MADE EASY

Leading Institute for ESE, GATE & PSUs

DETAILED SOLUTIONS

Test Centres: Delhi, Hyderabad, Bhopal, Jaipur, Pune

ESE 2026 : Prelims Exam

CLASSROOM TEST SERIES

ELECTRICAL ENGINEERING

Test 12

Section A : BEE + Analog Electronics + Electrical and Electronic Measurements [All Topics]

Section B : Power Electronics and Drives-1 [Part Syllabus]

Section C : Power Systems-2 [Part Syllabus]

ANSWER KEY

1.	(b)	**16.**	(c)	**31.**	(b)	**46.**	(d)	**61.**	(b)
2.	(d)	**17.**	(c)	**32.**	(c)	**47.**	(c)	**62.**	(b)
3.	(b)	**18.**	(c)	**33.**	(c)	**48.**	(d)	**63.**	(a)
4.	(c)	**19.**	(b)	**34.**	(b)	**49.**	(b)	**64.**	(a)
5.	(d)	**20.**	(b)	**35.**	(d)	**50.**	(c)	**65.**	(c)
6.	(b)	**21.**	(b)	**36.**	(d)	**51.**	(d)	**66.**	(b)
7.	(c)	**22.**	(b)	**37.**	(b)	**52.**	(a)	**67.**	(c)
8.	(c)	**23.**	(b)	**38.**	(c)	**53.**	(d)	**68.**	(b)
9.	(b)	**24.**	(d)	**39.**	(b)	**54.**	(a)	**69.**	(a)
10.	(c)	**25.**	(a)	**40.**	(a)	**55.**	(c)	**70.**	(c)
11.	(b)	**26.**	(c)	**41.**	(b)	**56.**	(b)	**71.**	(d)
12.	(c)	**27.**	(d)	**42.**	(b)	**57.**	(c)	**72.**	(d)
13.	(c)	**28.**	(d)	**43.**	(c)	**58.**	(c)	**73.**	(c)
14.	(c)	**29.**	(b)	**44.**	(a)	**59.**	(a)	**74.**	(b)
15.	(c)	**30.**	(c)	**45.**	(c)	**60.**	(c)	**75.**	(a)

DETAILED EXPLANATIONS

Section A : BEE + Analog Electronics + Electrical and Electronic Measurements

1. (b)

$$C_D = \frac{\tau I_D}{\eta V_T} = \frac{\tau}{r_d} = \tau \cdot g_d$$

$$g_d = \frac{2\times10^{-7}}{5\times10^{-6}} = 40\text{ m℧}$$

2. (d)

Given, $I_{DSS} = 10$ mA,

$V_P = -4$ V

$$I_D = I_{DSS}\left(1-\frac{V_{GS}}{V_P}\right)^2$$

By KVL in input loop,

$$-2.5 - V_{GS} = 0$$

$\Rightarrow$ $V_{GS} = -2.5$ V

$$I_D = I_{DSS}\left(1-\frac{V_{GS}}{V_P}\right)^2$$

$$I_D = 10\times10^{-3}\left(1-\frac{2.5}{4}\right)^2 \approx 1.4\text{ mA}$$

By KVL in the outer loop,

$$15 - I_D \times 2K - V_{DS} = 0$$

$$V_{DS} = 15 - I_D \times 2K$$

$$= 15 - 2.8$$

$$= 12.2\text{ V}$$

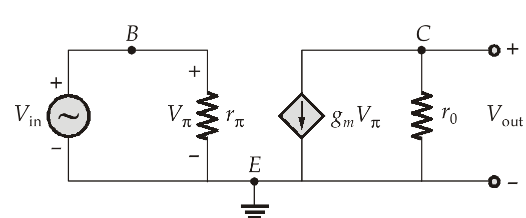
3. (b)

