1	C	**2**	A	**3**	D	**4**	B	**5**	D	**6**	C	**7**	A
8		**9**	A	**10**	D	**11**	C	**12**	A	**13**	D	**14**	B
15	A	**16**	B	**17**	D	**18**	D	**19**	B	**20**	A	**21**	C
22	A	**23**	A	**24**	C	**25**	D	**26**	C	**27**	B	**28**	A
29	B	**30**		**31**	C	**32**	A	**33**	A	**34**	C	**35**	D
36	A	**37**	C	**38**	D	**39**	B	**40**	C	**41**	D	**42**	B
43	C	**44**	A	**45**	C	**46**	B	**47**	A	**48**	D	**49**	B
50	A	**51**	B	**52**	D	**53**	C	**54**	D	**55**	B	**56**	B
57	A	**58**	D	**59**	C	**60**	D	**61**	C	**62**	B	**63**	D
64	B	**65**	C	**66**		**67**	C	**68**	A	**69**	D	**70**	B
71	C	**72**	B	**73**	D	**74**		**75**	D	**76**	D	**77**	A
78	C	**79**	C	**80**	C	**81**	C,B	**82**	A,B	**83**	B,C	**84**	D,B
85	B,D												

Explanations:

1. ( ) $8 = \frac{100}{R+5} \Rightarrow R = 7.5$

2. ( )

RMS value = $\sqrt{3^2 + \left(\frac{4}{\sqrt{2}}\right)^2} = \sqrt{3^2 + \frac{16}{2}} = \sqrt{17}$

RNS value = $\sqrt{17}$

3. ( )

4. ( ) In the steady state C is open

$\therefore V_C = 10V$

$V_1 = Z_1 I_1 + Z_1 I_2$

$V_2 = Z_2 I_2 + Z_1 I_2 + Z_1 I_1 = (Z_1 + Z_2) I_2 + I_1 Z_1$

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_1 & Z_2 \\ Z_1 + Z_2 & Z_1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

5. ( )

6. ( )

$$T(s) = \frac{s^2 + 4}{(s+1)(s+4)} = 0 \Rightarrow s = \pm j_2 = \pm j\omega$$

$\omega = 2$

7. ( ) All the root locus branches starts at S = 0

ε^1 also going to ∞ with an angle $\frac{180}{3} = 60$

So, answer is (A).

8. ( ) Phase = -180 + $\tan^{-1}(\omega)$

Phase = -180, ω = 0

Phase crossover frequency = 0;

$$gain = \frac{\sqrt{H\omega^2}}{\omega^2} = \infty$$

gain margin = ∞

9. ( )

10. ()

11. ()

$$S = \int_1^\infty x^{-3}dx = \frac{x^{-4}}{-4}\int_1^\infty = \frac{0+1}{4} = \frac{1}{4}$$

$$S = \frac{1}{4}$$

12. ()

$$\frac{dx}{dt} = -3x(t), sx(s) = -3x(s)$$

$$x(s) = \frac{xo}{s+3}$$

$$x(t) = xoe^{-3t}$$

13. ()

14. ()

15. ()

16. ()

17. ()

18. ()

$$P = \frac{V^2}{X_{series}}; \frac{P_1}{P_2} = \left(\frac{800}{400}\right)^2 = 4; P_2 = \frac{P_1}{4}$$

19. ()

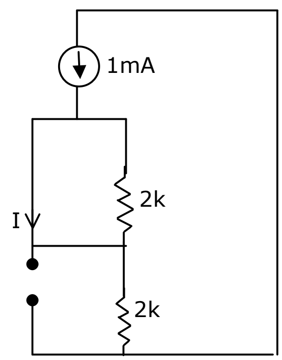
20. ()

21. ()

22. () PMMC voltmeter reads only DC

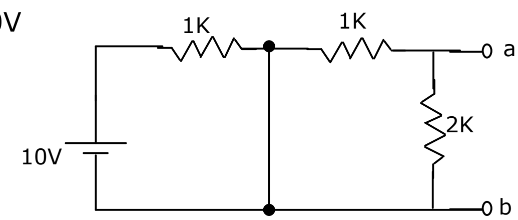
∴ V = 2V

23. () $D_1 \rightarrow$ short
$D_2 \rightarrow$ open
I = 0 mA



24. ()

