected in series with the alternator so that steady current on short circuit does not exceed 10 times the full load current

(A) 10% (B) 4%
(C) 6% (D) 8%

26. A balanced star connected load takes 80A from a balanced 3-phase, 4-wire supply. If the fuses in the *Y* and *B* are removed. The *Y*-phase current before the fuses are removed is

(A) 0A (B) $80\angle 0$
(C) $80\angle 120$ (D) $80\angle 240^{o}$\

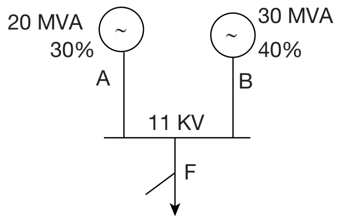
27. A star-connected 3-phase, 20 MVA, 6.6kV alternator is protected by merz-price circulating current principle using 500/5 amperes current transformers. The star point of the alternator is earthed through a resistance of 8Ω, if the minimum operating current of the relay is 1.25A. The percentage of each phase of the stator winding which is unprotected against earth faults is

(A) 26.24% (B) 31.23%
(C) 16.24% (D) 8.32%

28. A two wire d.c distributor cable 1500 meters long is loaded with 0.8 A/meter, Resistance of each conductor is 0.05Ω/km. The maximum voltage drop of distributor, if the distributor is fed from both ends with equal voltages of 200V is.

(A) 22 V (B) 45 V
(C) 90 V (D) 60 V

29. The percentage reactance of each alternator on its own capacity as shown in the figure. Calculate the short circuit current when a 3-phase short circuit occurs at point *F*. (Base MVA = 50)



(A) 8747.7 A (B) 2624.3 A
(C) 5248.6 A (D) 9499.8 A

30. Calculate the distance over which a load of 20MW at a p.f 0.8 lagging can be delivered by a 3-phase transmission line having conductors each of resistance 2Ω per kilometer. The voltage at the receiving end is to be 220 kV and the transmission loss is to be 8%.
(A) 62 km (B) 124 km
(C) 372 km (D) 186 km

31. A 50Hz generator is delivering 40% of the power that it is capable of delivering through a transmission line to an infinite bus. A fault occurs that increases the reactance between the generator and the infinite bus to 400% of the value before the fault when the fault is isolated, the maximum power that can be delivered is 60% of the original maximum value. The critical clearing angle of the machine is
(A) 69.23° (B) 23.57°
(C) 138.19° (D) 41.81°

Common Data Questions 32 and 33:

An alternator and a synchronous motor each rated for 100 MVA, 11 kV having sub transient reactance of 25% are connected through a transmission line of reactance 15% on the base of machine ratings. The motor acts as a load of 30MW at 0.8 p.f lead and terminal voltage 10kV when a 3-phase fault takes place at the motor terminals.

32. The p.u fault current supplied by generator
(A) 3.63 p.u (B) 2.27 p.u
(C) 5.90 p.u (D) 5.24 p.u

33. The p.u fault current supplied by motor
(A) 3.63 p.u (B) 2.27 p.u
(C) 5.24 p.u (D) 5.90 p.u

Linked Answer Question 34 and 35:

A 50Hz, 11kV, 3-phase alternator with earthed neutral has a reactance of 8 ohms and is connected to a bus-bar through a circuit breaker. The capacitance between phase and neutral is 0.05μF.

34. The frequency of oscillation is
(A) 9.00 kHz (B) 4.50 kHz
(C) 28.28 kHz (D) 48.23 Hz

35. The average RRRV upto first peak is
(A) 8.98 kV/sec
(B) 161.82×10^3 kV/sec
(C) 80.91 kV/sec
(D) 114.42×10^3 kV/sec

Answer Keys

1. A	**2.** C	**3.** A	**4.** A	**5.** B	**6.** B	**7.** D	**8.** B	**9.** A	**10.** A
11. D	**12.** 94.8 to 95.8	**13.** A	**14.** A	**15.** D	**16.** A	**17.** B	**18.** A	**19.** A	
20. A	**21.** D	**22.** A	**24.** A	**25.** B	**26.** D	**27.** A	**28.** A	**29.** A	**30.** A
31. A	**32.** B	**33.** A	**34.** B	**35.** B					

