Worksheet

1. Simplified aircraft model. Transfer function =

num = 10 den = [1 10 0]

Controller transfer function =

*k* = 2 *D* = 0.323 seconds

Phase margin = -143+180 = 37 degrees

Amount of extra time delay which can be tolerated = Phase\_margin(rad)/ws(freq when magnitude is zero) = 37\*(pi/180) /2 = 0.323 seconds

* 1. PIO.

Period of oscillation (observed) = 2.2 s (ave)

Period of oscillation (theoretical) = 2.685 s

* 1. Sinusoidal disturbances. Maximum stabilising gain =gain margin 8.94 dB

Gain at 0.66 Hz =9.01dB Phase at 0.66 Hz =-188 deg

Open loop T.F. (*y → d*) = G(s) (since e(s) will be 0-0, so K(s)\*zero = u(s)=zero

Closed loop T.F. (*y → d*) = G(s)/(1+K(s)G(s))

* 1. Fastest pole. *T* =0.45 s

1. Autopilot. Proportional gain *Kc* =17.4

Period of oscillation *Tc* =1.908

3.1 Transfer function of PID controller =Kp(1 + 1/(Ti\*s) + Td\*s)

PID constants: *Kp* =10.44 *Ti* =0.954

*Td = 0.2385*

Final value of *Td* =0.3339