Since the current source is ideal,

The collector resistance,

$$R_C \rightarrow \infty$$

Small signal model,



$$V_\pi = V_{in}$$

$$\frac{V_{out}}{V_{in}} = -g_m r_0$$

$$g_m = \frac{I_C}{V_T}$$

$$r_0 = \frac{V_A}{I_C}$$

$$\frac{V_{out}}{V_{in}} = -\frac{V_A}{V_T} = \frac{-10000}{25} = -400$$

4. (c)

For the given circuit,

For I_{in} positive,

$$D_1 = \text{ON}$$

and $$D_2 = \text{OFF}$$

$$V_0 = R_1 I_{in}$$

$$V_0 \propto I_{in}$$

For I_{in} negative,

$$D_1 = \text{OFF}$$

and $$D_2 = \text{ON}$$

$$V_0 = V_{D2} = 0 \text{ V} \quad \text{(Since diode is ideal)}$$

5. (d)

Common base current gain

$$\alpha = \frac{\Delta I_C}{\Delta I_E} = \frac{0.995}{10^{-3}} \times 10^{-3} = 0.995$$

Common collector current gain

$$\gamma = 1 + \beta = 1 + \frac{\alpha}{1-\alpha} = \frac{1}{1-\alpha} = \frac{1}{1-0.995}$$

$$\gamma = \frac{1}{0.005} = \frac{1000}{5} = 200$$

6. (b)

At high frequencies, amplifier performance degrades due to parasitic capacitances (like Miller capacitance, Junction capacitance etc) that causes bandwidth reduction. So, cascode amplifier reduces Miller effect, improves bandwidth and high frequency response.

7. (c)

For saturation mode of operation,

$$V_{DS} \geq V_{GS} - V_T$$

$$V_D - V_S \geq V_{GS} - V_T$$

$$V_D \geq V_{GS} - V_T + V_S$$
$$(V_D)_{min} = (V_{GS} - V_T + V_S)$$
$$= (4 - 2 + 1) = 3 \text{ V}$$

8. (c)

W_B ↑, (recombination in base region) ↑, (current gain) ↓,

⇒ Statement-1 is true.

W_B ↑, (Base transit time) ↑, (unity gain frequency) ↓,

⇒ Statement-2 is false.

W_B ↑, (Early voltage) ↑,

⇒ Statement-3 is true.

9. (b)

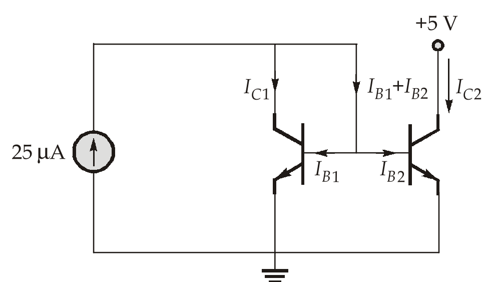
Bypass capacitor increase the AC voltage gain of the RC-coupled amplifier.

10. (c)

Bistable multivibrator is known as flip-flop.

Astable multivibrator can be synchronized or used as frequency divider by applying either positive or negative pulses to either transistor or both the transistor simultaneously.

11. (b)



Both transistors are in the forward active region.

So, $25\ \mu A = I_{C1} + I_{B1} + I_{B2}$

Since the transistor are identical and have the same V_{BE}

$$I_{C2} = I_{C1}, I_{B1} = I_{B2}$$

So, $25\ \mu A = I_{C1} + 2I_{B1} = (2 + \beta)I_{B1}$

$$I_{C2} = \beta I_{B2} = \beta I_{B1}$$
$$= \left(\frac{\beta}{\beta+2}\right) \times 25\ \mu A = \frac{25 \times 25}{27}\ \mu A = 23.15\ \mu A$$

12. (c)

$$V_{GS} = 0$$

∴ $I_D = I_{DSS} = 10 \text{ mA}$

$$V_{DS} = 20 \text{ V} - (10 \text{ mA})(1.7 \text{ k}\Omega) = 3 \text{ V}$$

13. (c)