25. () For MOSFET, VGS = 2V, Vt = 1V
VGS > Vt, so MOSFET is turn-on
$V_{ab} = 0V$



26. ()

27. ()

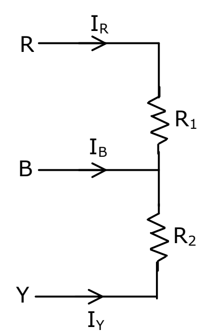
28. ()

29. ()

30. ()

31. ()

32. ()



$$V_{RY} = V\angle 0$$
$$V_{YB} = V\angle -120$$
$$V_{BR} = V\angle 120$$
$$I_R = \frac{V_{RB}}{R} = \frac{-V\angle 120}{R} = \frac{V}{R}\angle -60$$
$$I_Y = \frac{V_{YB}}{R} = \frac{V}{R}\angle -120$$
$$I_R + I_Y + I_B = 0$$
$$I_B = -\left(I_Y + I_R\right) = \frac{-V}{R}\left(\angle -60 + \angle -120\right)$$
$$= \frac{-V}{R}\left(-0.5 - j0.866 - 0.5 - j0.866\right)$$
$$= \frac{-\sqrt{3}V}{R}\angle -90 = \sqrt{3}\left(\frac{V}{R}\right)\angle 90$$
$$I_R : I_Y : I_B = 1 : 1 : \sqrt{3}$$

33. ()

$$V\ rms = \sqrt{\frac{\frac{1}{3}\times 1^2 \times \frac{T}{2}}{T}} = \sqrt{\frac{1}{6}}$$

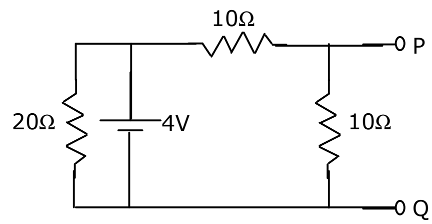
$$V\ rms = \frac{1}{\sqrt{6}}$$

34. () In the steady state, inductor is drawing 1A, ε^1 acts as a short.
When $t = 0^+$, inductor acts as a open circuit.
$i_L = 1A$

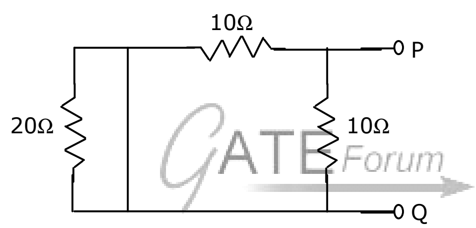
35. ()

36. ()

$V_{PQ} = 2V$
$V_{Th} = 2V$



For R_{Th},



$R_{Th} = 5\Omega$

37. ()

Characteristic equation is $1 + G(s)\,H(s) = 0$;

$$\frac{K(1-s)}{(1+s)} + 1 = 0$$

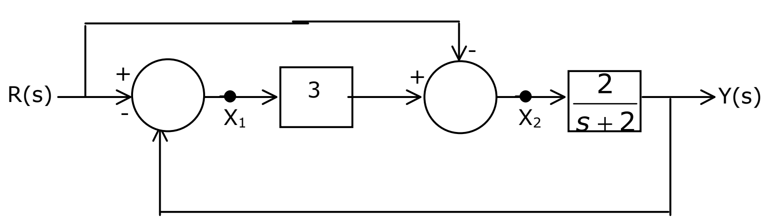
$K - Ks + S + 1 = 0$; $S(1 - K) + (K + 1) = 0$

For stable system, $1 - K > 0$ $K + 1 > 0$

$1 > K$; $K < +1$ $K > -1$

$$|K| < 1$$

38. ()



$X_1 = R(s) - y(s)$

$X_2 = 3[R(s) - y(s)] - R(s) = 2R(s) - 3y(s)$

$$y(s) = [2R(s) - 3y(s)]\frac{2}{s+2}$$

$$\frac{y(s)}{R(s)} = \frac{4}{s+8}$$

$R(s) = \frac{1}{s}$ given

$$y(s) = \frac{4}{s(s+8)}$$

steady state error = $\underset{S \to 0}{\text{lt}}\, sy(s) = \underset{S \to 0}{\text{lt}} \frac{4s}{s+8}$

steady state error = 0.5

39. ()

