PEP CLASS CONTROL SYSTEM

UNIT-01

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2. For open control system which of the following statements is incorrect ?

- **(a) Less expensive**
- **(b) Recalibration is not required for maintaining the required quality of the output**
- **(c) Construction is simple and maintenance easy**
- **(d) Errors are caused by disturbances**

- ANS--B

3. A control system in which the control action is somehow dependent on the output is

- **known as**
- **(a) Closed loop system**
- **(b) Semi closed loop system**
- **(c) Open system**
- **(d) None of the above**

- ANS--A

4. In closed loop control system, with positive value of feedback gain the overall gain of the system will

- **(a) decrease**
- **(b) increase**
- **(c) be unaffected**
- **(d) any of the above**

- ANS--B

5. Which of the following statements is not necessarily correct for open control system?

- **(a) Input command is the sole factor responsible for providing the control action**
- **(b) Presence of non-linearities causes malfunctioning**
- **(c) Less expensive**
- **(d) Generally free from problems of non-linearities**

The statement that is **not necessarily correct** for open-loop control systems is:

d) Generally free from problems of non-linearities

Here's why the other statements are generally true:

a) Input command is the sole factor responsible for providing the control action: This is true for open-loop systems, as they rely solely on the pre-determined input without feedback to adjust the control action. **b) Presence of non-linearities causes malfunctioning:** While not always the case, the lack of feedback in open-loop systems makes them less able to adapt to non-linearities in the system dynamics, potentially leading to unexpected behavior or errors in the output. **c) Less expensive:** Due to their simpler design without feedback mechanisms, open-loop systems are often less expensive to implement and maintain compared to closed-loop systems.

However, **statement d) is not entirely accurate**. While they don't have feedback to directly address non-linearities, open-loop systems can still be affected by them. Depending on the specific system and non-linearities present, they can still cause issues like:

- **Inaccurate output:** If the pre-determined input doesn't account for non-linearities, the actual output may deviate significantly from the expected behavior.
- **Instability:** In some cases, non-linearities can exacerbate system instability, leading to oscillations or even unintended system shutdowns.
- **Unpredictable behavior:** The lack of feedback makes it difficult to predict how non-linearities will affect the system, potentially leading to unforeseen issues.

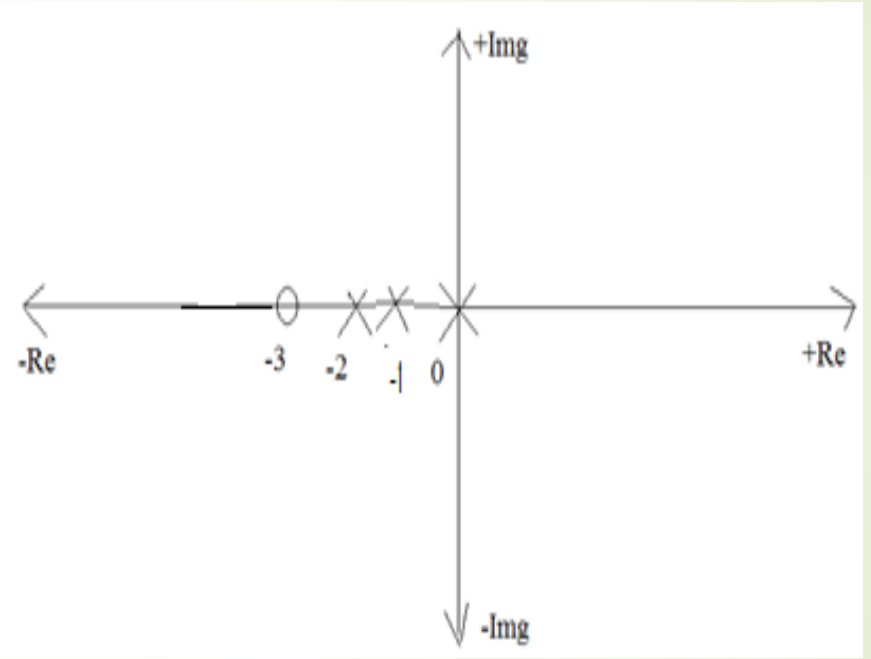
Therefore, while they may not necessarily **malfunction** due to non-linearities, open-loop systems are certainly not "generally free" from their potential problems.

