GATE 2010 EE(40-52)

EE24BTECH11030 - J.KEDARANANDA

1) A separately excited DC machine is coupled to a 50 Hz, three-phase, 4-pole induction machine as shown in the figure. The DC machine is energized first and the machines rotate at 1600 rpm. Subsequently, the induction machine is also connected to a 50 Hz, three-phase source, the phase sequence being consistent with the direction of rotation. In steady state,

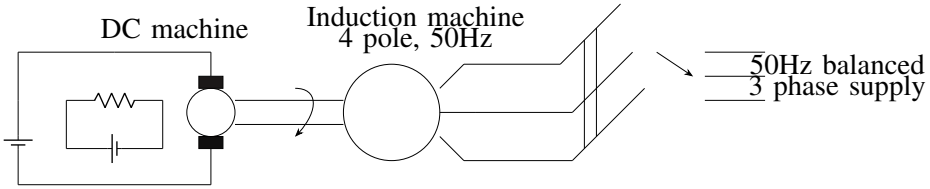
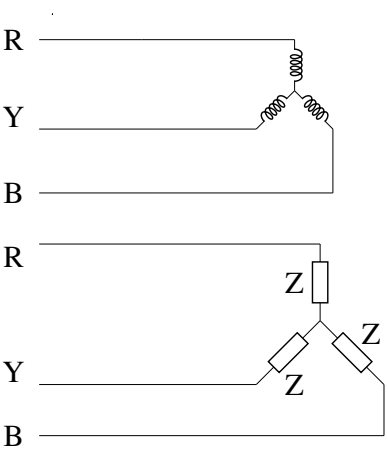
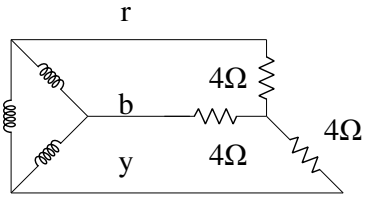


Fig. 1

a) both machines act as generators
b) the DC machine acts as a generator, and the induction machine acts as a motor
c) the DC machine acts as a motor, and the induction machine acts as a generator
d) both machines act as motors

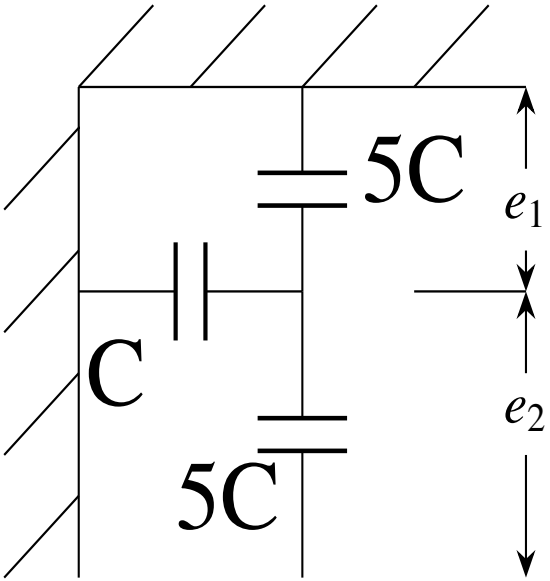
2) A balanced star-connected and purely resistive load is connected at the secondary of a star-delta transformer as shown in the figure. The line-to-line voltage rating of the transformer is 110 V / 220 V. Neglecting the non-idealities of the transformer, the impedance Z of the equivalent star-connected load, referred to the primary side of the transformer, is:





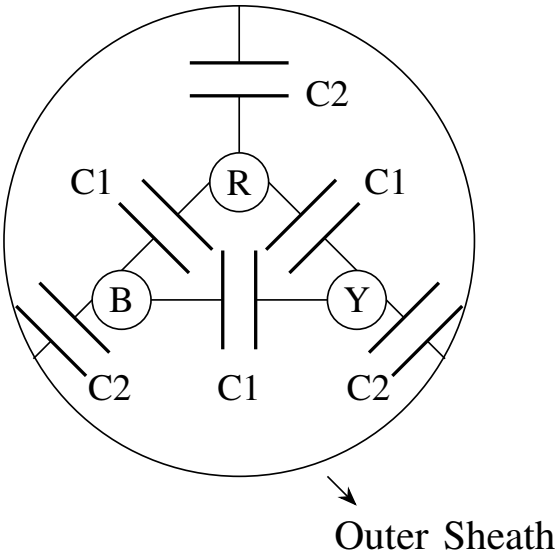
a) $3 + j0\ \Omega$
b) $0.866 - j0.5\ \Omega$
c) $0.866 + j0.5\ \Omega$
d) $1 + j0\ \Omega$