Phase of G(s)H(s) is $-90 - \left(\frac{180}{\pi}\right)(0.25w)$

$$-90 - \left(\frac{180}{\pi}\right)0.25w = -90 - \left(\frac{180}{\pi}\right)\left(\frac{w}{4}\right)$$

when it passes through negative real axis phase = -180

$$-90 - \left(\frac{180}{\pi}\right)\left(\frac{\omega}{4}\right) = -180$$

$$\omega = 2\pi$$

gain at this point is $\left|\frac{\pi e^{-\frac{s}{4}}}{s}\right| = \frac{\pi}{\omega}$

$$= \frac{\pi}{2\pi} = 0.5$$

it cross – vertical axis at –0.5+j0

40. ()

$$G(s)H(s) = \frac{K + 0.366s}{s(s+1)}$$

phase margin (PM)= $180 + \left[-90 - \tan^{-1}\omega - \tan^{-1}\left(\frac{0.366\omega}{K}\right)\right]$

PM = 60, ω 1 rad/sec.

Substitutions, K = 1.366

41. ()

42. ()

43. ()

44. ()

$$f(x) = x^2e^{-x}, \frac{df(x)}{dx} = 2xe^{-x} + x^2e^{-x}(-1) = 0$$
$$\left(2x - x^2\right)e^{-x} = 0$$
$$x = 2$$

45. ()

$$\text{gradient} = \frac{\partial u}{\partial x} i + \frac{\partial u}{dy} j$$
$$= xi + \frac{2}{3} yj$$

@(1,3) point, i+2j

magnitude is $\sqrt{5}$

46. ()

$$\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 2x(t) = 5$$
$$\left(s^2 + 3s + 2\right) \times (s) = 5$$
$$x(s) = \frac{5}{s^2 + 3s + 2}$$
$$t \to \infty, s \to 0$$
$$\underset{t\to\infty}{Lt}\ f(t) = \underset{S\to 0}{Lt}\ SF(s) = \underset{S\to 0}{Lt}\left[\frac{s.5}{s^2 + 3s + 2}\right] = 0$$
$$\underset{t\to\infty}{Lt}\ f(t) = 0$$

47. () As t → ∞ ⇒ S → 0

$$\underset{S\to 0}{H}\ SF(s) = \frac{s\left[5s^2 + 23s + 6\right]}{s\left(s^2 + 2s + 2\right)} = 3$$
$$\underset{S\to 0}{H}\ SF(s) = 3$$

48. () $F(z) = \frac{1}{z+1} = 1 - \frac{1}{z^{-1}+1}; c$

inverse z-transform to 8(k) – $(-1)^K$; k≥0

49. ()

50. ()

51. () (i) E α speed; $\frac{50KW}{P} = \frac{1}{\left(\frac{1}{2}\right)}; P = 25KW$

Power α E.

(ii) In field control, speed is above rated speed by reducing field flux

$$\therefore\ E = \frac{\phi zNP}{60a}; E\alpha(\phi N)$$
$$\phi \downarrow N \uparrow$$

E is constant

P = 50 KW

52. () Torque = $K_a \phi I_a$

$E = K_a \phi \omega_m$

$P = EI_a = K_a \phi \omega_m I_a$

53. ()

54. ()

55. ()

56. ()

57. ()

$$\frac{Te(st)}{Te(fl)} = \left(\frac{Ist}{Ifl}\right)^2 sfl$$

$$= 6^2 \times 0.004$$

$$\frac{Te(st)}{Te(fl)} = 1.44$$

58. ()

$x_s = 0.4\Omega / km$

$x_m = 0.1\Omega / km$

$x_0 = x_s + 2x_m$

$x_0 = 0.62\Omega / km$

$x_l = x_s - x_m = 0.3\Omega / km$

59. () Power factor 0.97 lag is due to capacitor installed.

