GATE 2007 EE(18-34)

EE24BTECH11030 - J.KEDARANANDA

1) A single phase full-wave half-controlled bridge converter feeds an inductive load. The two SCRs in the converter are connected to a common DC bus. The converter has to have a freewheeling diode:
   a) because the converter inherently does not provide for free-wheeling
   b) because the converter does not provide for free-wheeling for high values of triggering angles
   c) or else the free-wheeling action of the converter will cause shorting of the AC supply
   d) or else if a gate pulse to one of the SCRs is missed, it will subsequently cause a high load current in the other SCR

2) The electromagnetic torque T_e of a drive, and its connected load torque T_L are as shown below 2. Out of the operating points A, B, C, and D, the stable ones are

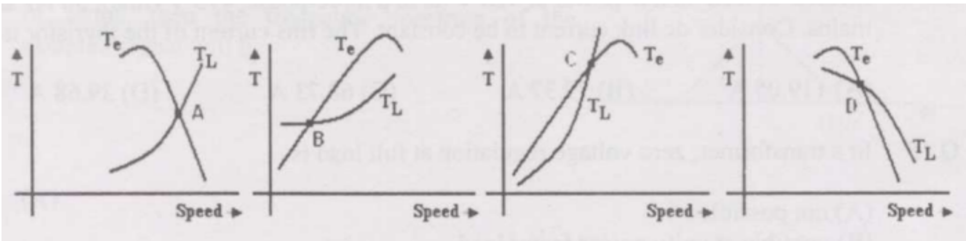

Fig. 2

a) A, C, D   b) B, C   c) A, D   d) B, C, D

3) "Six MOSFETs connected in a bridge configuration (having no other power device) MUST be operated as a Voltage Source Inverter (VSI)." This statement is
   a) True, because being majority carrier devices, MOSFETs are voltage driven
   b) True, because MOSFETs have inherently anti-parallel diodes
   c) False, because it can be operated both as Current Source Inverter (CSI) or a VSI
   d) False, because MOSFETs can be operated as excellent constant current sources in the saturation region

4) The input signal V_{in} shown in the figure 4 is a 1 kHz square wave voltage that alternates between $+7V$ and $-7V$ with a 50% duty cycle. Both transistors have the same current gain, which is large. The circuit delivers power to the load resistor R_L. What is the efficiency of this circuit for the given input? Choose the closest answer.

