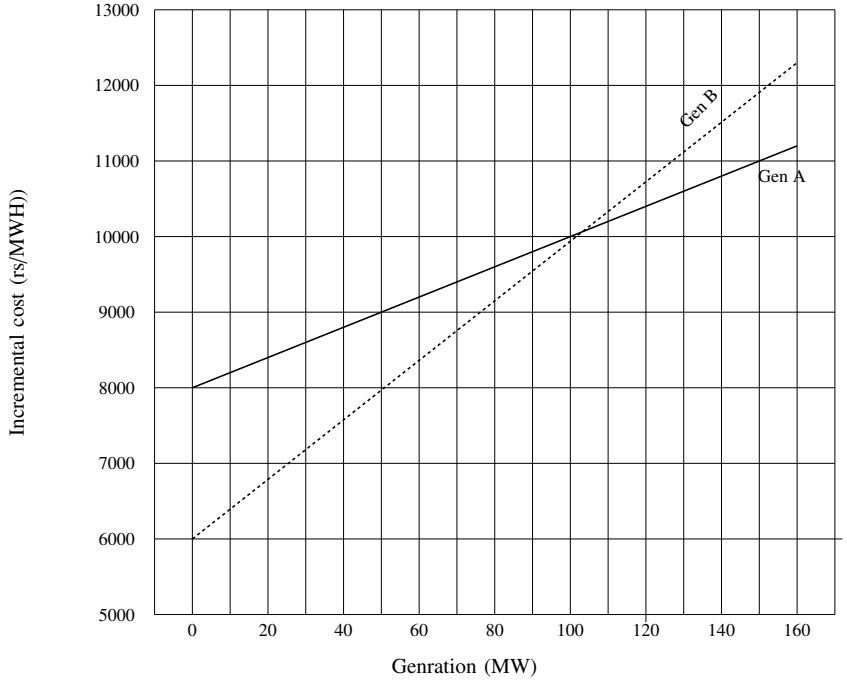
gate 8

EE24Btech11041 - Mohit

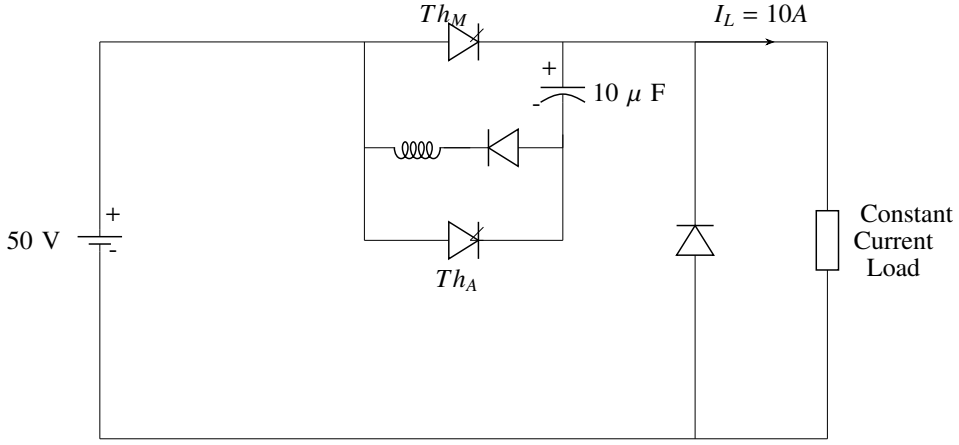
1) If the following switching devices have similar power ratings, which one of them is the fastest? (EE 2024)
   a) SCR
   b) GTO
   c) IGBT
   d) Power MOSFET
2) A single-phase triac based AC voltage controller feeds a series RL load. The input AC supply is 230 V, 50 Hz. The values of R and L are 10Ω and 18.37 mH, respectively. The minimum triggering angle of the triac to obtain controllable output voltage is (EE 2024)
   a) 15°
   b) 30°
   c) 45°
   d) 60°
3) Let X be a discrete random variable that is uniformly distributed over the set {-10, -9, …, 0, …, 9, 10}. Which of the following random variables is/are uniformly distributed? (EE 2024)
   a) X^2
   b) X^3
   c) $(X-5)^2$
   d) $(X+10)^2$
4) Which of the following complex functions is/are analytic on the complex plane? (EE 2024)
   a) $f(z) = Re(z)$
   b) $f(z) = Im(z)$
   c) $f(z) = e^{|z|}$
   d) $f(z) = z^2 - z$
5) Consider the complex function $f(z) = \cos z + e^{z^2}$.The cofficient of z^5 in the Taylor series expansion of $f(z)$ about the origin is _____ (rounded off to 1 decimal place). (EE 2024)
6) The sum of the eigenvalues of the matrix $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}^2$ is _____ (rounded off to the nearest integer). (EE 2024)
7) Let $X(w)$ be the Fourier transform of the signal

