ECE 3510 homework # 10 Due: Wed, 2/18/09

c

1. Draw a basic control system loop such as that shown in Fig 4.7 (Bodson), show all the items listed on p. 59 plus a feedback sensor labeled $F(s)$ and a disturbance input.

2. Add $F(s)$ or $n_f(s)$ and $d_f(s)$ into the following equations: full $Y(s) =$

   With disturbance as zero: Eq. 4.5 Eq. 4.7 Eq. 4.10

   With input ($R(s)$) as zero: Eq. 4.13 Eq. 4.15

3. List 5 measures of a control system's quality (see p. 59-60) and list one or two things that can be done to achieve each.

4. The transfer functions of C(s) and P(s) are given below. In each case determine if the steady-state error will go to zero and whether disturbances will be completely rejected. Be sure to check for closed-loop stability when needed.

   a) $C(s) = \dfrac{s+4}{s^2+3\cdot s+2}$ $P(s) = \dfrac{s+1}{s^2+3\cdot s}$ b) $C(s) = \dfrac{s+1}{s^2+3\cdot s}$ $P(s) = \dfrac{s+4}{s^2+3\cdot s+2}$

   c) $C(s) = \dfrac{s\cdot(s+6)}{s^2+3\cdot s+2}$ $P(s) = \dfrac{s+8}{s^2+12\cdot s}$ d) $C(s) = \dfrac{s+9}{s^2+3\cdot s+2}$ $P(s) = \dfrac{s}{s+16}$

   e) $C(s) = \dfrac{s+1}{s^2+5\cdot s+6}$ $P(s) = \dfrac{s+1}{s^2+8\cdot s+15}$ f) $C(s) = \dfrac{s+1}{s^3+7\cdot s^2+12\cdot s}$ $P(s) = \dfrac{s+1}{s+3}$

5. Problem 4.2 (p.98) in the text. Use the Routh-Hurwitz method.

6. Characteristic equations of feedback sytems are shown below. In each case, use the Routh-Hurwitz method to determine the value range of K that will produce a stable system.

   a) $0 = s^4 + 20\cdot s^3 + 10\cdot s^2 + s + K$

   b) $0 = s^4 + 2\cdot K\cdot s^3 + 5\cdot s^2 + K\cdot s + K$

Answers

1., 2., 3. Read sections 4.1 - 4.2 in text (Bodson). $Y(s) = \dfrac{P\cdot C\cdot R + P\cdot D}{1 + P\cdot C\cdot F}$

4. a) Yes No b) Yes Yes

   c) No No d) No Yes

   e) No No f) Yes Yes

5. a) Yes b) No c) No

6. a) $0 < K < 0.4975$

   b) $0 < K < 2.25$

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