Select the correct answer for each of the following 15 questions and circle the corresponding letter on the answer sheet provided.

* A control system shown in Figure 1.Use this Figure to answer questions1-3

1. The closed loop gains are

(a) $-s^2, \frac{-1}{s}, \frac{-1}{s}$, and $-s^2$ (b) $s^2, \frac{1}{s}, \frac{1}{s}$, and s^2 (c) $-s^2, \frac{-1}{s}, \frac{1}{s}$, and s^2

(d) $-s^2, \frac{-1}{s}, \frac{-1}{s}$, and s^2 (e) none of the above

2. The transfer function $\frac{C(s)}{R(s)}$ is

(a) $\frac{s^3+1}{-2s^4+s^2+2s}$ (b) $\frac{s^3+1}{s^2}$ (c) $\frac{s^3+1}{2s^4+s^2+2s}$ (d) $\frac{s^3+1}{-2s^4+s^2-2s}$ (e) none of the above

3. The forward path gains(from $R(s)$ to $C(s)$) are

(a) $-s$, and $\frac{-1}{s}$ (b) s, and $\frac{-1}{s^2}$ (c) $-s$, and $\frac{-1}{s^2}$ (d) s, and $\frac{1}{s}$ (e) s, and $\frac{1}{s^2}$

*Consider the block diagram shown in Fig.2, Use this Figure to answer questions4-6

4. The transfer function $\frac{C(s)}{R(s)}$ (assume $D(s)=0$) is

(a) $\frac{G_1G_2}{1-G_1H_1-G_1G_2H_2}$ (b) $\frac{G_1G_2}{1+G_1H_1+G_1G_2H_2}$ (c) $\frac{G_1G_2}{1+G_1H_1-G_1G_2H_2}$ (d) $\frac{G_1G_2}{1-G_1H_1-G_1G_2H_2}$

(d) none of the above

5. The transfer function $\frac{C(s)}{D(s)}$ (assume $R(s)=0$) is

(a) $\frac{1+G_1H_1}{1-G_1H_1-G_1G_2H_2}$ (b) $\frac{1-G_1H_1}{1-G_1H_1-G_1G_2H_2}$ (c) $\frac{1+G_1H_1}{1+G_1H_1-G_1G_2H_2}$ (d) $\frac{1-G_1H_1}{1-G_1H_1-G_1G_2H_2}$

(e) none of the above

6.The transfer function $H_1(s)$ such that $D(s)$ has no effect on $C(s)$ is

(a) $H_1(s)=\frac{-1}{G_1(s)}$ (b) $H_1(s)=\frac{1}{G_1(s)}$ (c) $H_1(s)=-G_1(s)$ (d) $H_1(s)=G_1(s)$ (e) none of the above

7. A system has a transfer function $G(s)=\frac{s(s-1)}{(s+2)(s+p)}$ which can be expanded in partial fraction in the form $k_1+\frac{k_2}{s+2}+\frac{k_3}{s+p}$. If $p\neq 2$, and $k_2=1.5$. Then the value of p is

(a) 8 (b) 5 (c) 4 (d) 3 (e) 6

** A control system shown in Figure 3.Use this Figure to answer questions8-10

8. The transfer function $\frac{C(s)}{R(s)}$ is

(a) $\frac{k_1k_2}{s^2+(2-\beta k_2)s+k_1k_2}$ (b) $\frac{k_1k_2}{s^2+(2+\beta k_2)s+k_1k_2}$ (c) $\frac{k_1k_2}{s^2+(2+\beta)s+k_1k_2}$

(d) $\dfrac{k_1 k_2}{s^2 - (2+\beta k_2)s + k_1 k_2}$ (e) $\dfrac{1}{s^2 + (2+\beta k_2)s + k_1 k_2}$

9. Find β such that the unit step response is critically dammped (assume $k_1 = 2$, $k_2 = 5$)
   (a) 1.15 (b) 1.39 (c) 0.494 (d) 0.865 (e) none of the above

10. Find the range of β such that the unit step response is overdamped (assume $k_1 = 2$, $k_2 = 5$)
   (a) $\beta > 0.865$ (b) $\beta > 0.494$ (c) $\beta > 1.39$ (d) $\beta > 1.15$ (e) $\beta < 0.865$

11. Find the range of β such that the unit step response is underdamped (assume $k_1 = 2$, $k_2 = 5$)
   (a) $0 < \beta < 1.39$ (b) $0 < \beta < 0.494$ (c) $0 < \beta < 0.865$ (d) $0 < \beta < 1.15$ (e) $\beta > 0.865$

12. Consider a control system described by $\dot{y}(t) + 3y(t) = 4e(t)$, where $y(t)$ is the output, and $e(t)$ is the control signal. Suppose that $e(t) = 5(r(t) - y(t))$. Then the trasfer function $\dfrac{Y(s)}{R(s)}$ is
   (a) $\dfrac{15}{s^2 + 3s + 15}$ (b) $\dfrac{16}{s^2 + 3s + 16}$ (c) $\dfrac{20}{s^2 + 3s + 20}$ (d) $\dfrac{8}{s^2 + 3s + 8}$ (e) none of the above

13. One of the following components can be used as a controller in the feed back control system
   (a) computer (b) person (c) comparator and summer (d) motor (e) both a and b