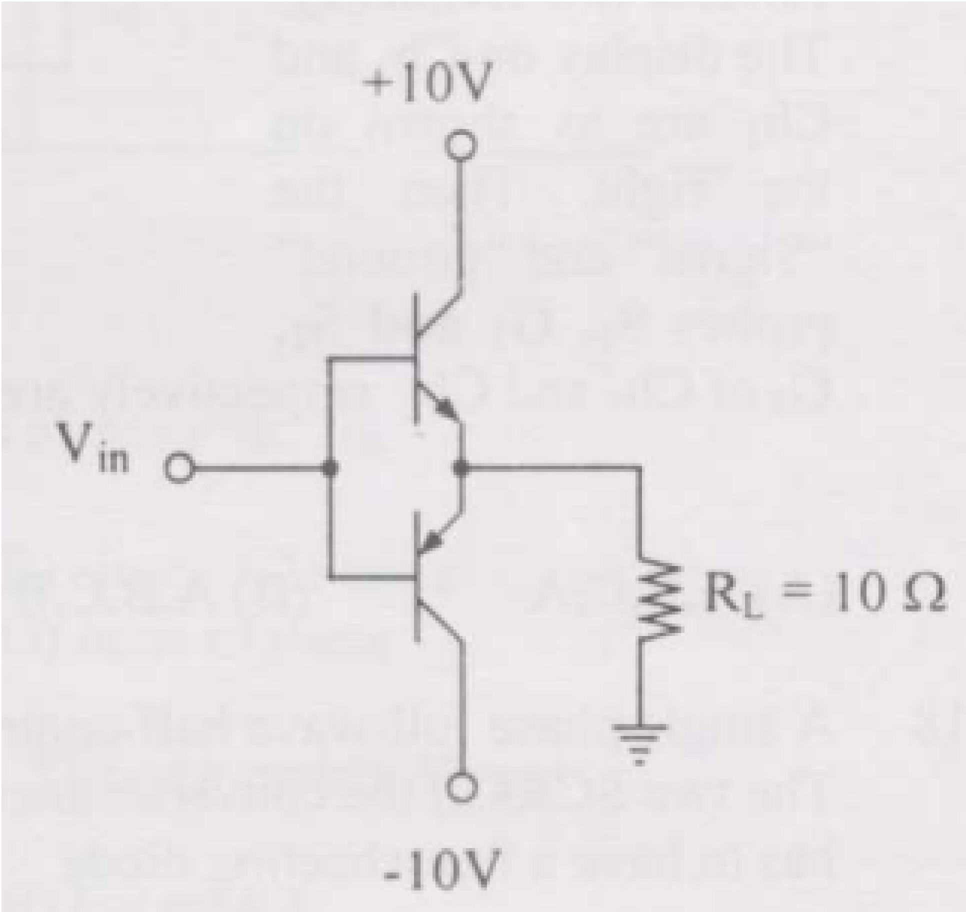

Fig. 4

a) 46% b) 55% c) 63% d) 92%

5) *A*, *B*, *C*, and *D* are input bits, and *Y* is the output bit in the XOR gate circuit of the figure below 5. Which of the following statements about the sum *S* of *A*, *B*, *C*, *D*, and *Y* is correct?

a) *S* is always either zero or odd
b) *S* is always either zero or even
c) *S* = 1 only if the sum of *A*, *B*, *C*, and *D* is even
d) *S* = 1 only if the sum of *A*, *B*, *C*, and *D* is odd

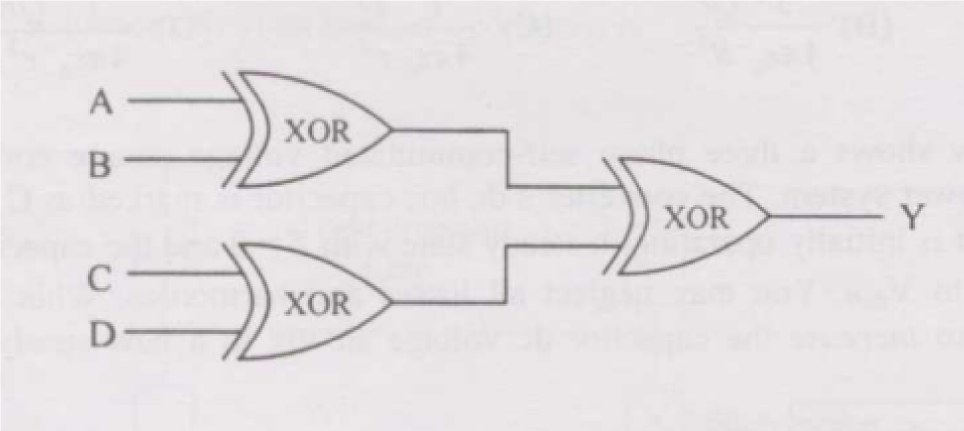

Fig. 5

6) The differential equation $\frac{dx}{dt} = \frac{1-x}{\tau}$ is discretised using Euler's numerical integration method with a time step $\Delta T > 0$. What is the maximum permissible value of ΔT to ensure stability of the solution of the corresponding discrete time equation?

a) 1 b) $\frac{\tau}{2}$ c) τ d) 2τ

7) The switch S in the circuit of the figure 7 is initially closed. It is opened at time $t = 0$. You may neglect the Zener diode forward voltage drops. What is the behaviour of V_{out} for $t > 0$?

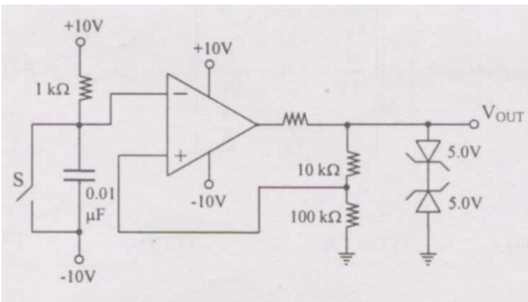

Fig. 7

a) It makes a transition from -5 V to +5 V at $t = 12.98\,\mu s$
b) It makes a transition from -5 V to +5 V at $t = 2.57\,\mu s$
c) It makes a transition from +5 V to -5 V at $t = 12.98\,\mu s$
d) It makes a transition from +5 V to -5 V at $t = 2.57\,\mu s$

8) A solid sphere made of insulating material has a radius R and has a total charge Q distributed uniformly in its volume. What is the magnitude of the electric field intensity, E, at a distance r $(0 < r < R)$ inside the sphere?

