EEE3094 Tutorial 1 Answers

WHTDYL001

# Question 1

Including the system inputs and outputs made it easier for me to identify the plant input

# a)

1. System input = desired angle of rocket
2. System output = current rocket angle
3. Plant input = direction rocket exhaust must be adjusted
4. Disturbance = inconsistent air densities/ winds/ vibrations in fuselage
5. Possible End user-requirements = rocket should never be more than 0.001 of its reference angle

## b)

1. System input = desired angle and position of rocked
2. System output = current angle and position of rocket
3. Plant input = direction exhaust must be adjusted and amount of rocket fuel to be burnt
4. Disturbance = wind/redistribution of mass due to using fuel
5. Possible End user-requirements= rocket must successfully land.

## c)

1. System Input= desired pressure
2. System output= current pressure
3. Plant input = a command to raise/lower the water level
4. Disturbance = someone using water ie: water level dropping or change in temperature causing change of pressure in water tank or causing evaporation/condensation
5. Possible End user-requirements:  
   Water level (pressure) must not deviate from the reference by more than 0.05 bar

## d)

1. System input= Desired pH level of discharge
2. System output= Current pH level of discharge
3. Plant input = instruction to add basic/acidic solution
4. Disturbance = Incomplete chemical reaction releases additional basic solution
5. Possible End user-requirements= pH level of output waste must not fall outside acceptable range of 7

## e)

method of using blood pressure was mentioned on group so I googled additional ways of measuring consciousness and brainwave measurement is one such method

1. System Input= desired neural activity
2. System Output= current neural activity
3. Plant input =amount of anaesthetic administered
4. Disturbance = external stimuli causing the patients brain to attempt to resume consciousess
5. Possible End user-requirements= patient neural activity must not exceed a certain threshold while the patient is meant to be unconscious. The voltage from the EEG electrodes must not exceed 0.5mV

## f)

1. System Input= Desired voltage and frequency of power system
2. System Output= Current voltage and frequency of ouput of power system
3. Plant input = Driving torque on generator
4. Disturbance = physical vibrations and distortions on generator shaft. Assorted rotational losses
5. Possible End user-requirements= Voltage must not deviate from its reference voltage by more than 2V and frequency must not deviate by more than 0.5Hz

## g)

1. System Input= Desired Tension in belt
2. System Output=Current Tension in belt
3. Plant input = applied voltage to DC motor
4. Disturbance = stretch in belt, motor slippage
5. Possible End user-requirements= tension in belt must not deviate from reference tension by more than 2N

## h)

1. System Input= input RMS voltage
2. System Output= amplified RMS voltage
3. Plant input = portion of output voltage
4. Disturbance = variation in open loop gain with temperature
5. Possible End user-requirements= amplifier must be able to amplify signals in 20kHz range to at least 20dB

## i)

1. System Input= data stream to be sent
2. System Output= data stream assembled from data packets
3. Plant input = Data packet
4. Disturbance = loss in transmission
5. Possible End user-requirements = data loss should not exceed 1%

## j)

1. System Input= Desired Attitude of Plane
2. System Output= Current Attitude of Plane
3. Plant input = Adjustment of wing flaps
4. Disturbance = Variations in air density, warping of wing materials
5. Possible End user-requirements = plane attitude must not vary from desired angle by more than 0.5

# Question 3

## a)

We are tracking an input disturbance p\*=p=4

## b)

With f=1

Therefore, for worst case scenario of p=1, g=99

With f=f

&

Solving simultaneously gives

1.0034

## c)

Disturbance is at output therefore p\*=1  
 and

We want tracking within 99% and disturbance rejection within 1%

Assuming H=1:

For tracking: worst case is where d=-1 and p=1

Therefore:

For error rejection: worst case is also where p=1