- ANS--B

8. A car is running at a constant speed of 50 km/h, which of the following is the feedback

- **element for the driver ?**
- **(a) Clutch**
- **(b) Eyes**
- **(c) Needle of the speedometer**
- **(d) Steering wheel**
- **(e) None of the above**

The forward path gain of a cc
system is 2.5 and the pole
configuration of the overall trc
function is shown in figure.
overall transfer function is



(a) $\frac{2.5(s+1)}{s(s+2)(s+3)}$ (b) $\frac{2.5(s+2)}{s(s+1)(s+3)}$ (c) $\frac{2.5(s+3)}{s(s+1)(s+2)}$ (d) $\frac{(s+3)}{2.5(s+1)(s+2)}$

- ANS--C

An automatic toaster is a _____ loop control system.

- **(a) open**
- **(b) closed**
- **(c) partially closed**
- **(d) any of the above**

- ANS-- a

is a part of the human temperature control system.

- **(a) Digestive system**
- **(b) Perspiration system**
- **(c) Ear**
- **(d) Leg movement**

- B

- **By which of the following the control action is determined when a man walks along a path ?**
- **(a) Brain**
- **(b) Hands**
- **(c) Legs**
- **(d) Eyes**

- D

Which of the following should be done to make an unstable system stable ?

- **(a) The gain of the system should be decreased**
- **(b) The gain of the system should be increased**
- **(c) The number of poles to the loop transfer function should be increased**
- **(d) The number of zeros to the loop transfer function should be increased**

Out of the provided options, the correct approach to stabilize an unstable system is:

(b) The gain of the system should be increased.

Here's why:

- **Unstable systems:** These systems tend to have at least one pole in the right half of the complex plane (s-plane). This means that any small deviation from the desired state will be amplified, causing the system to diverge and become uncontrollably large or oscillate endlessly.
- **Stability and poles:** For a system to be stable, all its poles must reside in the left half of the s-plane. Shifting poles towards the left decreases their magnitude, meaning any deviation will decay and the system will return to its desired state.
- **Gain and pole location:** Increasing the gain in an unstable system generally pushes its poles further to the left in the s-plane, bringing them closer to the stable region. This reduces the rate of divergence and potentially stabilizes the system. However, increasing gain without caution can lead to overshoot or oscillations, so careful tuning is crucial.

Reasoning for other options:

- **Decreasing the gain:** This typically moves poles further to the right, exacerbating instability and making the system diverge faster.
- **Increasing the number of poles:** This doesn't inherently change the location of existing poles and might not guarantee stability.
- **Increasing the number of zeros:** Zeros generally do not affect the system's stability; they introduce phase shifts in the frequency response.

It's important to note that increasing gain isn't always a magic bullet, as excessive gain can create other problems like saturation or actuator limitations. Selecting the appropriate method to stabilize a system requires careful analysis and consideration of its specific dynamics and constraints.

- B

A.C. servomotor resembles

- **(a) two phase induction motor**
- **(b) Three phase induction motor**
- **(c) direct current series motor**
- **(d) universal motor**

- A

As a result of introduction of negative feedback which of the following will not decrease ?

- **(a) Band width**
- **(b) Overall gain**
- **(c) Distortion**
- **(d) Instability**

- A

- **The output of the feedback control system must be a function of:**
  a) Reference input
  b) Reference output
  c) Output and feedback signal
  d) Input and feedback signal

- **Answer: d**
  Explanation: Feedback control system has the property of reducing the error and that is by differencing the output with the desired output and as the equation of the output of the system is C=GR/1+GH.

