TOPIC

Engineering Mechanics (Statics and Dynamics) – Section VII – Question 12

QUESTION

A damped free response of a spring-mass-damper system is given by the differential equation

$$2\ddot{x} + c\dot{x} + 5x = 0$$

The value of c for which the response would be non-oscillatory (overdamped) satisfies

(A) $c < \sqrt{40}$
(B) $c \geq \sqrt{40}$
(C) $c < 40$
(D) $c \geq 40$

HINT

Find the roots of the characteristic equation of the ordinary differential equation. If the roots of the equation are complex, the transient response is oscillatory.

SOLUTION

The characteristic equation of the linear ordinary differential equation is given by

$$2m^2 + cm + 5 = 0$$

$$m = \frac{-c \pm \sqrt{c^2 - 4 \times 2 \times 5}}{2.2}$$

$$= \frac{-c \pm \sqrt{c^2 - 40}}{4}$$

So if $c^2 - 40 < 0$, the roots of the characteristic equation would be complex, hence resulting in a oscillatory response. So, for $c^2 - 40 \geq 0$, the response would non-oscillatory.

$$c^2 - 40 \geq 0$$

$$c^2 \geq 40$$

$$c \geq \sqrt{40}$$

ANSWER

(B)

CONTRIBUTOR

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