The frequency of RC phase shift oscillator using an op-amp is given by,

$$f_c = \frac{1}{2\pi RC\sqrt{6}}$$

14. (c)

The given circuit is a log amplifier. So, thus the output will be

$$V_{out} = -V_{BE}$$

$$I_C = I_0\, e^{\frac{V_{BE}}{V_T}}$$

So, $$V_{out} = -V_{BE} = -V_T \ln\left(\frac{I_C}{I_0}\right) \text{ and } I_C = \frac{V_{in}}{R_1}$$

So, $$V_{out} = -V_T \ln\left(\frac{V_{in}}{I_0 R_1}\right)$$

15. (c)

When op-amp is ideal,

$$V_0\left(\frac{10}{10+20}\right) = 6.3 \text{ V}$$

So, $$V_0 = \left(\frac{10+20}{10}\right)6.3 \text{ V} = 3\times 6.3 \text{ V} = 18.9 \text{ V}$$

16. (c)

When electrons enter the emitter (as in an NPN transistor) they travel from emitter → base → collector. After reaching the collector region, these electrons leave the collector terminated.

17. (c)

Various properties of a CC amplifier:

- High current gain.
- Voltage gain of approximately unity.
- Power gain approximately equal to current gain.
- No current or voltage phase shift.
- Large input impedance
- Small output impedance.

18. (c)

$$V_{id} = V_1 - V_2 = 500 - 440 = 60\ \mu\text{V}$$

$$V_{cm} = \frac{500+440}{2} = 470\ \mu\text{V}$$

$$\text{CMRR} = \frac{A_{id}}{A_{cm}}$$

$$A_{cm} = \frac{A_{id}}{\text{CMRR}} = \frac{5000}{100} = 50$$

$$V_{out} = [5000 \times 60 + 50 \times 470] \times 10^{-6}$$

$$= 0.3235 \text{ V}$$

19. (b)

$$\frac{V_{in}}{R} = K_n(V_{GS} - V_T)^2$$

$$V_{GS} = -V_{out}$$

$$V_{out} = -\sqrt{\frac{V_{in}}{RK_n}} - V_{Th} = -A\sqrt{V_{in}} - V_{Th} \text{ (A is constant)}$$

20. (b)

At $t = 0$, $V_{in} = 0$, $V_{out} = 0$

At $t > 0$, $I_{in} = \frac{C_1 dV_{in}}{dt} = C_1 V_1 \delta(t)$

The current flows through R_1 , generating an output given by

$$V_{out} = -I_{in}R_1$$

$$= -V_1R_1C_1\delta(t)$$

$$= -5 \times 10^{-6} \times 10^3 \delta(t)$$

$$V_{out} = -5 \times 10^{-3} \delta(t) \text{ at } t = 0^+$$

$$V_{out} = 5 \times 10^{-3} \delta(t - T_b) \text{ at } t = T_b$$

21. (b)

For the given circuit,

For $f = 0$, $v_o(t) = 0$

For $f = \infty$, $v_o(t) = v_i(t)$

So, the given circuit acts as a high pass filter.

22. (b)

Null type instruments are highly sensitive, more accurate and have a slower intrinsic response. Therefore they are less suited for measurement under dynamic conditions.

23. (b)

1-ϕ electrodynamometer type power factor meter is more accurate than moving iron type power factor meter.

24. (d)

The gauge factor equation is given by,

$$G_f = 1 + 2v + \frac{\Delta\rho / \rho}{\Delta L / L}$$

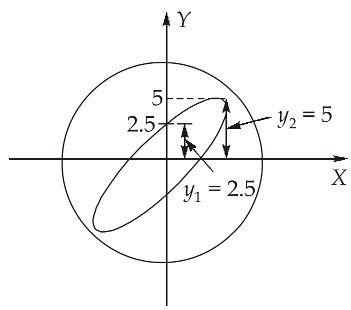
Where, $\frac{\Delta L}{L}$ is per unit change in length, and $\frac{\Delta \rho}{\rho}$ is per unit change in resistivity