A linear system at rest is subject to an input signal $r(t)=1-e^{-t}$. The response of the system for $t>0$ is given by $c(t)=1-e^{-2t}$. The transfer function of the system is:

a) (s+2)/(s+1)

b) (s+1)/(s+2)

c) 2(s+1)/(s+2)

d) (s+1)/2(s+2)

How to solve this Q?

- **Answer: c**
  Explanation: $c(t)=1-e^{-2t}$
  R(s)=1/s-1/s+1
  C(s)=1/s-1/s+2
  Tf=2(s+1)/(s+2).

- **In regenerating the feedback, the transfer function is given by**
  a) C(s)/R(s)=G(s)/1+G(s)H(s)
  b) C(s)/R(s)=G(s)H(s)/1-G(s)H(s)
  c) C(s)/R(s)=G(s)/1+G(s)H(s)
  d) C(s)/R(s)=G(s)/1-G(s)H(s)

- **Answer: d**
  Explanation: Regenerating feedback is positive feedback and it increases the infinitely and hence the speed of response of the system reduces.

- What will be the transfer function of a body of mass M, in which input quantity is force and output quantity is displacement?

a) sM
b) s^2M
c) 1/sM
d) 1/(s^2 M)

- View Answer
- Answer: d

Explanation: Force can be described as the product of mass and acceleration, or in terms of displacement $F = M(dx^2(t)) / (dt^2)$. Converting to Laplace domain and finding transfer function we obtain the answer.

- Restoring force of a spring under stress is F(s) = _____

a) X(s)
b) KX(s)
c) K
d) None of the mentioned

- View Answer
- Answer: b

Explanation: Restoring force of a spring under stress is given by KX(s), where K is the stiffness of spring and X(s) is the displacement made.

- Spring is a _____ order system.

a) Zero
b) First
c) Second
d) Third

- View Answer
- Answer: a

Explanation: From transfer function of spring, it is clear that spring is a zero order system. Transfer function (F(s))/(G(s))=K.

- What will you call the friction between a relative motion of two bodies?

a) Static friction
b) Dynamic friction
c) Viscous friction
d) None of the mentioned

- View Answer
- Answer: c

Explanation: Viscous friction acts when there is a relative motion between two bodies. It always acts opposite to direction of velocity.

1. Static friction:
    - Occurs when two objects are at rest in contact with each other.
    - It acts in the opposite direction of any applied force that tends to move the objects.
    - Its magnitude increases with the applied force up to a maximum value beyond which the object starts to move.
    - This maximum value is known as the coefficient of static friction, which is a property of the materials in contact and the surface conditions.

2. Dynamic friction:
    - Occurs when two objects are already moving in contact with each other.
    - It is generally slightly lower than the maximum value of static friction.
    - It acts in the opposite direction of the relative motion between the objects.
    - Its magnitude is often approximated to be a constant, independent of the applied force, but it can vary depending on the materials and surface conditions.

- 8. What is the equivalent quantity of capacitance in the transfer function of the viscous force?

a) Viscous force
b) Viscosity
c) Damping coefficient
d) Inertia

- View Answer
- Answer: c

Explanation: Transfer function of the viscous force is given as 1/sB, and the transfer function of the capacitor is given as 1/sC. On equating B and C becomes equivalent quantities.

