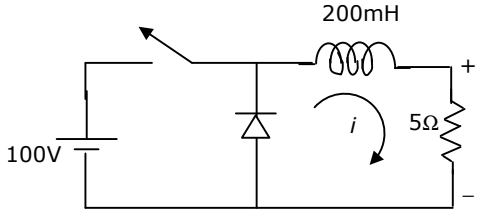
(a) Only P (b) P and Q (c) P and R (d) R and S

78. Fig.Q78 shows a step-down chopper switched at 1 KHz with a duty ratio D = 0.5. The peak-peak ripple in the load current is close to

(a) 10 A
(b) 0.5 A
(c) 0.125 A
(d) 0.25 A

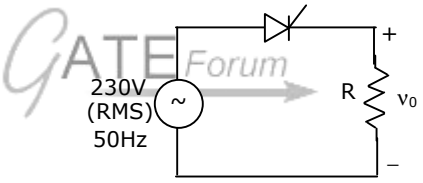


79. An electric motor, developing a starting torque of 15 Nm, starts with a load torque of 7 Nm on its shaft. If the acceleration at start is 2 rad/sec^2, the moment of inertia of the systems must be (neglecting viscous and Coulomb/friction).

(a) 0.25 kg m^2 (b) 0.25 Nm^2 (c) 4 kg m^2 (d) 4 Nm^2

80. Consider a phase controlled converter shown in Fig.Q.80. The thyristor is fired at an angle α in every positive half cycle of the input voltage. If the peak value of the instantaneous output voltage equals 230 V, the firing angle α is close to

(a) 45°
(b) 135°
(c) 90°
(d) 83.6°

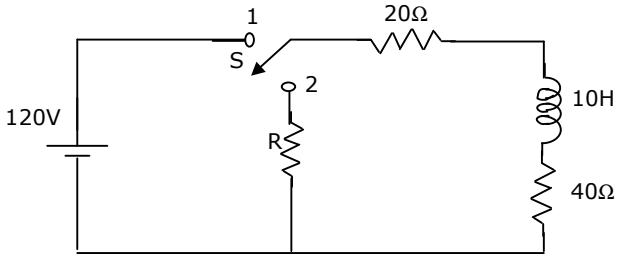


Linked Answer Questions: 81a to Q85b carry two marks each

Statement for Linked Answer Questions 81a & 81b: A coil of inductance 10 H resistance 40Ω is connected as shown in Fig.Q81. After the switch S has been in connection with point 1 for a very long time, it is moved to point 2 at t = 0.

81. **(A)** If, at t = 0$^+$, the voltage across the coil is 120V, the value of resistance R is:

(a) 0Ω
(b) 20Ω
(c) 40Ω
(d) 60Ω



(B) For the value of R obtained in (a), the time taken for 95% of the stored energy dissipated is close to

(a) 0.10 sec (b) 0.15 sec (c) 0.50 sec (d) 1.0 sec

Statement for Linked Answer Questions 82a & 82b:

A state variable system

$\dot{X}(t) = \begin{bmatrix} 0 & 1 \\ 0 & -3 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)$, with the initial condition $X(0) = \begin{bmatrix} -1 & 3 \end{bmatrix}^T$ and the unit step input $u(t)$ has

82. **(A)** The state transition matrix

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

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

(B) and the state transition equation

(a) $X(t) = \begin{bmatrix} t - e^{-t} \\ e^{-t} \end{bmatrix}$ (b) $X(t) = \begin{bmatrix} t - e^{-t} \\ 3e^{-3t} \end{bmatrix}$

(c) $X(t) = \begin{bmatrix} t - e^{-3t} \\ 3e^{-3t} \end{bmatrix}$ (d) $X(t) = \begin{bmatrix} t - e^{-3t} \\ e^{-t} \end{bmatrix}$

Statement for Linked Answer Questions 83a & 83b: A 1000 kVA, 6.6 kV, 3-phase star connected cylindrical pole synchronous generator has a synchronous reactance of 20 Ω. Neglect the armature resistance and consider operation at full load and unity power factor.

83. **(A)** The induced emf (line-to-line) is close to

(a) 5.5 kV (b) 7.2 kV (c) 9.6 kV (d) 12.5 kV

(B) The power (or torque) angle is close to

(a) 13.9° (b) 18.3° (c) 24.6° (d) 33.0°

Statement for Linked Answer Questions 84a & 84b: At a 220 kV substation of a power system, it is given that the three-phase fault level is 4000 MVA and single-line to ground fault level is 5000 MVA. Neglecting the resistance and the shunt susceptances of the system,

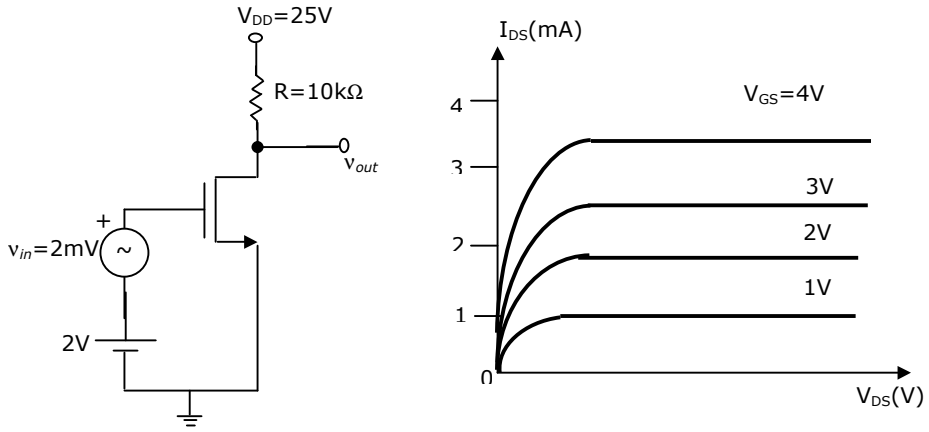
84. **(A)** the positive sequence driving point reactance at the bus is:

(a) 2.5Ω (b) 4.033Ω (c) 5.5Ω (d) 12.1Ω

(B) and the zero sequence driving point reactance at the bus is:

(a) 2.2Ω (b) 4.84Ω (c) 18.18Ω (d) 22.72Ω

Statement for Linked Answer Questions 85a & 85b: Assume that the threshold voltage of the N-channel MOSFET shown in Fig. Q85 is +0.75V. The output characteristics of the MOSFET are also shown.



85. **(A)** The transconductance of the MOSFET is:

(a) 0.75 mS (b) 1 mS (c) 2 mS (d) 10 mS

(B) The voltage gain of the amplifier is:

(a) +5 (b) -7.5 (c) +10 (d) -10