3) Consider a three-phase, 50 Hz, 11 kV distribution system. Each of the conductors is suspended by an insulator string having two identical porcelain insulators. The self-capacitance of the insulator is 5 times the shunt capacitance between the link and the ground, as shown in the figure. The voltage across the two insulators are:



a) e_1 = 3.74 kV, e_2 = 2.61 kV
b) e_1 = 3.46 kV, e_2 = 2.89 kV
c) e_1 = 6.0 kV, e_2 = 4.23 kV
d) e_1 = 5.5 kV, e_2 = 5.5 kV

4) Consider a three-core, three-phase, 50 Hz, 11 kV cable whose conductors are denoted as R, Y, and B in the figure. The inter-phase capacitance (C_1) between each pair of conductors is 0.2 μF and the capacitance between each line conductor and the sheath is 0.4 μF. The per-phase charging current is



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a) 2.0 A b) 2.4 A c) 2.7 A d) 3.5 A

5) For the power system shown in the figure below5, the specifications of the components are as follows:

- G_1: 25 kV, 100 MVA, X = 9%
- G_2: 25 kV, 100 MVA, X = 9%
- T_1: 25 kV/220 kV, 90 MVA, X = 12%
- T_2: 220 kV/25 kV, 90 MVA, X = 12%
- Line 1: 220 kV, X = 150 ohms

Choose 25 kV as the base voltage at generator G_1, and 200 MVA as the MVA base. The impedance diagrams are shown below:

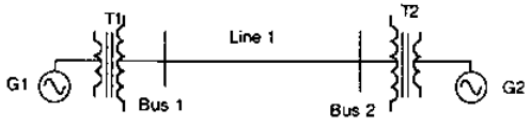
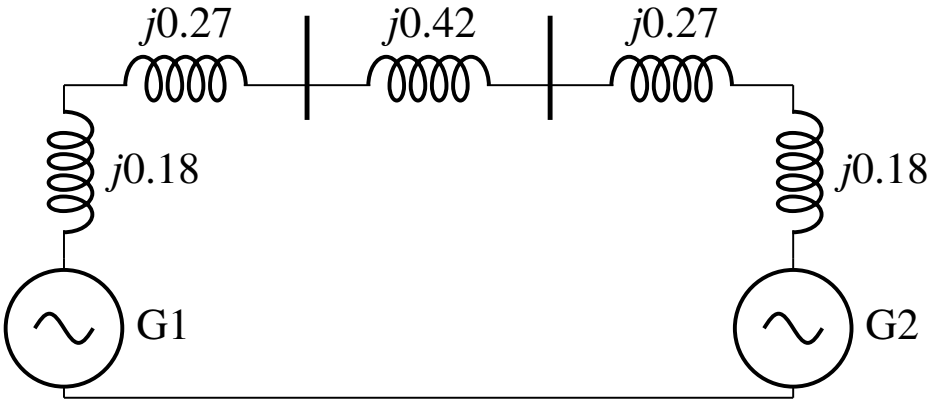
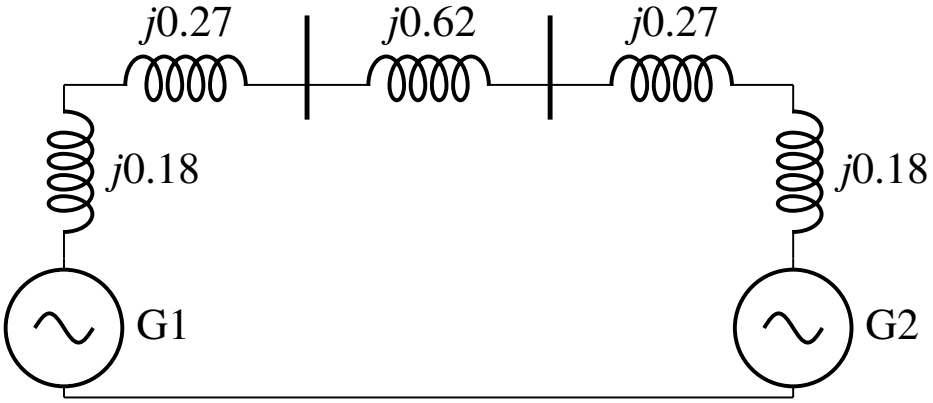