Hints and Explanations

1. The voltage appears across the contacts of the circuit breaker during the arcing period is Arc voltage. Choice (A)

2. In low oil circuit breaker oil is used only for arc extinction. So, the conducing parts are insulated by air, porcelain and organic insulating material. Choice (C)

3. Choice (A)

4. $I_a + I_b + I_c = I_n$

⇒ I_a, I_b, I_c are line currents of phases a, b, c respectively

⇒ if there is no path neutral current. The sum of line currents is zero. Choice (A)

5. In L-G-fault:-

$$I_{RO} = I_{R1} = I_{R2} = \frac{I_R}{3}$$ Choice (B)

6. Self GMD = 2.176 × 0.4 cm
= 0.8704cm Choice (B)

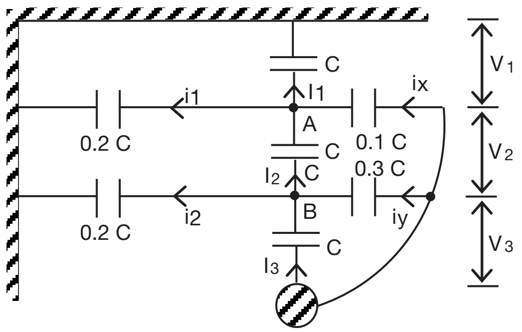
7. Choice (D)

8. The total number of individual wires
$= 3n(n + 1) + 1$
$= 3 \times 4(4 \times 1) + 1 = 61$ Choice (B)

11. $E = 1.0 + j1.0(0.9 - j0.435)$
$= 1.435 + j0.9$
$= 1.693 \angle 32.09$

$$P = \frac{1.69 \times 1.0}{1.0} \sin 32.09 = 0.897 \text{ p.u}$$ Choice (D)

12. Redrawing the circuit with the currents.



KCL @ A & B

$I_2 + i_x = I_1 + i_1$

$WCV_2 + 0.1\ C\ (V_2 + V_3)$

$= WCV_1 + W(0.2C)\ V_1$

$1.2\ V_1 = 1.1\ V_2 + 0.1\ V_3$ (1)

$I_3 + i_y = I_2 + i_2$

$WCV_3 + W0.3C\ V_3 = WCV_2 + W0.2C\ (V_1 + V_2)$

$1.3\ V_3 = 0.2\ V_1 + 1.2\ V_2$ (2)

Solve equation (1) and (2) we get

$V_2 = \frac{154}{155}V_1$ and $V_3 = \frac{166}{155}V_1$

String efficiency $= \frac{V_1 + V_2 + V_3}{3V_3} \times 100$

$$= \frac{V_1 + \frac{154}{155}V_1 + \frac{166}{155}V_1}{3 \times \frac{166}{155}V_1} \times 100$$

$$= \frac{155 + 154 + 166}{3 \times 166} \times 100$$

$= 95.38\%.$

13. short circuit MVA $= \frac{20}{15} \times 100 = 133.34\,\text{MVA}$

short circuit current $= \frac{133.34}{\sqrt{3} \times 11} = 6.99\,\text{kA}$ $= 7\text{kA}$

Choice (A)

14. $v = i\sqrt{\frac{L}{C}} = 10\sqrt{\frac{5}{0.05}}$ $= 100\text{kV}$ Choice (A)

15. Choice (D)

16. $R = 0.04 \times 20 = 0.8\Omega$

$X_L = 2\pi fL \times 20 = 2\pi \times 50 \times 0.8 \times 10^{-3} \times 20$

$= 5.02\Omega$

Receiving end voltage/phase

$= V_R = \frac{11 \times 10^3}{\sqrt{3}} = 6351\text{V}$

Load Power Factor $\cos\phi_R = 0.9$ lagging

Line current

$$= \frac{2000 \times 10^3}{\sqrt{3} \times V_L \times \cos\varphi} = \frac{2000 \times 10^3}{\sqrt{3} \times 11 \times 10^3 \times 0.9} = 116.63\text{A}$$

