A

北京航空航天大学

2015－2016 学年 期中考试

Modern Control Engineering

Examination Paper

班 级_____学 号 _____

姓 名_____成 绩 _____

2015 年 11 月 15 日

Class_____ Student number_____ Name_____ Score_____

Examination Questions

1.（15 points） A system consists of the following equations:

$$x_1 = r - c$$

$$x_2 = \tau \dot{x}_1 + K_1 x_1,$$

$$x_3 = K_2 x_2,$$

$$x_4 = x_3 - x_5 - K_5 c,$$

$$\dot{x}_5 = K_3 x_4,$$

$$K_4 x_5 = T\dot{c} + c,$$

where τ, K_1, K_2, K_3, K_4, K_5 and T are positive constants, $r(t)$ is the input signal and $c(t)$ is the output signal. Draw its block diagram and obtain the transfer function $C(s)/R(s)$.

2.（15 points） A block diagram of a system is shown in Figure 2. Obtain the transfer function $C(s)/R(s)$.

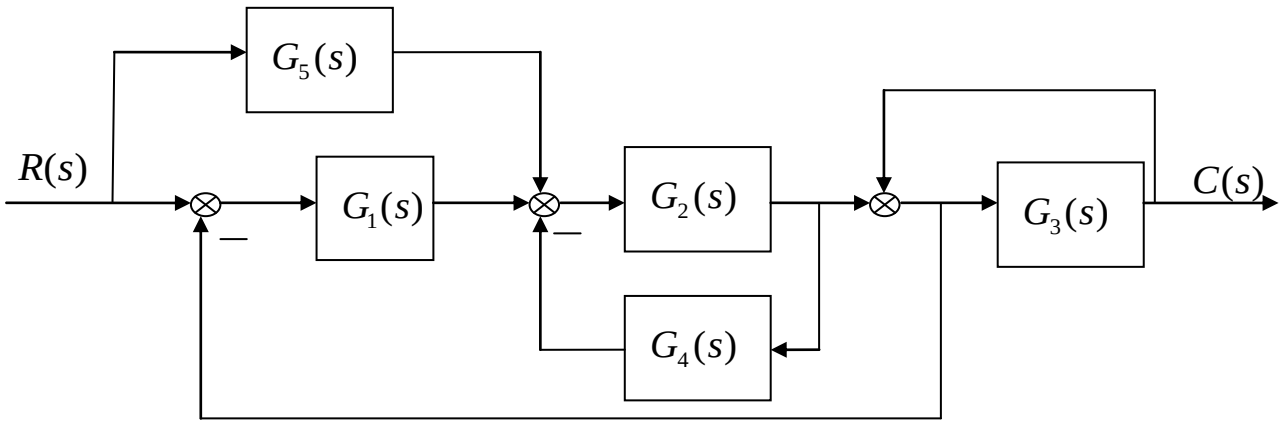

Figure 2

3.（**20 points**）The block diagram of a system is given by Figure 3. Determine the positive parameter τ such that the damping ratio is $1/\sqrt{2}$. Then, obtain the unit-step response $c(t)$, t_p, M_p and t_s (5%), respectively.

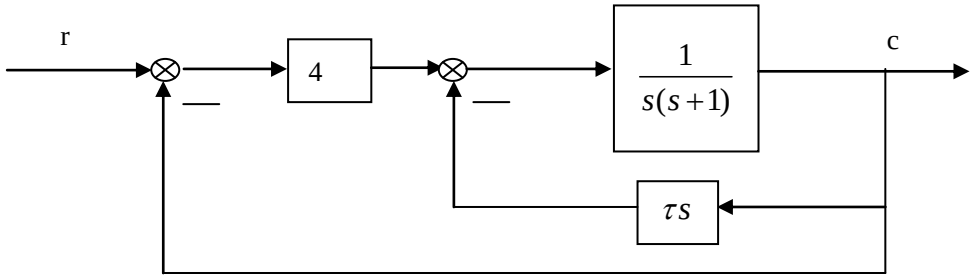

Figure 3

4. (15 points) The block diagram of a system is shown in Figure 4. Determine the system stability. If the system is stable, determine the steady-state errors e_{ssr} and e_{ssn}.

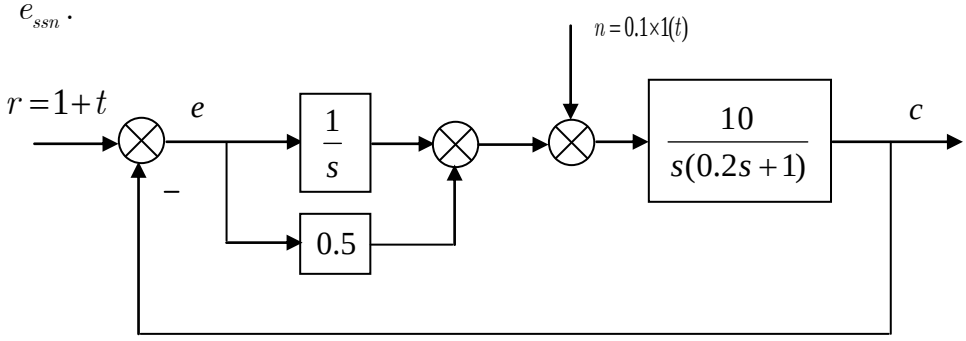

Figure4

5. (15 points) The open loop transfer function of a unity feedback system is

$$G(s)=\frac{3s+2}{s^2(Ts+1)}$$

Sketch, according to the rules, the root loci when T varies from 0 to $+\infty$. Further, determine the range of T for which the system is stable.

6. (20 points) The open loop transfer function of a unity feedback system is

$$G(s)=\frac{K}{s(s+6)(s+8)}$$

Sketch, according to the rules, the root loci when K varies from 0 to $+\infty$. Determine the value of K such that the two closed loop dominant poles have damping ratio $1/\sqrt{2}$. What are the locations of the three closed loop poles for such a damping ratio?