If piezoresistive effect is neglected

i.e. $\frac{\Delta \rho}{\rho} = 0$

Gauge factor, $G_f = 1 + 2v$

25. (a)



As spot generating the pattern moves in clockwise direction

So, $\sin \phi = \frac{y_1}{y_2}$ (Where ϕ = phase differentiate)

$$\sin \phi = \frac{2.5}{5} = 0.5$$

$$\phi = 30°$$

26. (c)

Under balance condition,

$$Z_1 Z_4 = Z_2 Z_3$$

$$(200\angle 70°) \times (200\angle 10°) = (400\angle 60°) \times (100\angle \theta)$$

$$40000\angle(70° + 10°) = 40000\angle(60° + \theta)$$

$$\Rightarrow \quad 40000\angle 80° = 40000\angle(60° + \theta)$$

Comparing the angle value of phasor on both sides,

$$60° + \theta = 80°$$

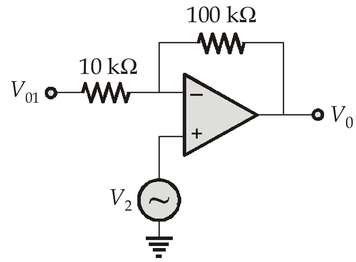
$$\theta = 20°$$

27. (d)

$$V_{01} = \left(1 + \frac{R_f}{R_1}\right) V_1$$

$$= \left(1 + \frac{10k}{100k}\right) V_1$$

$$V_{01} = 1.1\ V_1$$



There are two inputs V_{01} and V_2, so by applying superposition theorem.

$$V'_{02} = \frac{-R_f}{R_1} \times V_{01} \qquad \text{(by grounding } V_2\text{)}$$

$$= \frac{-100k}{10k} \times 1.1V_1 = -11\ V_1$$

While V_{01} grounded and V_2 active,

$$V''_{02} = \left(1 + \frac{R_f}{R_1}\right)V_2$$

$$= \left(1 + \frac{100k}{10k}\right)V_2 = 11\ V_2$$

Output of the circuit is,

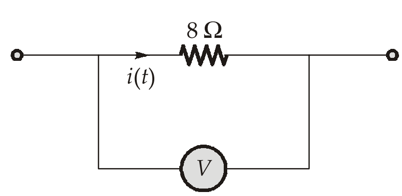
$$V_0 = V'_{02} + V''_{02}$$

$$= 11\ (V_2 - V_1)$$

28. (d)

High value of $\left(\frac{d\phi}{d\omega}\right)$ indicates high frequency stability.

29. (b)



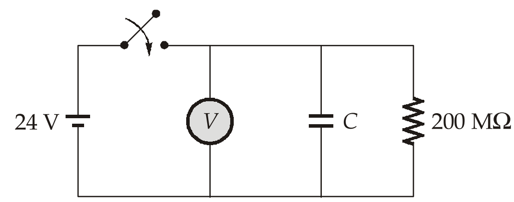
Moving iron voltmeter reads RMS value,

$$I_{rms} = \sqrt{\frac{1}{2T}\left[(3^2)T + (0)^2 T\right]} = \sqrt{\frac{9}{2}} = 2.121\text{ A}$$

Voltage read by voltmeter $= I_{rms} \times R$

$= 2.12 \times 8 = 16.97$ V

30. (c)



The discharge of capacitor can be expressed by relation

$$V_c(t) = Ve^{-t/\tau}$$

Where, $\tau = RC$

Taking natural log both sides, we can write,

$$C = \frac{t}{R\ln\left(\frac{V}{V_c}\right)} = \frac{4\times60}{200\times10^6\times\ln\left(\frac{24}{12}\right)} = 1.731\times10^{-6}\text{ F} = 1.731\ \mu\text{F}$$