$V_s = V_R + IR\cos\phi_R + IX_L\sin\phi_R$

$= 6351 + 116.63 \times 0.8 \times 0.9 + 116.63 \times 5.02 \times \sin(\cos^{-1}(0.9)) = 6689.17$ V

Percentage voltage regulation $= \frac{V_S - V_R}{V_R} \times 100$

$= \frac{6689 - 6351}{6351} \times 100$ $= 5.32\%$ Choice (A)

17. The maximum voltage appears across the lowest unit in the string

$V_1 = 15\text{kV}$

$K = \frac{1}{6} = 0.167$

$V_2 = V_3(1 + k) \Rightarrow V_3 = \frac{V_2}{1 + k}$

$V_3 = \frac{V_2}{1 + 0.167} = 0.85V_2$

$V_1 = V_2 + (V_3 + V_2)k$

$= V_2 + (0.85V_2 + V_2) \times 0.167$

$V_1 = 1.308\ V_2$

$\Rightarrow\ V_2 = \frac{15kv}{1.308} = 11.46\text{KV}$

$\Rightarrow\ V_3 = 9.74$ kV

Voltage across the string $= V_1 + V_2 + V_3$

$= 9.74 + 11.46 + 15$

$= 36.20$ kV

String efficiency $= \frac{36.20}{3 \times 15} \times 100 = 80.44\%$

Choice (B)

18. $V_S = AV_R + B\,I_R$

When $V_R = V_S \Rightarrow V_R(1 - A) = B\,I_R$

$\frac{V_R}{I_R} = \frac{B}{1 - A}$

$= \frac{150\angle 90}{1 - 0.95\angle 0}$ $= 3000 \angle 90$ Choice (A)

19. self GMD of each conductor

$= 1.5 \times 0.7788\text{cm} = 0.01168\text{cm}$

$D_{bc} = D_{ab} = \sqrt{5^2 + 1^2} = 5.099\text{m}$

$D_{ab^1} = \sqrt{5^2 + 9^2} = 10.295\text{m}$

$D_{aa^1} = \sqrt{10^2 + 8^2} = 12.806\text{m}$

$D_{m1} = \sqrt[4]{5.099 \times 10 \times 8 \times 10.295}$ $= 8.050\text{m}$

$D_{m2} = \sqrt[4]{5.099 \times 5.099 \times 10.295 \times 10.295}$ $= 7.245\text{m}$

$D_{m3} = D_{m1} = 8.05\text{m}$

$$D_m = \sqrt[3]{D_{m1} \times D_{m2} \times D_{m3}} = 7.772\text{m}$$

Self GMD of each phase $D_{S1} = \sqrt{0.01168 \times 12.806}$

$= 0.3867\text{m} = D_{S3}$

$$D_{S2} = \sqrt{0.01168 \times 10} = 0.3417\text{m}$$

$$D_s = \sqrt[3]{D_{s1} \times D_{s2} \times D_{s3}} = 0.3710\text{m}$$

Inductance $= 2\times10^{-4}\, \ell n\left(\frac{7.772}{0.3710}\right)$

$= 0.608$ mH/km/phase Choice (A)

20. The radius of conductors $r = 0.5$cm

The mutual GMD of conductors $D_m = 2$m

Capacitance per phase per meter $= \dfrac{2\pi t_o}{\ln\left(\frac{200}{0.5}\right)} \dfrac{F}{m}$

$= 9.285 \times 10^{-9}$ F/km

The charging current $= \dfrac{132\times1000}{\sqrt{3}} \times 9.285\times10^{-9} \times 314$

$= 0.222$ A/km Choice (A)