$\therefore$ Q = P $\tan\phi$ = 4 $\times$ $\tan[\cos^{-1}(0.97)]$

Q = 1 MVAR

P = 4 MW

If capacitor goes out of service,

Q = P$\tan\phi$ → $P = \frac{Q}{\tan\phi} \rightarrow \tan\phi = \frac{2+1}{4} = 0.75$

$\cos\phi$ = 0.8 lag

Q = 2+1=3

60. ()

Y_{22} = j0.1 – j20 + j0.1 = -j19.8

Y_{22} = -j19.8

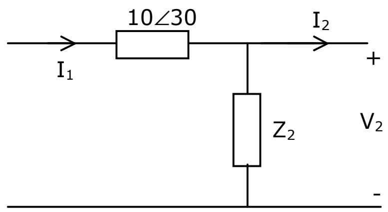
$$\frac{dF_1}{dP_1} = \frac{dF_2}{dP_2};$$

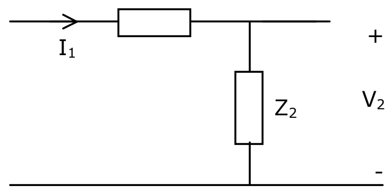
61. () $b + 2CP_1 = b + 4CP_2$

$P_1 = 2P_2; P_1 + P_2 = 150$

$P_1 = 100, P_2 = 400$

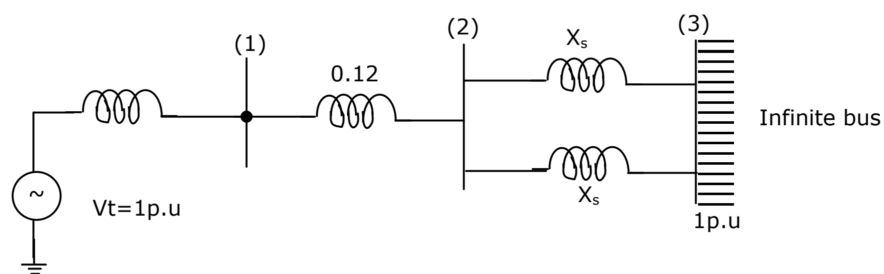
62. () $I_2=0,\ C=\frac{I_1}{\sqrt{2}}=\frac{1}{Z_2}$





$Z_2 = 40\angle -45$

63. ()



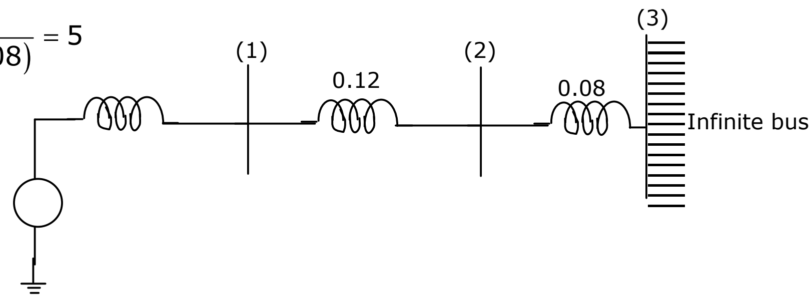
$$P=\left(\frac{Vt_1\times Vt_2}{x_s}\right)\sin\delta$$

$$P_{\max}=\frac{Vt_1Vt_2}{x_s}$$

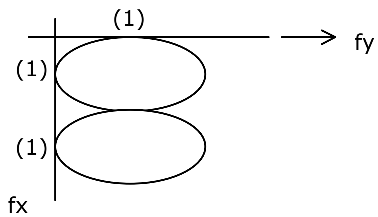
$$6.25=\frac{1\times 1}{\left(\frac{x_s}{2}+0.12\right)}$$

$$x_s=0.08$$

$$P_{\max_{now}} = \frac{1\times 1}{(0.12+0.08)} = 5$$



64. ()



$$\frac{fy}{fx} = \frac{\text{No. of intersections of the horizontal line with curve}}{\text{No. of intersections of the vertical line with curve}} = \frac{1}{2}$$

$fx = \frac{4}{2\pi}$ $\quad x(t) = P\sin(4t+30)$

$fy = \frac{2}{2\pi};$ $\quad \omega_x = 4 = 2\pi fx$

$\omega_y = 2$

y(t) = Qsin(2t+15)

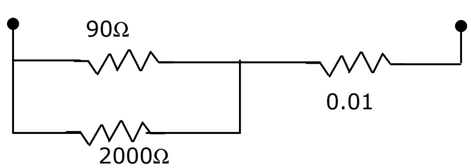
65. () Multiplying power m = $\frac{I}{Im} = \frac{500}{100} = 5$

m = 5;

$m = 1 + \frac{R_m}{R_{shint}} = 5 \Rightarrow$ R_{short} = $\frac{0.1}{4} = 0.025\Omega$

66. ()

67. ()