Ques 10

Zero initial condition for a system means

(a) input reference signal is zero

(b) zero stored energy

(c) no initial movement of moving parts

(d) system is at rest and no energy is stored in any of its components

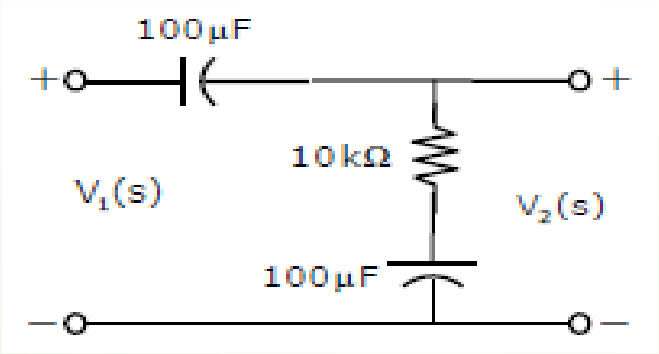
Answer

Ans: d

8. The transfer function $\frac{V_2(s)}{V_1(s)}$ of the circuit shown below is

(a) $\frac{0.5s+1}{s+1}$ (b) $\frac{3s+6}{s+2}$ (c) $\frac{s+2}{s+1}$ (d) $\frac{s+1}{s+2}$

How to solve this



- Ans : (d)

Which is the following relate to rational transfer function of a system ?

1. Ratio of Fourier transform of output to input with zero initial conditions
2. Ratio of Laplace transform of output to input with zero initial conditions
3. Laplace transform of system impulse response
4. Laplace transform of system unit step response

Select the correct answer using the codes given below codes :

(a) 1 and 4 (b) 2 and 3 (c) 1 and 3 (d) 2 and 4

- B

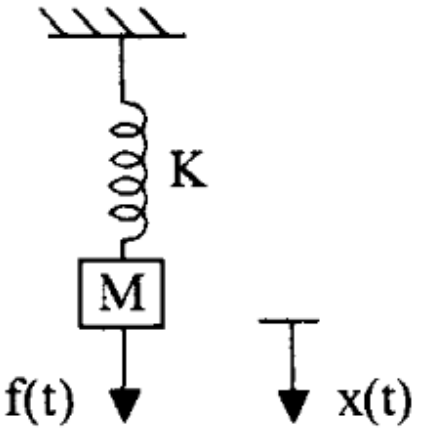
For the system shown in the given figure the transfer function $\frac{X(s)}{F(s)}$ is

(a) $\frac{1}{Ms^2 + K}$

(b) $\frac{Ms^2 + 1}{K}$

(c) $\frac{K}{Ms^2 + 1}$

(d) $\frac{1}{Ks^2 + M}$



- A

Match List-I with List-II and select the correct answer by using the codes given below the lists :

List-I	List-II
A. Synchro	1. Amplifier
B. Amplidyne	2. Actuator
C. Servo	3. Compensator
D. RC Network	4. Transducer

Codes :

(a)	A	B	C	D	(b)	A	B	C	D
	1	2	3	4		4	3	2	1
(c)	A	B	C	D	(d)	A	B	C	D
	3	2	4	1		4	1	2	3

- D

Which of the following are the characteristics of closed-loop systems ?