14. Suppose the unit step response of a LTI-system is $tu(t)$, then the transfer function of the system is
   (a) $\dfrac{1}{s^2}$ (b) $\dfrac{1}{s}$ (c) 1 (d) s (e) s^2

15. One can convert the open loop control system into a closed loop control system by adding the following Components
   (a) Feedback loop (b) controller (c) feedback loop+controller (d) feedbak loop +comparator
   (e) feedback loop+comparator+ controller

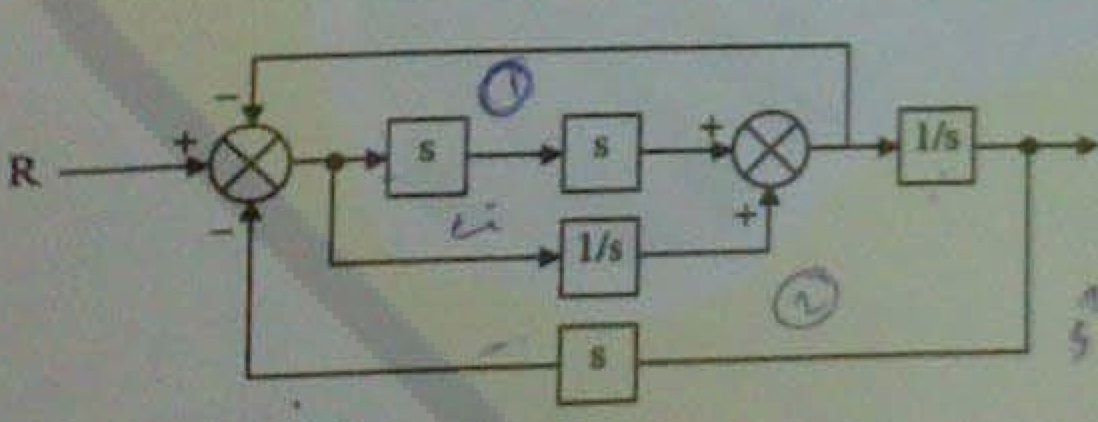

fig.1

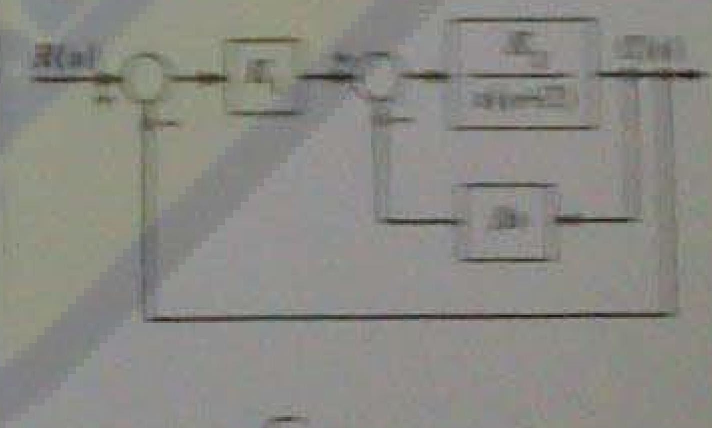

Fig3

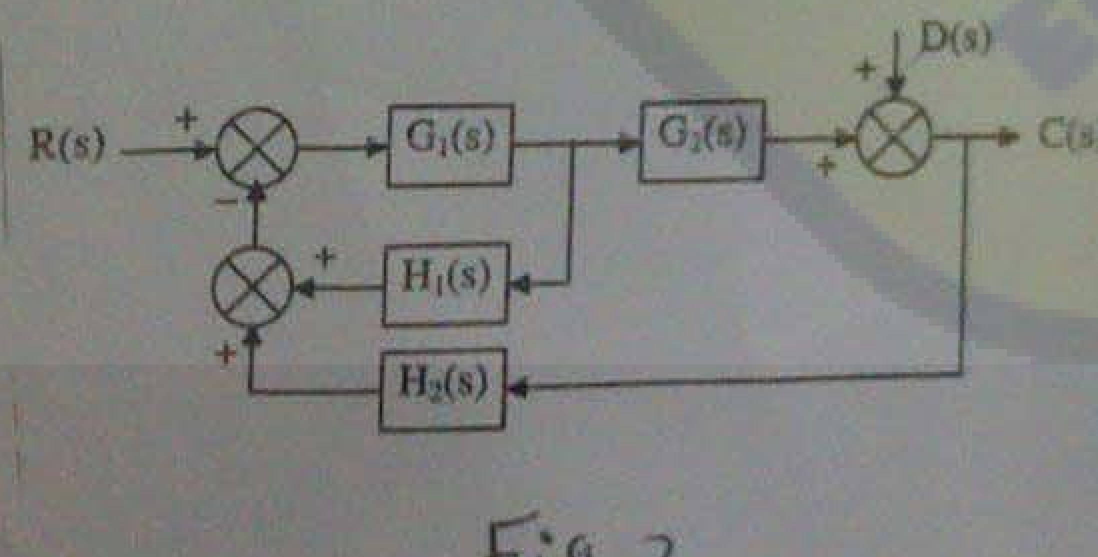

Fig.2