→ 86.124Ω

error = $\frac{90 - 86.124}{86.124} = 4.5\%$

68. ()

69. () W_1 = 10.5

W_2 = -2.5

W = WHW$_2$; W = 8 kW

$$\tan\phi = \sqrt{3}\left(\frac{w_1 - w_2}{w_1 + w_2}\right) = \sqrt{3}\left[\frac{10.5-(2.5)}{10.5-2.5}\right]$$

$$\phi = 70.43$$

$$\cos\phi = 0.3347$$

70. ()

$$I_E = 1mA, \alpha = \frac{\beta}{\beta+1} = 0.9909$$

$$\beta = 100$$

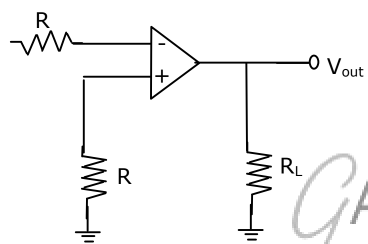
$$I_C = \alpha I_E = \left(\frac{100}{101}\right)\Bigg| mA = 990.099\mu A$$

$$I_C = \beta I_B, I_B = 9.9\mu A \approx I_B = 10\mu A$$

71. ()

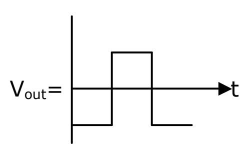
72. ()

73. ()



Here op-amp in saturation.

So,

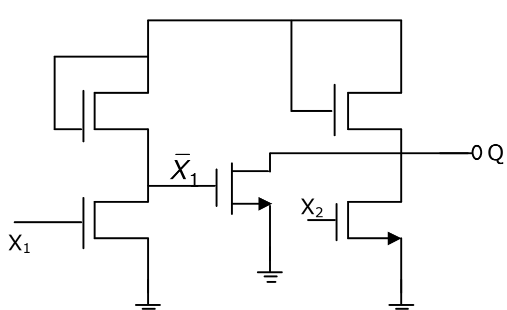


$$\bar{Q} = X_2 + \bar{X}_1;$$

$$Q = X_1\bar{X}_2$$

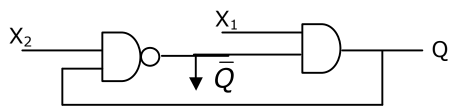
74. () Ambiguous

75. ()



$\bar{Q} = X_2 + \bar{X}_1; Q = X_1\bar{X}_2$

76. ()



$x_1 = x_2 = 1$;l Q is always toggling

so, Q is unstable.

77. () Even though voltage across the device → 0, current is flowing

so device is turn on

Energy lost = $\frac{1}{2}VI(t_1 + t_2)$

78. ()

79. () $V_S = 100V$ f = 1 KHz

$R_L = 5$ D = 0.5

L = 200 mH T = 1 msec.

$T_a = \frac{L}{R_L} = 40m\sec.$

Ripple current in the load current is

$$= \frac{V_S}{R}\left[\frac{\left(1 - e^{\frac{-\alpha T}{Ta}}\right)\left(1 - e^{\frac{-(1-\alpha)T}{Ta}}\right)}{1 - e^{\frac{-T}{Ta}}}\right]$$

$$= \frac{100}{5}\left[\frac{\left(1 - e^{-\frac{1}{2}\times\frac{1}{40}}\right)\left(1 - e^{-\frac{1}{2}\cdot\frac{1}{40}}\right)}{\left(1 - e^{\frac{-1}{40}}\right)}\right]$$

Ripple current = 0.1249 $\approx 0.125A$

80. () Test = Tl + $J\left(\frac{d\omega}{dt}\right) = Tl + J(a)$

15 = 7 + J(2) ⇒ J = 4Nm²

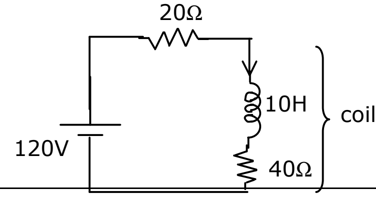
81. (A) ( )

$V_{out} = \frac{V_{max}}{2\pi}(1 + \cos\alpha) = V_{o(rms)}(1 + \cos\alpha)$

$V_{out} = 230V, V_o = 230$

$\alpha = 90$

Position 1:



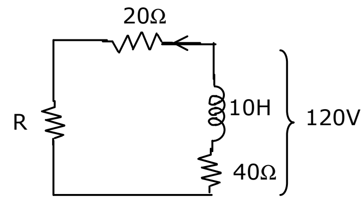
$I_{coil} = \frac{120}{40+20} = 2A$

Inductor acts as a short circuit.