a) $\frac{1}{4\pi\epsilon_0}\frac{Qr}{R^3}$
b) $\frac{3}{4\pi\epsilon_0}\frac{Qr}{R^3}$
c) $\frac{1}{4\pi\epsilon_0}\frac{Q}{r^2}$
d) $\frac{1}{4\pi\epsilon_0}\frac{QR}{r^2}$

9) The figure below 9 shows a three-phase self-commutated voltage source converter connected to a power system. The converter's dc bus capacitor is marked as C in the figure. The circuit is initially operating in steady state with $\delta = 0$ and the capacitor dc voltage is equal to V_{dc0}. You may neglect all losses and harmonics. What action should be taken to *increase* the capacitor dc voltage slowly to a new steady state value?

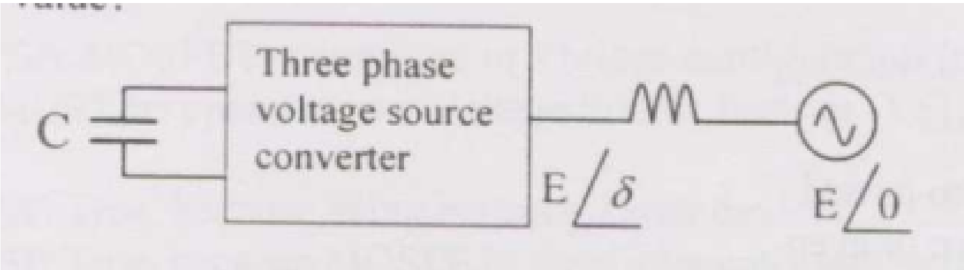

Fig. 9

a) Make δ positive and maintain it at a positive value
b) Make δ positive and return it to its original value
c) Make δ negative and maintain it at a negative value
d) Make δ negative and return it to its original value

10) The total reactance and total susceptance of a lossless overhead EHV line, operating at 50 Hz, are given by 0.045 pu and 1.2 pu respectively. If the velocity of wave propagation is 3×10^5 km/s, then the approximate length of the line is

a) 122 km
b) 172 km
c) 222 km
d) 272 km

11) Consider the protection system shown in the figure 11. The circuit breakers, numbered from 1 to 7, are of identical type. A single line to ground fault with zero fault impedance occurs at the midpoint of the line (at point F), but circuit breaker 4 fails to operate (”stuck breaker”). If the relays are coordinated correctly, a valid sequence of circuit breaker operations is

