Class Test No. 13 Thursday 10th Oct 2019 Duration: 10 Minutes Closed notes

Name: _____ Roll No. _____

Choose only one option which is the most appropriate for questions 1 - 5.

1. In the context of the standard 2nd order closed loop transfer function, the largest frequency among these is,

(a) resonant frequency
(b) bandwidth
(c) gain crossover frequency
(d) phase crossover frequency

2. Bandwidth of a closed loop system for $\zeta = 1/\sqrt{2}$ is

(a) 0
(b) ω_n
(c) $(1/\sqrt{2})\ \omega_n$
(d) $(\sqrt{2})\ \omega_n$

3. Resonant peak for a standard 2nd order closed loop transfer function is unity for

(a) $\zeta = 1$
(b) $\zeta = 1/\sqrt{2}$
(c) $\sqrt{2}$
(d) no value of ζ

4. Phase angle of the closed loop response for $\zeta = 1/\sqrt{2}$ is

(a) -90^o
(b) $\pm 180^o$
(c) 0^o
(d) $+90^o$

5. The expression for resonant peak in terms of damping ratio, 'ζ' is

(a) $2\zeta/\sqrt{(1-\zeta^2)}$
(b) $1/\{2\zeta\sqrt{(1-\zeta^2)}\}$
(c) $\pi\zeta/\sqrt{(1-\zeta^2)}$
(d) $\sqrt{(1-\zeta^2)}$

Give short (1 - 2 lines) answer to the questions 6-10

6. Give the definition of cut-off frequency.

Cut-off frequency is the frequency beyond which output amplitude is less than 70% of the input amplitude.

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7. Give the expression for resonant frequency, for a standard 2nd order closed loop frequency response function as given alongside.

$$G(j\omega) = \frac{\omega_n^2}{-\omega^2 + j2\zeta\omega_n\omega + \omega_n^2}$$

$$\omega_r = \omega_n\sqrt{1-2\zeta^2}$$

8. What is the physical connotation of closed loop bandwidth?

Closed loop bandwidth indicates al those frequencies which will be tracked by the system if these are present in the input.

9. In what way is the resonant peak a physical feature of the closed loop system?

Resonant peak denotes the response amplitude to a sinusoidal input at the resonant frequency and has a strong influence on the peak overshoot in time domain.

10. A 2nd order type 1 plant shows a GCO of 1.84 rad/s. Predict the approximate bandwidth of the corresponding unity feedback closed loop system.

$$\omega_b = \omega_{GCO} + \frac{3}{|Slope|}\times 10 = 1.84 + \frac{3}{40}\times 10 = 2.59$$