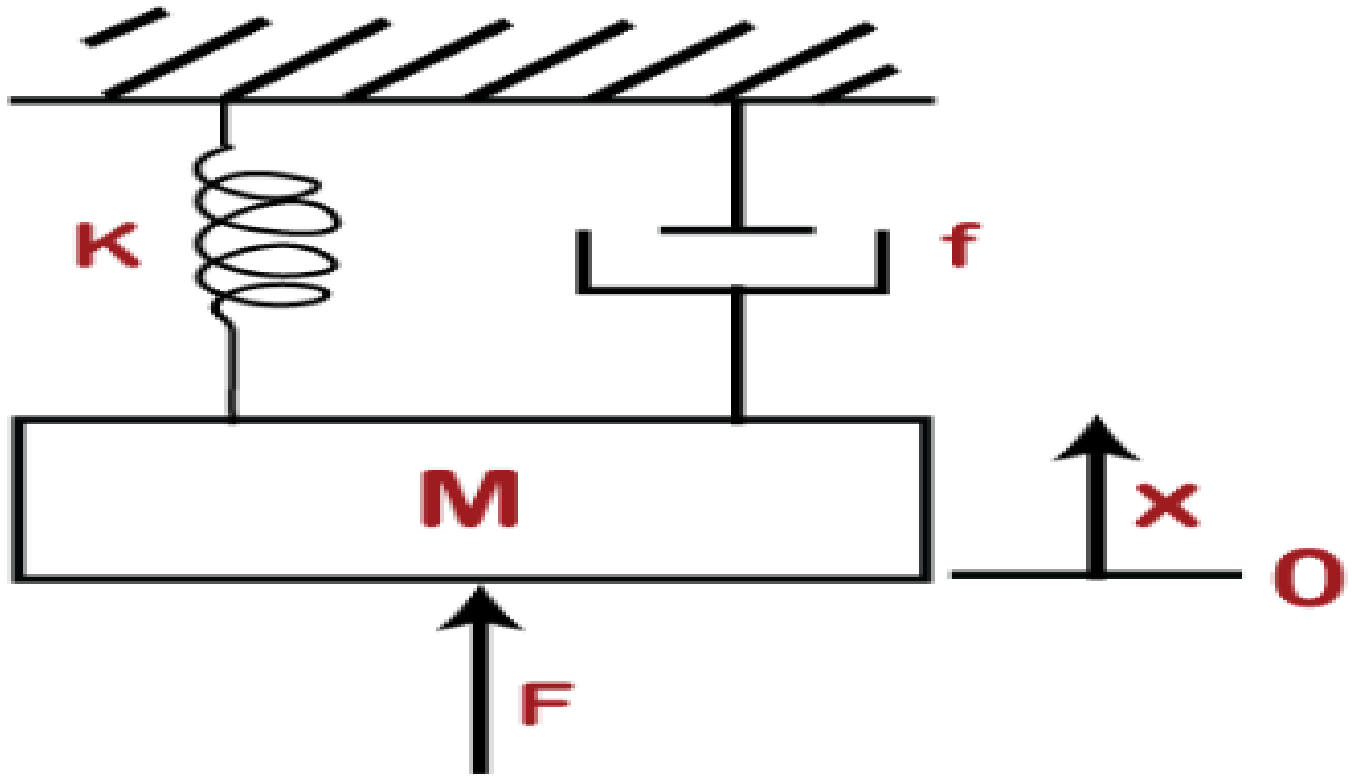
1. It does not compensate for disturbances.
2. It reduces the sensitivity of plant-parameter variations.
3. It does not involve output measurements.
4. It has the ability to control the system transient response.

Select the correct answer using the codes given below:

(a) 1 and 4 (b) 2 and 4 (c) 1 and 3 (d) 2 and 3

- B

7) The force equation of the given system is:



a. $F = K\frac{d^2x}{dt^2} + f\frac{dx}{dt} + Mx$

b. $F = f\frac{d^2x}{dt^2} + K\frac{dx}{dt} + Mx$

c. $F = M\frac{d^2x}{dt^2} + f\frac{dx}{dt} + Kx$

d. $F = K\frac{d^2x}{dt^2} + M\frac{dx}{dt} + fx$

$$(c)\ F = M\frac{d^2x}{dt^2} + f\frac{dx}{dt} + Kx$$

- Calculate the poles and zeroes for the given transfer function G(s) = 5 (s + 2)/ (s^2 + 3s + 2)

1. -2, (-1, -2)
2. 2, (-1, 2)
3. 2, (1, 2)
4. -2, (1, -2)

- Answer: (a) -2, (-1, -2)

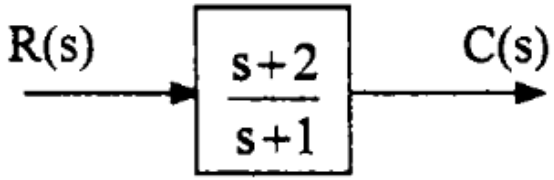
The block diagrams shown in figure-I and figure-II are equivalent if 'X' (in figure-II) is equal to