$$x(t) = e^{-t^4}\cos t, \qquad -\infty < t < \infty. \tag{1}$$

   The value of the derivative of $X(w)$ at $w = 0$ is _____ (rounded off to 1 decimal place). (EE 2024)
8) The incremental cost curves of two generators (Gen A and Gen B) in a plant supplying a common load are shown in the figure. If the incremental cost of supplying the common load is Rs. 7400 per MWh, then the common load in MW is_____ (rounded off to the nearest integer). (EE 2024)



9) A forced commutated thyristorized step-down chopper is shown in the figure. Neglect the ON-state drop across the power devices. Assume that the capacitor is initially charged to 50 V with the polarity shown in the figure. The load current (I_l) can be assumed to be constant at 10 A. Initially, Th_M is ON and Th_A is OFF. The turn-off time available to Th_M in microseconds, when Th_A is triggered, is _____ (rounded off to the nearest integer). (EE 2024)



10) Consider a vector $\mathbf{u} = 2\hat{x} + \hat{y} + 2\hat{z}$, where $\hat{x}, \hat{y}, \hat{z}$ represent unit vectors along the coordinate axes x, y, z respectively. The directional derivative of the function $f(x, y, z) = 2\ln(xy) + 3\ln(yz) + 3\ln(xz)$ at the point $(x, y, z) = (1, 1, 1)$ in the direction of $\mathbf{u}$ is (EE 2024)

a) 0
b) $\frac{7}{5\sqrt{2}}$
c) 7
d) 21

11) The input $x(t)$ and the output $y(t)$ of a system are related as (EE 2024)

$$y(t) = e^{-t} \int_{-infty}^{t} e^{\tau} x(\tau)\, d\tau, \qquad -\infty < t < \infty. \tag{2}$$

The system is (EE 2024)

a) nonlinear.

b) linear and time-invariant.
c) linear but not time-invariant.
d) noncausal.

12) Consider the discrete-time systems T_1 and T_2 defined as follows:

$$\{T_1 x\}[n] = x[0] + x[1] + \cdots + x[n] \tag{3}$$

$$\{T_2 x\}[n] = x[0] + \frac{1}{2}x[1] + \cdots + \frac{1}{2^n}x[n] \tag{4}$$

Which one of the following statements is true? (EE 2024)

a) T_1 and T_2 are BIBO stable.
b) T_1 and T_2 are not BIBO stable.
c) T_1 is BIBO stable and T_2 is not BIBO stable.
d) T_1 is not BIBO stable and T_2 is BIBO stable.

13) If the Z-transform of a finite-duration discrete-time signal $x[n]$ is $X(z)$, then the Z-transformation of the signal $y[n] = x[2n]$ is (EE 2024)

a) $Y(z) = X(z^2)$
b) $Y(z) = \frac{1}{2}[X(z^{-\frac{1}{2}}) + X(-z^{-\frac{1}{2}})]$
c) $Y(z) = \frac{1}{2}[X(z^{\frac{1}{2}}) + X(-z^{\frac{1}{2}})]$
d) $Y(z) = \frac{1}{2}[X(z^2) + X(-z^2)]$