T1
Line 1
T2
G1
Bus 1
Bus 2
G2

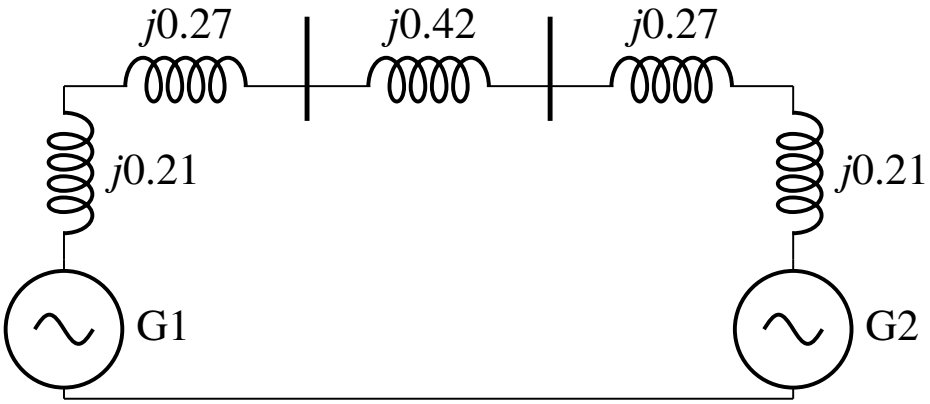
Fig. 5


j0.27
j0.42
j0.27
j0.18
j0.18
G1
G2

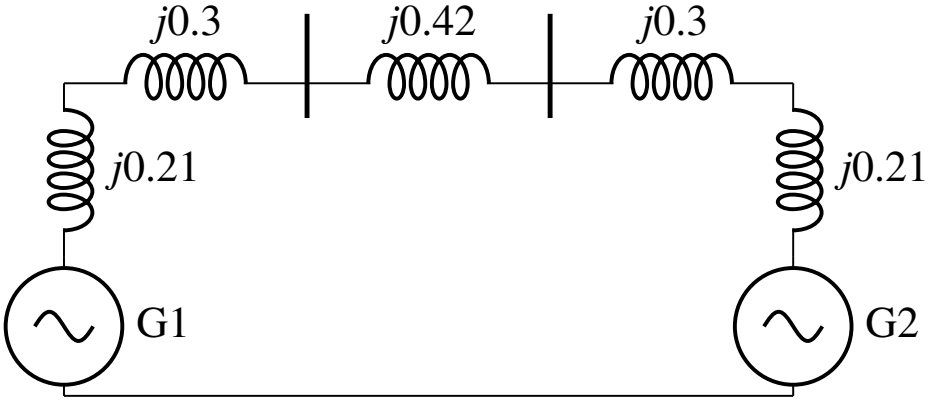
a)


j0.27
j0.62
j0.27
j0.18
j0.18
G1
G2

b)

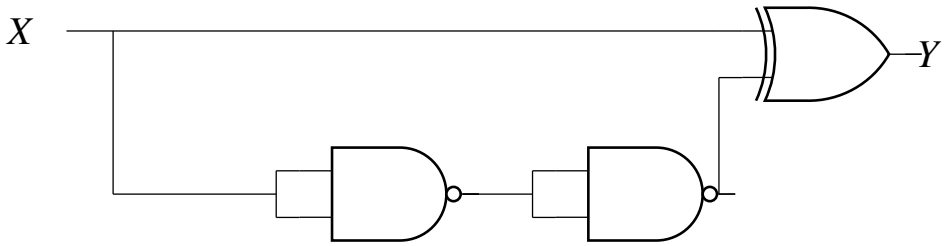


c)



d)