Position 2:

120 V = (20 + R) 2

R = 40Ω



(B) ( ) Total resistance = 40 + 40 + 20 = 100 Ω = R

Time constant = $\frac{R}{L} = \frac{100}{10} = 10\,\text{sec}$

$\therefore i(t) = 2e^{-10t}$

Balance energy left = 100 – 95 = 5% = 0.05.

Since the stored energy is proportional to the square of the current, the current at this instant is

$i = \sqrt{0.05} \times \text{initial current}$

$= 2\sqrt{0.05}$

$2\sqrt{0.05} = 2e^{-1at} \Rightarrow t = 0.15$ sec.

82. (A) ( )

$A = \begin{bmatrix} 0 & 1 \\ 0 & -3 \end{bmatrix} B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

$X(0) = \begin{bmatrix} -1 \\ 3 \end{bmatrix}$

$\phi(t) = L^{-1}\left[(SI - A)^{-1}\right] = L^{-1}\left[\left[\begin{pmatrix} S & 0 \\ 0 & S \end{pmatrix} - \begin{pmatrix} 0 & 1 \\ 0 & -3 \end{pmatrix}\right]^{-1}\right]$

$= L^{-1}\left[\begin{bmatrix} S & -1 \\ 0 & S+3 \end{bmatrix}^{-1}\right] = L^{-1}\begin{bmatrix} \frac{1}{s} & \frac{1}{s(s+3)} \\ 0 & \frac{1}{s+3} \end{bmatrix}$

$\phi(t) = \begin{bmatrix} 1 & \frac{1}{3}\left(1 - e^{-3t}\right) \\ 0 & e^{-3t} \end{bmatrix}$

(B) ( )

$$x(t) = L^{-1}\left[(SI - A)^{-1}\left[x(0) + BVCS\right]\right]$$

$$= L^{-1}\left[\begin{Bmatrix} \frac{1}{s} & \frac{1}{s(s+3)} \\ 0 & \frac{1}{s+3} \end{Bmatrix}\left\{\begin{pmatrix} -1 \\ 3 \end{pmatrix} + \begin{pmatrix} \frac{1}{s} \\ 0 \end{pmatrix}\right\}\right]$$

$$= L^{-1}\left[\begin{Bmatrix} \frac{1}{s} & \frac{1}{s(s+3)} \\ 0 & \frac{1}{s+3} \end{Bmatrix}\begin{Bmatrix} -1 + \frac{1}{s} \\ 3 \end{Bmatrix}\right]$$

$$= L^{-1}\begin{bmatrix} \frac{1}{s^2} - \frac{1}{s} + \frac{3}{s(s+3)} \\ \frac{3}{s+3} \end{bmatrix}$$

$$x(t) = \begin{bmatrix} t - e^{-3t} \\ 3e^{-3t} \end{bmatrix}$$

83. (A) ( ) S = 1000 KVA, 6.6 KV, λ, 3-phase

X_S = 20Ω

p.f = 1

$S = \sqrt{3}V_L I_L \cos\phi, 1000 \times 10^3 = \sqrt{3} \times 6600 \times I_L \times 1$

$I_L = 87.47(L - L)$

$E_{ph} = V_{ph} + jI_{ph} \times s = 3810.62 + j1749.4$

$E_{ph} = 4192.99V$

$E_{induced} = 7.262KV\ L - L$

(B) ( ) KW = KVA cosϕ

P = 1000 KW

$10000 = \dfrac{7.2 \times 10^3 \times 6.6 \times 10^3}{20} \sin\delta$

$\delta = 24,88$

84. (A) ( ) When a 3-ϕ, fault occurs, the fault current is limited by the positive sequence reactance only

∴ 4000 × 10^6 = 220 × 10^3 × I

$I = \dfrac{220 \times 10^3}{X}$

X positive = 12.1Ω

(B) ( )

85. (A) ( ) Im = $\dfrac{\partial ids}{\partial Vgs} = 1ms$

(B) ( ) Av = -gm rds

small signal equivalent circuit is