31. (b)

$$\frac{f_y}{f_x} = \frac{\text{Horizontal tangencies}}{\text{Vertical tangencies}}$$

$$\frac{f_y}{6} = \frac{4}{2}$$

$$f_y = 12\text{ kHz}$$

33. (c)

$$\Delta R_1 = 10\text{ k}\Omega\times\frac{2}{100} = 0.2\text{ k}\Omega$$

$$\Delta R_2 = 5\text{ k}\Omega\times\frac{5}{100} = 0.25\text{ k}\Omega$$

Total resistance in series,

$$R = 10\text{ k}\Omega + 5\text{ k}\Omega + 0.2\text{ k}\Omega + 2.5\text{ k}\Omega = 15.45\text{ k}\Omega$$

Original resistance, $R' = 10 + 5 = 15\text{ k}\Omega$

$$\%\text{error} = \frac{15.45-15}{15}\times100 = \frac{0.45}{15}\times100 = 3\%$$

34. (b)

Substitution method is used for measurement of medium resistance.

35. (d)

Distribution capacitance,

$$C_d = \frac{C_1 - n^2C_2}{n^2-1}$$

$$n = \frac{f_2}{f_1} = \frac{2f}{f} = 2$$

$$C_1 = 220 \text{ pF and } C_2 = 10 \text{ pF}$$

$$C_d = \frac{220 - 40}{3} = 60 \text{ pF}$$

37. (b)

No. of revolution in 300 sec = 120

$$\text{No. of revolution in 1 hour} = \frac{120}{300} \times 3600 = 1440$$

$$\text{Power consumed} = \frac{1440}{1200} = 1.2 \text{ kW}$$

Energy consumed in 3 hours = 1.2 × 3 = 3.6 kWh

38. (c)

Magnetizing component of exciting current,

$$I_m = \frac{250}{1} = 250 \text{ A}$$

Turns ratio, $$K_t = \frac{500}{5} = 100$$

Primary current, $$I_P = \sqrt{(K_t I_s)^2 + I_m^2} = \sqrt{(500)^2 + (250)^2} = 559 \text{ A}$$

Actual transformation ratio,

$$K_{\text{act}} = \frac{I_P}{I_S} = \frac{559}{5} = 111.8$$

$$\text{Ratio errors} = \frac{K_{\text{nominal}} - K_{\text{actual}}}{K_{\text{actual}}} \times 100$$

$$= \frac{100 - 111.8}{111.8} \times 100 = -10.56\%$$

39. (b)

Looking back into terminals x and y and using Thevanin's equivalent resistance,

$$R_t = R_1 + \frac{R_2 \times R_3}{R_2 + R_3} = 1k + \frac{1k \times 1k}{1k + 1k} = 1.5 \text{ k}\Omega$$

$$\frac{I_m}{I} = \frac{R_t}{R_t + R_m}$$

$$\therefore \quad \frac{I_m}{I} = \frac{1.5 \text{ k}\Omega}{1.5 \text{ k}\Omega + 100\,\Omega} = \frac{1.5k}{1.6k} = 0.9375$$

$$\text{Error due to loading} = \left(1 - \frac{I_m}{I}\right) \times 100$$

$$= (1 - 0.9375) \times 100 = 6.25\%$$

40. (a)

$$R_2 = \frac{0.9 \text{ in}}{3.0 \text{ in}} \times 5k = \frac{9}{30} \times 5k = 1500\ \Omega$$

$$\therefore \quad \frac{V_0}{V_t} = \frac{R_2}{R_1 + R_2};$$

$$V_0 = \left(\frac{R_2}{R_1 + R_2}\right) \times V_t$$

$$= \frac{1500}{5k} \times 5V = \frac{1500}{1k} = 1.5\text{ V}$$

41. (b)

It is the disadvantage of Anderson's bridge that it is more complex than its prototype Maxwell's bridge.

43. (c)

The base width of a BJT is chosen to be small so that the recombination of injected minority carriers is reduced.

