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Jordan University of Science and Technology
Electrical Engineering Department
EE440 Control Systems
spring 2016

April 19, 2016

Second midterm

Name: **Number** _____ **ectio** _____

Select the correct answer for each of the following 22 questions and write the corresponding letter in the answer space provided. **Please use Capital letters ONLY**

Selected formulas for your use $t_s = \frac{4}{\zeta\omega_n}$, $t_r = \frac{2.16\zeta + 0.6}{\omega_n}$, $P.O = 100e^{-\pi\zeta/\sqrt{1-\zeta^2}}$

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Answer	A	D	A	D	B	C	B	~~E~~ 6A	C	A	C	C	C	C	C	B	B	B	B	B	A	A

- **For a unity feedback control system with** $G(s) = \frac{k}{s(s+\alpha)}$**. If** α **and** $k > 0$**, answer the following**

Questions Q1-Q7

Q1. The position error constant and the system type number are respectively,
A. 0 &1 B. $\frac{1}{\alpha}$ & 1 C. $\frac{K}{\alpha}$ & 1 D. ∞ &1 E. None

Q2. The steady state error to a unity ramp input and the velocity error constant are respectively,
A. $\frac{k}{\alpha}$ & 0 B. $\frac{1}{\alpha}$ & 0 C. $\frac{k}{\alpha}$ & $\frac{\alpha}{k}$ D. $\frac{\alpha}{k}$ & $\frac{k}{\alpha}$ E. None

Q3. If the steady state error to a ramp is 0.01then,
A. K =100α B. K=10α C. K=0.1α D. K=0.01α E. None

Q4. The sensitivity of the closed loop TF to variation in k is (s=1, k=4& $\alpha = 5$)
A. 10% B. 20% C. 25% D. 15 % E. None

Q5. The sensitivity of the closed loop TF to variation in α is (s=1, k=10 & $\alpha = 1$)
A. 15% B. 17% C. 12.5% D. 8% E. None

Q6. If k=4 and the settling time (2%) is 4 sec. then the damping ratio and α respectively are,
A. 0.707 & 2 B. 0.707 & 0.707 C. 0.5 &2 D. 0.45 & 2 E. None

Q7. If k=4 and the settling time (2%) is 4 sec. then the peak time and the rise time in sec. are;
A. 0.84 &0.42 B. 1.8 &0.84 C. 2.16 & 1.4 D. 042 &0.24 E. None

- **For a unity feedback control system with $G_c = k + \frac{p}{s}$ and $G(s) = \frac{5}{s(s+5)}$, answer the following questions (Q8-Q11)**

Q8. The system is (asymptotically) stable for
A. $k = \frac{p}{5}$ & p > 0 B. $25k > p > 0$ C. 5k > 0 & p >0 D. k & p > 0 E. None

Q9. If the error due to unit acceleration input($r(t) = 0.5t^2$) is zero, then
A. $k = \frac{p}{5}$ & p > 0 B. $25k > p > 0$ C. 5k > 0 & p >0 D. k & p > 0 E. None

Q10. If k = 1& p = 26, then the error due to unit step input is
A. 0 B.1/26 C.1 D. ∞ E. None

Q11. If p =0, then by increasing k >0
A. Percent over shoot (P.O.S) will increase while the settling time will decrease
B. Percent over shoot (P.O.S) and the settling time will decrease
C. Percent over shoot (P.O.S) will increase while the settling time remains constant
D. Percent over shoot (P.O.S) remains constant while the settling time become faster
E. None

- **For a unity feebdback control system with $G(s) = \frac{(ks+p)}{s^2}$. Answer the following three questions (Q12-Q14)**

Q12. The sensitivity of the error signal to variation in p (for k=1,p=10 and s=1) is

A. 0 B. 1 C. 1.64 D. 0.1 E. None

Q13. The system is not a standard second order (zero in the numerator) but can be approximated to second order with settling time 4 second if
A. p > 10k B. $\xi^2 < \frac{1}{20}$ C. A & B D. $p > k$ E. None

Q14. Design k and p such that the unit step response has no oscillation
A. k, p > 0 B. $k > 2\sqrt{p}$, p >0 C. $p = k = 2$ D. $k > 0, p < 0$ E. None

- **A closed loop system characteristic equation is given as $\Delta(s) = s^4 + s^3 + k\,s^2 + ps + 10 = 0$, answer the following four question (Q15-Q18)**

Q15. The closed loop system is (asymptotically) stable for
A. k >p& k>kp-1 B. kp>10& k>0 C. p(k-p)>10& k>p D. k_1=1 & k_2=10 E. None

Q16. For k=2 & p=5, the system will be
A. Asymptotically Stable B. Unstable C. CriticallyStable D. cannot tell E. None

Q17. For k=10 & p=8, the number of closed loop poles in the left half plane will be
A. 1 pole B. 2 poles C. 3 poles D. 4 poles E. None

Q18. For k=1& p=2, the number of closed loop poles in the right half plane will be
A. 1 pole B. 2 poles C. 3 poles D. 4 poles E. None

Q19. For k=10& p=0, the number of closed loop poles in the right half plane will be

A. 1 pole B. 2 poles C. 3 poles D. 4 poles E. None

- Q20. Suppose the output of the closed loop control system is given as $Y(s)=\frac{2}{(s+2)^2}R(s)-\frac{1}{s+2}D(s)$, where Y is the output, R is the input and D is the disturbance. Then the value of the steady state error is (assume that $R(s)=\frac{1}{s}$, $D(s)=\frac{1}{s}$)

A. 0 B. 0.25 C. 1 D. 1.5 E. None

- **Q21. In a unity feedback control system with very large gain ($G_cG\to\infty$), the steady state error is actually reduced and**

A. Disturbance is rejected with noise minimized
B. Disturbance is rejected with sensitivity is maximized.
C. Noise is maximized with sensitivity to variation in G_c is made very large.
D. Steady state tracking error will increase with disturbance is minimized.
E. None.

- **Q22. When System sensitivity to feed forward TF is made very small, system sensitivity to feedback Tf is 100%, then a good engineer will**

A. Try to reduce noise and disturbance.
B. Maximize Sensitivity to forward TF in order to reduce that of Feedback.
C. Buy very precise components for foward device so to minimize changes.
D. Call a friend who has more experience
E. None of the above but minimize the use of the system.