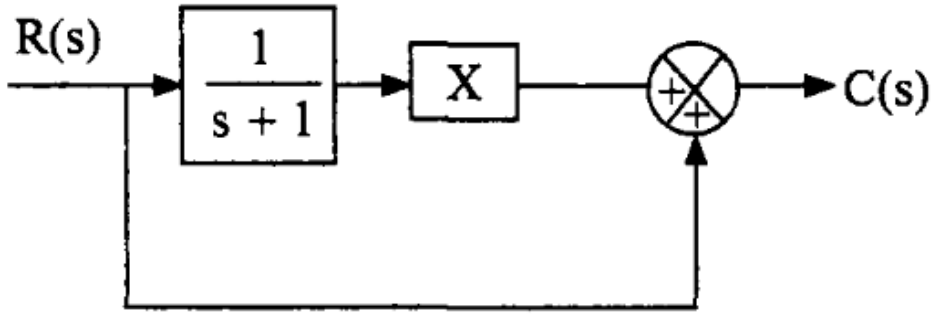
(a) 1

(b) 2

(c) s + 1

(d) s + 2





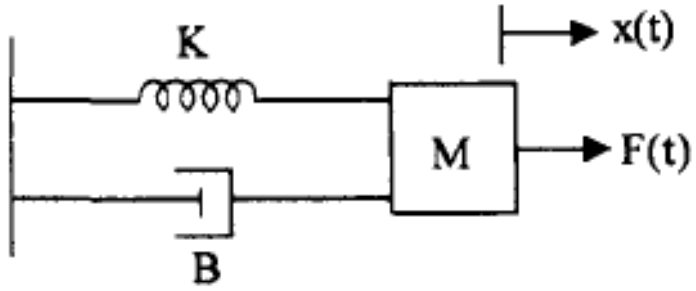
- a

- As compared to a closed-loop system, an open-loop system is
- (a) more stable as well as more accurate
- (b) less stable as well as less accurate
- (c) more stable but less accurate
- (d) less stable but more accurate

In the figure alongside, spring constant is K, viscous friction coefficient is B, mass is M and the system output motion is x(t) corresponding to input force F(t). Which of the following parameters relate to the above system ?

1. Time constant = $\frac{1}{M}$

2. Damping coefficient = $\frac{B}{2\sqrt{KM}}$



3. Natural frequency of oscillation = $\sqrt{\frac{K}{M}}$

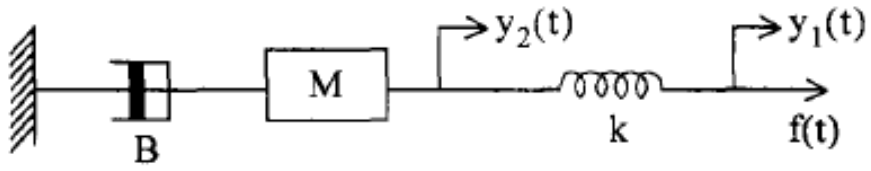
Select the correct answer using the codes given below :

Codes :

(a) 1, 2 and 3 (b) 1 and 2 (c) 2 and 3 (d) 1 and 2

- C

The mechanical system is shown in the given figure



The system is described as

(a) $M \frac{d^2y_1(t)}{dt^2} + B \frac{dy_1(t)}{dt} = k[y_2(t) - y_1(t)]$

(b) $M \frac{d^2y_2(t)}{dt^2} + B \frac{dy_2(t)}{dt} = k[y_2(t) - y_1(t)]$

(c) $M \frac{d^2y_1(t)}{dt^2} + B = k[y_1(t) - y_2(t)]$

(d) $M \frac{d^2y_2(t)}{dt^2} + B \frac{dy_2(t)}{dt} = k[y_1(t) - y_2(t)]$

- d