6) The TTL circuit shown in the figure 6is fed with the waveform X (also shown). All gates have equal propagation delay of 10 ns. The output Y of the circuit is



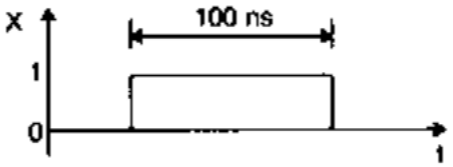
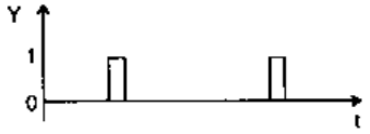
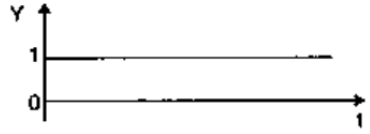


Fig. 6

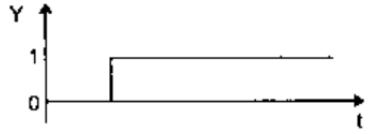
a)



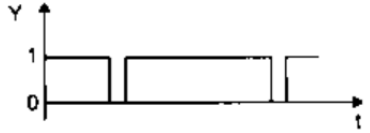
b)



c)



d)



7) When a CALL Addr instruction is executed, the CPU carries out the following sequential operations internally:

a) (SP) incremented
(PC) ← Addr
((SP)) ← (PC)

b) (PC) ← Addr
((SP)) ← (PC)
(SP) incremented

c) (PC) ← Addr
(SP) incremented
← (PC)

d) ((SP)) ← (PC)
(SP) incremented
(PC) ← Addr

COMMON DATA QUESTIONS
COMMON DATA FOR QUESTIONS 48 AND 49

A separately excited DC motor runs at 1500 rpm under no-load with 200 V applied to the armature. The field voltage is maintained at its rated value. The speed of the motor, when it delivers a torque of 5 Nm, is 1400 rpm as shown in the figure.7 The rotational losses and armature reaction are neglected.

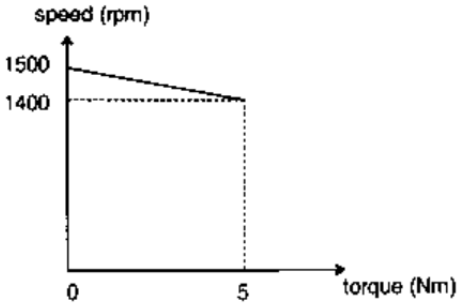


Fig. 7

8) The armature resistance of the motor is:

a) 2 Ω b) 3.4 Ω c) 4.4 Ω d) 7.7 Ω

9) For the motor to deliver a torque of 2.5 Nm at 1400 rpm, the armature voltage to be applied is:

a) 125.5 V b) 193.3 V c) 210 V d) 241.7 V

COMMON DATA FOR QUESTIONS 50 AND 51
Given $f(t)$ and $g(t)$ as shown below:9

Fig. 9

10) $g(t)$ can be expressed as

a) $g(t) = f(2t - 3)$
b) $g(t) = f\left(\frac{t}{2} - 3\right)$
c) $g(t) = f\left(2 - \frac{3}{2}\right)$
d) $g(t) = f\left(\frac{t}{2} - \frac{3}{2}\right)$

11) The Laplace transform of $g(t)$ is

a) $\frac{1}{s}\left(e^{a} - e^{b}\right)$
b) $\frac{1}{s}\left(e^{a} - e^{c}\right)$
c) $\frac{e^{b}}{s}\left(1 - e^{-a}\right)$
d) $\frac{1}{s}\left(e^{a} - e^{c}\right)$

Linked Answer Questions
Statement for Linked Answer Questions 52 and 53:

The following Karnaugh map 11 represents a function F.

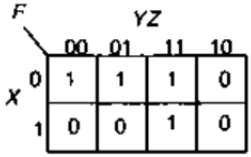


Fig. 11

12) A minimized form of the function F is

a) $F = \overline{X}Y + YZ$
b) $F = \overline{XY} + YZ$
c) $F = \overline{X}Y + \overline{Z}$
d) $F = \overline{XY} + \overline{Z}$