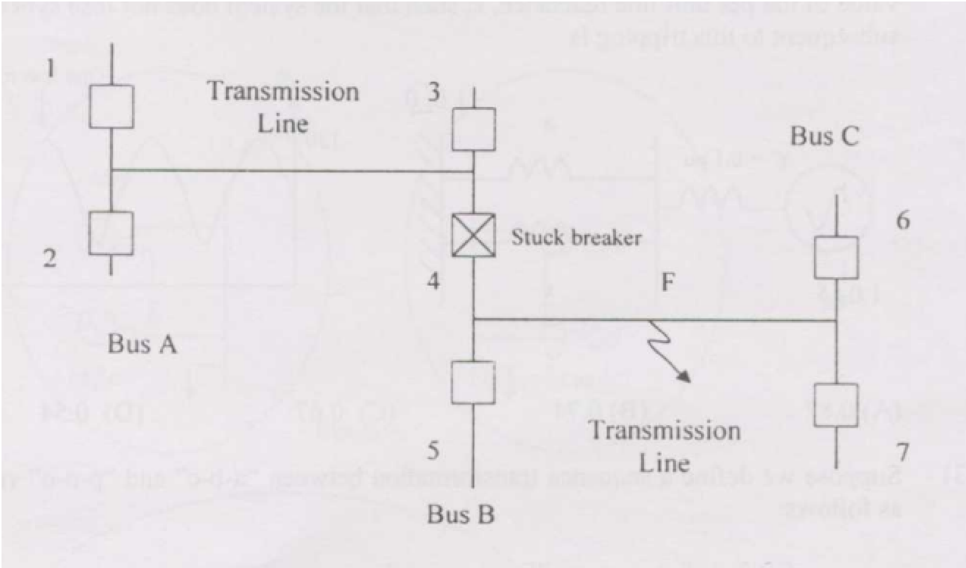

Fig. 11

a) 1, 2, 6, 7, 3, 5 b) 1, 2, 5, 6, 7, 3 c) 5, 6, 7, 3, 1, 2 d) 5, 1, 2, 3, 6, 7

12) A three-phase balanced star-connected voltage source with frequency ω rad/s is connected to a star-connected balanced load which is purely inductive. The instantaneous line currents and phase to neutral voltages are denoted by (i_a, i_b, i_c) and (v_{an}, v_{bn}, v_{cn}) respectively, and their rms values are denoted by V and I. If $R = \begin{bmatrix} 0 & \frac{1}{\sqrt{3}} & -\frac{1}{\sqrt{3}} \\ -\frac{1}{\sqrt{3}} & 0 & \frac{1}{\sqrt{3}} \\ \frac{1}{\sqrt{3}} & -\frac{1}{\sqrt{3}} & 0 \end{bmatrix} \begin{bmatrix} v_{an} \\ v_{bn} \\ v_{cn} \end{bmatrix}$, then the magnitude of R is

a) 3VI b) VI c) 0.7VI d) 0

13) Consider a synchronous generator connected to an infinite bus by two identical parallel transmission lines. The transient reactance x' of the generator is 0.1 pu and the mechanical power input to it is constant at 1.0 pu. Due to some previous disturbance, the rotor angle (δ) is undergoing an undamped oscillation, with the maximum value of $\delta(t)$ equal to 130°. One of the parallel lines trips due to relay maloperation at an instant when $\delta(t) = 130°$ as shown in the figure 13. The maximum value of the per unit line reactance, x, such that the system does not lose synchronism subsequent to this tripping is

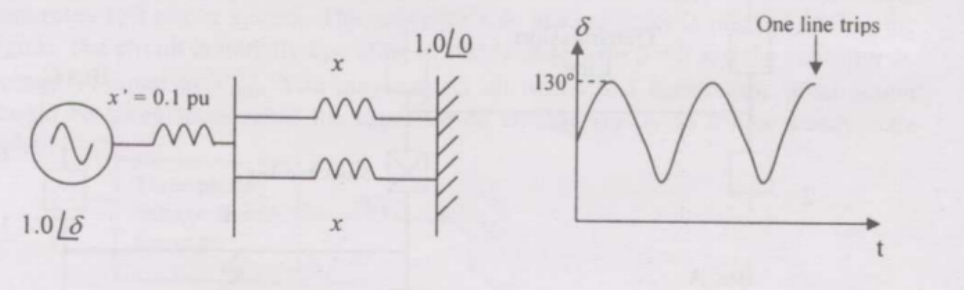

Fig. 13

a) 0.87 b) 0.74 c) 0.67 d) 0.54

14) Suppose we define a sequence transformation between "a-b-c" and "p-n-o" variables as follows:

$$\begin{bmatrix} f_a \\ f_b \\ f_c \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ k\alpha^2 & \alpha & 1 \\ \alpha & \alpha^2 & 1 \end{bmatrix} \begin{bmatrix} f_p \\ f_n \\ f_o \end{bmatrix}$$ where $\alpha = e^{j\frac{2\pi}{3}}$ and k is a constant.

Now, if it is given that: $\begin{bmatrix} V_p \\ V_n \\ V_o \end{bmatrix} = \begin{bmatrix} 0.5 & 0 & 0 \\ 0 & 0.5 & 0 \\ 0 & 0 & 2.0 \end{bmatrix} \begin{bmatrix} i_p \\ i_n \\ i_o \end{bmatrix}$ and $\begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = Z \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix}$ then,

a) $Z = \begin{bmatrix} 1.0 & 0.5 & 0.75 \\ 0.75 & 1.0 & 0.5 \\ 0.5 & 0.75 & 1.0 \end{bmatrix}$

c) $Z = 3k^2 \begin{bmatrix} 1.0 & 0.75 & 0.5 \\ 0.5 & 1.0 & 0.75 \\ 0.75 & 0.5 & 1.0 \end{bmatrix}$

b) $Z = \begin{bmatrix} 1.0 & 0.5 & 0.5 \\ 0.5 & 1.0 & 0.5 \\ 0.5 & 0.5 & 1.0 \end{bmatrix}$

d) $Z = \frac{k^2}{3} \begin{bmatrix} 1.0 & -0.5 & -0.5 \\ -0.5 & 1.0 & -0.5 \\ -0.5 & -0.5 & 1.0 \end{bmatrix}$

15) Consider the two power systems shown in figure 15, which are initially not interconnected, and are operating in steady state at the same frequency. Separate loadflow solutions are computed individually for the two systems, corresponding to this scenario. The bus voltage phasors so obtained are indicated on figure A. These two isolated systems are now interconnected by a short transmission line as shown in figure B, and it is found that $P_1 = P_2 = Q_1 = Q_2 = 0$.