21. $g_{1\max} = \dfrac{q}{2\pi \in_o r}$

$$g_{2\max} = \frac{q}{2\pi \in_o \in_r r_1}$$

$\Rightarrow \quad g_{1\max} r = g_{2\max} \times 5 \times 2$

$\Rightarrow \quad g_{1\max} 1.5 = g_{2\max} \times 5 \times 2$

$g_{1\max} = 6.67\, g_{2\max}$

now $g_{2\max} = \dfrac{g_{1\max}}{6.67} = 0.15\, g_{1\max}$

$$20 = g_{1\max} r \ln\left(\frac{2}{1.5}\right) + g_{2\max} \times 2\ln\left(\frac{5}{2}\right)$$

$$= 1.5\, g_{1\max} . \ln\left(\frac{2}{1.5}\right) + 0.15\, g_{1\max} \times 2\ln\left(\frac{5}{2}\right)$$

$= 0.431 g_{1\max} + 0.274 g_{1\max} = 0.706 g_{1\max}$

$\Rightarrow \quad g_{1\max} = \dfrac{20}{0.706} = 28.32$ kV/cm. Choice (D)

22. The inductive reactance for neutralizing 85% of the capacitance

$$L = \frac{1}{3c} = \frac{10^6}{3\times314\times2\times0.85}$$

$= 624.45$ ohms Choice (A)

23. $S_B = \dfrac{P}{P.f} \times \dfrac{Z_A}{Z_A + Z_B}$

$= \dfrac{20\times10^3}{0.8} \times \dfrac{j15}{j35} \angle -36.86$

$= 10714.28 \angle -36.86$ KVA

$P_B = 10714.28 \times \cos(-36.86)$

$= 8572.53$ KW.

24. $P = 241 \times 10^{-5} \left(\dfrac{f+25}{\delta}\right)\sqrt{\dfrac{r}{d}}\left(V - V_c\right)^2$ kw/km/phase

$$\delta = \frac{3.926 b}{273+t} = \frac{3.92\times76}{273+40} = 0.952$$

$g_o = 21.1$ kV/cm (r.m.s)

$V_c = m_o g_o\, \delta\, r \ln\left(\dfrac{d}{r}\right)$ KV

$= 0.85 \times 21.1 \times 0.952 \times 2 \times \ln\left(\dfrac{400}{2}\right)$

$= 180.92$kV

Supply voltage per phase $= V = \dfrac{400}{\sqrt{3}} = 230.94$ kV

$$P = 241\times10^{-5}\left(\frac{50+25}{0.952}\right) \times \sqrt{\frac{2}{400}} \times \left(230.94 - 180.92\right)$$

$= 0.6715$ kw/km/phase

Total corona loss per km $= 3 \times 0.6715$

$= 2.014$ kw/km Choice (A)

25. Full load current $I = \dfrac{20\times10^6}{\sqrt{3}\times11\times10^3}$

Voltage per phase $V = \dfrac{11\times10^3}{\sqrt{3}}$

Total percentage reactance required

$= \dfrac{\text{Full load current}}{\text{short circuit current}} \times 100$

$= \dfrac{1}{10} \times 100 = 10\%$

External percentage reactance required

$= 10\% - 6\% = 4\%$ Choice (B)

26. Before the fuses are removed from Y and B lines, the system is balanced and current in each line is 80A

$I_Y = 80 \angle 240^\circ$ A Choice (D)

27. X% of the winding be unprotected $r = 8\Omega$

$$V_{ph} = \frac{6.6\times10^3}{\sqrt{3}} = 3810\text{V}$$

Minimum fault current which will operate the relay

$= \dfrac{500}{5} \times 1.25 = 125$

e.m.f induced in x% winding

$= V_{ph} \times \left(\dfrac{x}{100}\right) = 3810 \times \dfrac{x}{100}$

The current $125 = \frac{38.1x}{8}$

Unprotected winding $x = \frac{125 \times 8}{38.1} = 26.24\%$

Choice (A)

28. $i = 0.8$A/m,
$r = 2 \times 0.05/1000 = 0.1 \times 10^{-3}\ \Omega$/m
$l = 1500$m
$I = il = 0.8 \times 1500 = 1200$A
$R = rl = 0.1 \times 10^{-3} \times 1500 = 0.15\Omega$
Maximum voltage drop $= \frac{IR}{8} = \frac{1200 \times 0.15}{8} = 22.5$V