44. (a)

Low torque/weight ratio results in low sensitivity and increased frictional losses.

45. (c)

Slew rate is the maximum rate of change of the output voltage of the operational amplifier when a large amplitude step is applied to its input.

Section B : Power Electronics and Drives-1

47. (c)

$$\text{Derating factor} = 1 - \text{string efficiency}$$

$$\text{String efficiency} = \frac{\text{Actual voltage rating of whole string}}{\text{(Individual voltage rating of one SCR)} \times \text{(No. of SCR)}}$$

$$\eta = \frac{(10 \times 10^3)}{(500) \times (n_s)}$$

$$\text{DRF} = 0.15 = 1 - \frac{10 \times 10^3}{(500) \times (n_s)}$$

Number of SCR's required in series,

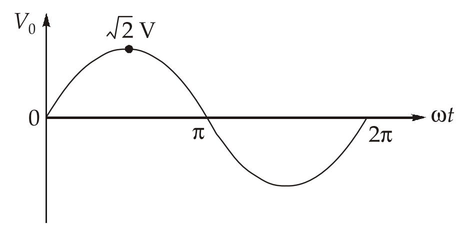
$$n_s = \frac{10 \times 10^3}{(500) \times (0.85)} \cong 23.53 = 24$$

48. (d)

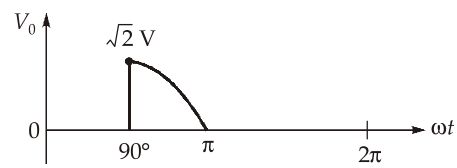
Its switching speed is lower than MOSFET.

49. (b)

The output voltage waveform in absence of SCR is



The output voltage waveform in presence of SCR with α = 90° is



∴ The power consumed by R will be reduced by a factor of $\frac{1}{4}$.

50. (c)

- In 1-ϕ and 3-ϕ semi-converters output voltage cannot be reversed.
- 1-ϕ full bridge VSI gives alternating current, but the purpose of machine is dc.

51. (d)

The Source inductance causes overlapping of conduction of thyristor in every half cycle

Over lapping angle, $\mu = 10°$

Firing angle, $\alpha = 55°$

Displacement power factor,

$$\text{DPF} = \cos\left(\alpha + \frac{\mu}{2}\right) = \cos\left(55 + \frac{10}{2}\right)$$

$$= \cos(60°) = 0.5$$

52. (a)

Rms value of freewheeling diode current

$$= 20\sqrt{\frac{3(60-30)}{360}} = 20\sqrt{\frac{90}{360}} = 10\,\text{A}$$

53. (d)

In centre tap full wave 1-ϕ rectifier circuit,

PIV of each diode = $2V_m$

$\therefore$ $$\text{PIV} = 2 \times 100 = 200 \text{ V}$$

$$\text{PIV in rms} = \frac{200}{\sqrt{2}} = 141.42 \text{ V}$$

54. (a)

We know that,

$$V = L\frac{di}{dt}$$

$$t = \frac{L}{V}i = \frac{0.1}{100} \times 40 \times 10^{-3} = 40 \text{ µsec}$$

55. (c)

Thermal resistance, $$\theta_i = \frac{T_j - T_A}{P_{av}} = \frac{50}{50} = 1° \text{ C/W}$$

If junction temperature reduced to 80° C then

$$T_j - T_A = 80° - 50° = 30°$$

$$\frac{\theta_{\text{old}}}{\theta_{\text{new}}} = \frac{(T_j - T_A)_{\text{old}}}{(T_j - T_A)_{\text{new}}}$$

$$\theta_{\text{new}} = 1 \times \frac{30}{50} = \frac{3}{5}$$

The percentage of new thermal resistance

$$= \frac{3}{5} \times 100 = 60\%$$

$\therefore$ The reduction is thermal resistance = 40%

56. (b)