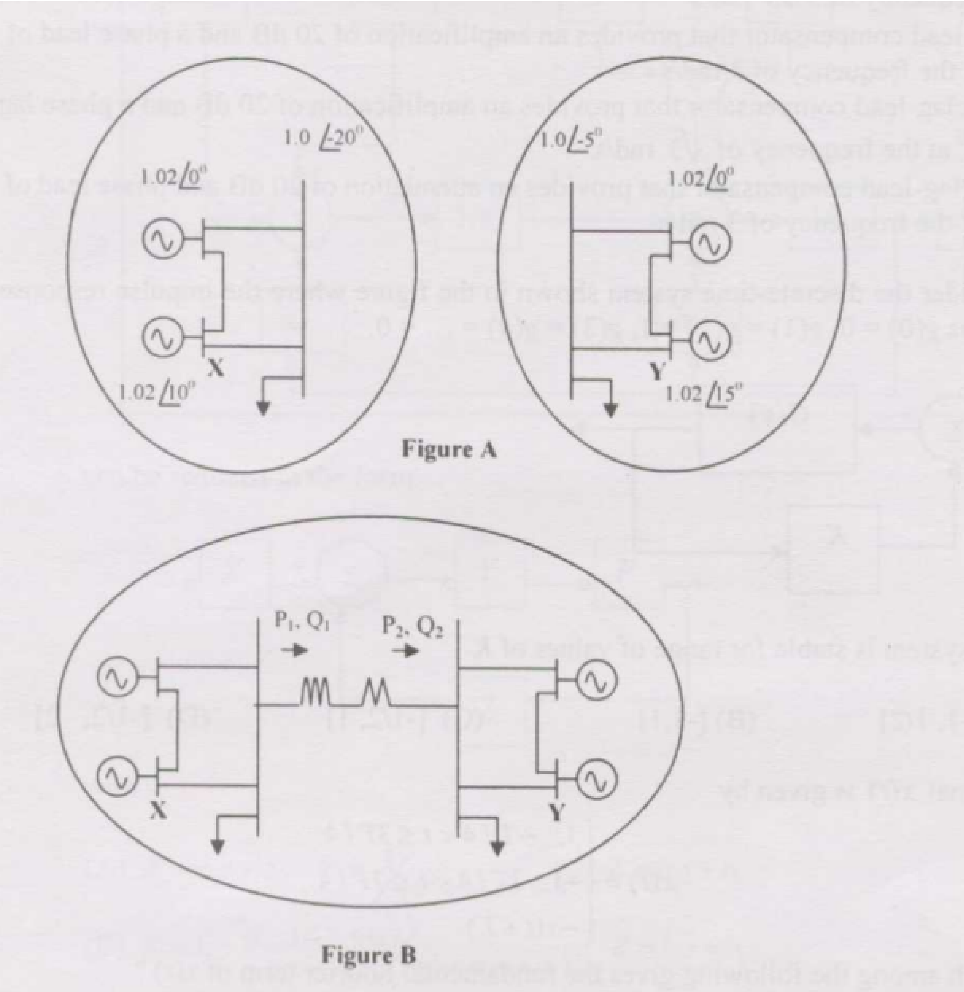

Fig. 15

The bus voltage phase angular difference between generator bus X and generator bus Y after the interconnection is

a) 10° b) 25° c) −30° d) 30°

16) The octal equivalent of the HEX number **AB.CD** is

a) (A) 253.314 b) (B) 253.632 c) (C) 526.314 d) (D) 526.632

17) If $x = Re(G(j\omega))$, and $y = Im(G(j\omega))$ then for $\omega \to 0^+$, the Nyquist plot for $G(s) = \frac{1}{s(s+1)(s+2)}$ becomes asymptotic to the line

a) (A) $x = 0$ b) (B) $x = -\frac{3}{4}$ c) (C) $x = y - \frac{1}{6}$ d) (D) $x = \frac{y}{\sqrt{3}}$