Choice (A)

29. $\%X_A = \frac{50}{20} \times 30 = 75\%$

$\%X_B = \frac{50}{30} \times 30 = 50\%$

Line current $I = \frac{50,000 \times 10^3}{\sqrt{3} \times 11 \times 10^3} = 2624.31$A

$$\%X = \frac{X_A X_B}{X_A + X_B} = \frac{75 \times 50}{75 + 50} = 30\%$$

Short circuit current $I_{SC} = I \times \frac{100}{\%X}$

$= 2624.31 \times \frac{100}{30}$

$= 8747.7$ A

Choice (A)

30. $I = \frac{20 \times 10^6}{\sqrt{3} \times 220 \times 10^3 \times 0.8} = 65.60$A

Line loss = 8% of power delivered
$= 0.08 \times 20,000 = 1600$ kw
$\Rightarrow$ $3I^2 R = 1600 \times 10^3$
$3 \times 65.60^2 \times R = 1600 \times 10^3$
Total resistance $R = 123.93\Omega$
$r = 2\Omega$/km
length of line $= \frac{R}{r} = \frac{123.93}{2} = 61.96$ km

Choice (A)

31. $P_m \sin\delta_o = 0.4P_m \Rightarrow \delta_o = \sin^{-1}(0.4) = 23.57^\circ$
During fault the reactance is 400% of the value before the fault
$r_1 = 0.25$ and $r_2 = 0.6$

$$\delta_c = \cos^{-1}\left[\frac{\left(\frac{P_s}{P_m}\right)(\delta_m - \delta_o) + r_2 \cos\delta_m - r_1 \cos\delta_o}{r_2 - r_1}\right]$$

$\Rightarrow$ $0.4P_m = 0.6P_m \sin\delta_m \Rightarrow \delta_m = \sin^{-1}\left(\frac{0.4}{0.6}\right) = 41.81$

$\delta_m = 180 - 41.81 = 138.19$
$\delta_m = 2.412$ rad
$\delta_c = \cos^{-1}$

$$\left(\frac{0.4(2.412 - 0.411) - 0.6 \times 0.74547 - 0.25 \times 0.916}{0.6 - 0.25}\right)$$

$= \cos^{-1}(0.354)$
$= 69.23^\circ$

Choice (A)

32. Base MVA = 100MVA
Base kv = 11kV

The base current $= \frac{100 \times 1000}{\sqrt{3} \times 11} = 5248.63$A

The prefault voltage $= \frac{10}{11} = 0.909$ p.u

The fault impedance $= j0.4 \times \frac{j0.25}{j0.65} = j0.154$ p.u

$\therefore$ The fault current $= \frac{0.909}{j0.154} = -j5.902$ p.u

The full load current before the fault takes place

$= \frac{30 \times 1000}{\sqrt{3} \times 10 \times 0.8} = 2165.06$A

P.U load current $= \frac{2165.06}{5248.63} = 0.412\angle 36.8$

The p.u fault current supplied by the generator

$-j5.902 \times \frac{25}{65} = -j2.27$ p.u

Choice (B)

33. The p.u fault current supplied by the motor

$= -j5.902 \times \frac{4}{6.5} = -j3.632$ p.u

Choice (A)

34. Inductance per phase $= L = \frac{X_L}{2\pi f} = \frac{8}{2\pi \times 50}$

$= 0.025$H
Capacitance per phase $C = 0.05\mu$F

$$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{0.025 \times 0.05 \times 10^{-6}}}$$

$= 4501.58$ Hz

Choice (B)

35. $t = \frac{1}{2f_n} = 1.11 \times 10^{-4}$ sec

Average RRRV $= \frac{\text{Peak restriking voltage}}{\text{Time upto first peak}}$

$$\frac{2\sqrt{2} \times \frac{11}{\sqrt{3}}}{1.11 \times 10^{-4}} = 161.82 \times 10^3 \text{ kV/sec}$$

Choice (B)