Given, $$E_S = 20 \text{ V},$$

$$\frac{V_g}{I_g} = 140$$

and $$V_g I_g = 0.5$$

$$(140 \times I_g)I_g = 0.5$$

$$I_g = 0.06 \text{ A}$$

$$V_g = 140 \times 0.06 = 8.4 \text{ V}$$

$$E = I_g R_s + V_g$$

$$20 = 0.06 \times R_s + 8.4$$

$$\frac{11.6}{0.06} = R_s$$

$$R_s = 193.33 \ \Omega$$

57. (c)

Given, ON state resistance = 0.1 Ω

MOSFET carries a current = 8 A

$$\text{Average power loss} = \frac{1}{2\pi}\int_0^{\pi} I^2 R = \frac{1}{2\pi}\int_0^{\pi} 0.1\times 64$$

$$= \frac{64(0.1)\pi}{2\pi} = 3.2 \text{ W}$$

58. (c)

Output has three pulse in one cycle of input.

∴ Output frequency = 3 × 400 = 1200 Hz

60. (c)

Freewheeling improves the active power fed to the load. So, power factor is improved.

Section C : Power Systems-2

61. (b)

$$Y_{11(\text{new})} = Y_{11(\text{old})} + Y_{13(\text{link})} = -j30$$

$$Y_{13(\text{new})} = -(Y_{13\text{ old}}) + (Y_{13\text{ link}})$$

$$= -[+j10 - j10] = 0$$

62. (b)

$$Z_{g0} = Z_0 + 3Z_n = 0.15 + 3(0.05) = 0.3$$

$$I_f = \frac{3Eg_0}{Z_1 + Z_2 + Z_{g0}} = \frac{3\times 1}{0.2+0.25+0.3}$$

$$= \frac{3}{0.75} = 4$$

$$V_n = I_f \times Z_n = 4 \times 0.05 = 0.2$$

63. (a)

$$Y_{\text{bus}} = 100 \times 100$$

Zero admittance = 0.95 × 10000 = 9500

Non-zero admittance = 0.05 × 10000 = 500

The number of off diagonal non-zero admittances

= 500 – 100 = 400

The number of transmission lines

$$= \frac{400}{2} = 200$$

64. (a)

$$I_{R0} = I_{Y0} = I_{B0} = \frac{1}{3}(I_R + I_Y + I_B)$$

$$= \frac{1}{3}(3 + j5 + 2 + j2 - 2 - j1)$$

$$= (1 + j2)\text{A}$$

65. (c)

Inertia constant, $$H \propto \frac{1}{\text{MVA rating}}$$

$$H_{1\text{ new}} = H_{1\text{old}} \times \frac{S_{1\text{old}}}{S_{\text{new}}} = 0.8 \times \frac{500}{200} = 2 \text{ p.u.}$$

$$H_{2\text{ new}} = H_{2\text{old}} \times \frac{S_{2\text{old}}}{S_{\text{new}}} = 0.5 \times \frac{1000}{200} = 2.5 \text{ p.u.}$$

$$H_{\text{eq}} = H_{1\text{ new}} + H_{2\text{ new}} = 2 + 2.5 = 4.5 \text{ p.u.}$$

66. (b)

For 3-phase fault,

$$I_{f,3\phi} = \frac{E_a}{X_1} = \frac{1}{X_1}\text{p.u.}$$

For fault on terminal to ground

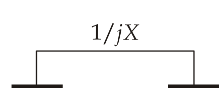
$$I_{f,LG} = \frac{3E_1}{X_1 + X_2 + X_0} = \frac{3}{X_1 + X_2 + X_0}\text{p.u.}$$

$$\frac{\text{L-G fault}}{\text{3-phase fault}} = \frac{I_{f,LG}}{I_{f,3\phi}}$$

$$= \frac{3X_1}{X_1 + X_2 + X_0} = \frac{3 \times 0.3}{0.3 + 0.3 + 0.1} = 1.285 \text{ p.u.}$$

67. (c)

