

## 1.12 Casualty

Two systems are defined by the relationships between their input and outputs as follows:

system 1: The input is  $u(t)$  and at the same instant of time the output is  $y(t) = u(t + T), T > 0$

system 2: The input is  $u(t)$  and at the same instant of time the output is  $y(t) = u(t - T), T > 0$   
Are either of these systems causal?

### **Solution :**

In system 1, the output depends only on the input  $T$  seconds in the future. Thus it is not causal. An operation of this type is called prediction.

In system 2 the output depends only on the input  $T$  seconds in the past. Thus it is causal. An operation of this type is called a time delay.

### **GPT Answer :**

For system 1, where  $y(t) = u(t+T)$  with  $T > 0$ , the output at time  $t$  depends on the input at a future time  $t+T$ . This means that the system's output is based on future, not current or past inputs, thereby violating the principle of causality. **System 1 is not causal.**

For system 2, where  $y(t) = u(t-T)$  with  $T > 0$ , the output at time  $t$  depends on the input at a past time  $t-T$ . Since the system's output depends only on past (and possibly current, if  $T$  can be 0) inputs, this aligns with the principle of causality. **System 2 is causal.**

**Confidence Level: 100%**

### **Correct**

#### **Claude Answer:**

System 1 is non-causal (anticipative), while System 2 is causal.

#### **Explanation:**

- For a system to be causal, the output at any given time should depend only on the current and past inputs, not on future inputs.
- In System 1, the output  $y(t)$  depends on the input at a future time instant  $u(t+T)$ , which makes it non-causal (anticipative).
- In System 2, the output  $y(t)$  depends on the input at a past time instant  $u(t-T)$ , which makes it causal.

**Confidence Score: 100/100**

### **Correct**