# AUTOMATIC FLIGHT CONTROL SYSTEMS

## 3.ANALYSIS OF FEEDBACK CONTROL SYSTEMS

TEST INPUT SIGNAL:

Test input signal is technique of testing the stability of control systems by following given equations. There are four types of test function for testing the input signal.

☺STEP FUNCTION:

a(t) = 0 when (t≤0)

a(t)=1 when (0≤1)

taking laplace of a f(t) signal $?^{-??}$

L f(t)=$\int_0^\infty ?(?)?^{-??}??\ =\ \int_0^\infty ?^{-??}??$

R(s)=$\frac{?}{?}$

☺RAMP FUNCTION:

r (t)= 0 when t<0

r (t)=kt when t>0

taking laplace

L r(t)=$\int_0^\infty ??.?^{-??}??\ =\ \frac{?}{?^2}$

R(s)=$\frac{?}{??}$ (for unit ramp k=1)

R(s)=$\frac{?}{??}$

☺PARABOLIC FUNCTION:

r (t) = 0 when t<0

r(t) = $\frac{??^2}{2}$ when t>0

for unit parabolic k=1

r (t) =$\frac{?^2}{2}$ t>0

Laplace of function

L r(t) = $\int_0^\infty ?(?).?^{-??}?? = \frac{?}{?^3}$

R(s)= $\frac{?}{?^?}$

☺IMPULSE FUNCTION:

$?(?) = ?$ when t ≠0

$?(?) = \infty$ when t = 0

$\int_{-\infty}^{\infty} ?(?) = ?$ after integration

$?(?) = ?(?)$

The pulse for which the duration tends to zero and amplitude tend to infinity is called impulse function.

TIME DOMAIN PERFORMANCE OF CHARACTERISTICS OF FEEDBACK CONTROL SYSTEMS:

DAMPING RATIO: $\frac{??????????}{??????????? ?}$= $\frac{???}{??}$

Underdamped case (0<?<1)

Undamped case ($\in = 0$)

Critically damped case ($\in = 1$)

EFFECT OF DERIVATIVE AND INTEGRAL CONTROL:

Derivative control action:

$\frac{?\ (?)}{?\ (?)}$ =Skd

Kd is the derivative constant. E(S) is the input signal and M(s) is the output signal.

Integral control action:

$$\frac{?\ (?)}{?\ (?)} = \frac{?\ ?}{?}$$

Ki is the integral constant.

Derivative and integral control functions increases the sensitivity of control systems.

## STEADY STATE ERROR:

☺ Static position error coefficient:

$?_{??} = \frac{1}{1+??}$ where kp is the static position coefficient constant

☺Static velocity error coefficient:

$?_{??}=\frac{1}{??}$ where kv is the velocity error coefficient constant

☺Static acceleration error coefficient:

$?_{??}=\frac{?}{??}$ where ka is the acceleration error coefficient constant

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