Transformer equivalent reactance can be represented as 2-bus admittance network diagram as shown below,



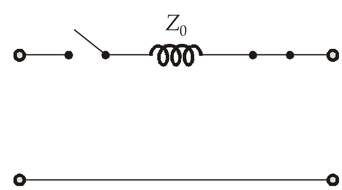
$$Y_{\text{bus}} = \begin{bmatrix} \frac{1}{jX} & \frac{-1}{jX} \\ \frac{-1}{jX} & \frac{1}{jX} \end{bmatrix}$$

68. **(b)**

In a double line to ground fault Z_1 , Z_2 and Z_0 all come into the picture.

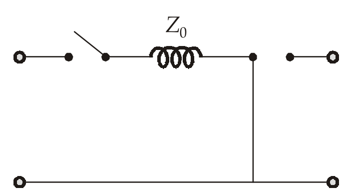
70. **(c)**

In statement 1:



The current cannot flow in this case, so the statement is wrong.

In statement 3:



Current cannot flow in this network, so the statement is wrong.

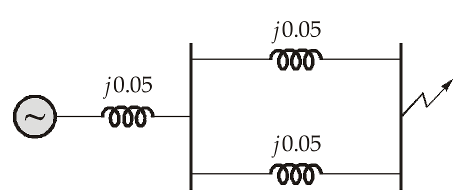
71. **(d)**

Let, base MVA = 100 MVA

$$Z_{\text{p.u. grid}} = \frac{1}{\text{MVA}_{\text{sc(p.u.)}}} = \frac{\text{MVA}_{\text{base}}}{\text{MVA}_{\text{s.c. actual}}}$$

$$Z_{\text{p.u. grid}} = \frac{100}{2000} = 0.05\,\text{p.u.}$$

The circuit reactance diagram:



$$\text{Total } Z_{\text{p.u.}} = 0.05 + (0.05 \,||\, 0.05) = 0.075 \text{ p.u.}$$

$$MVA_{\text{s.c.}} \text{ at 33 kV bus bar} = \frac{100}{0.075} = 1333.33 \text{ MVA}$$

A circuit breaker rating of 1333 MVA is required.

72. (d)

Step 1: Adding bus 1 to reference bus

$$Z_{bus} = [1]$$

Step 2: Adding new bus 3 to reference bus we get,

$$Z_{bus\ (new)} = \begin{array}{c} \\ 1 \\ 3 \end{array}\!\!\begin{array}{c} \begin{array}{cc} 1 & 3 \end{array} \\ \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} \end{array}$$

Step 3: Adding bus 2 new to bus 3 old

$$Z_{bus\ (new)} = \begin{array}{c} \\ 1 \\ 3 \\ 2 \end{array}\!\!\begin{array}{c} \begin{array}{ccc} 1 & 3 & 2 \end{array} \\ \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 2 \\ 0 & 2 & 2+3 \end{bmatrix} \end{array}$$

On rearranging,

$$Z_{bus\ (new)} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \end{array}\!\!\begin{array}{c} \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \begin{bmatrix} 1 & 0 & 0 \\ 0 & 5 & 2 \\ 0 & 2 & 2 \end{bmatrix} \end{array}$$

73. (c)

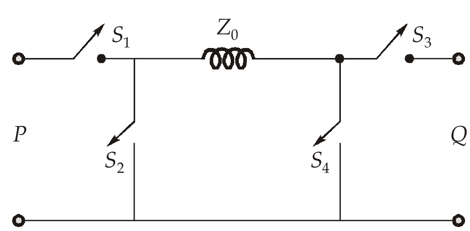
Statement 4 is not correct.

74. (b)

In Z_{BUS} matrix, the diagonal elements are short-circuit driving point impedance and the off diagonal elements are short-circuit transfer impedance.

75. (a)

According to switching diagram:



S_1 is open – Star with isolated neutral

S_4 is closed – Delta.

❍❍❍❍