請於答案卷上作答，於試題卷上作答者，不予計分。

【題目共 4 題】

1. Consider a damped spring-mass system with an actuator as shown in **Fig. 1(a)**. For a position-regulation system, which attempts to maintain the position of the block in one fixed place regardless of disturbances. (a) Please derived the closed-loop dynamics. (10%) (b)if the parameters of the damped spring-mass system are m=1, b=1 and k=1, find the gains K_p and K_v for a position-regulation control law the results in the system's being critically damped with a closed-loop stiffness of 16.0. (15%)

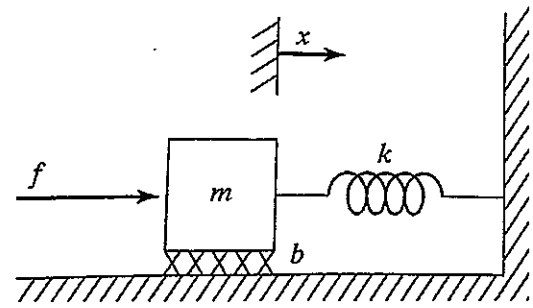

Fig. 1(a)

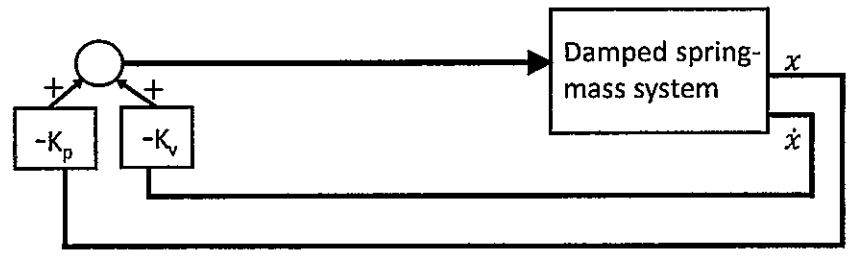

Fig. 1(b)

2. Consider a feedback control system shown in **Fig. 2(a)**. The root loci of the feedback control system are shown in **Fig. 2(b)**. (a) Find the parameters *a*, *b*, *c*, and *d* indicated in the forward-path transfer function of **Fig. 2(a)** (10%). (b) Find the gain *K* that the root loci of the system intersects the imaginary axis. (15%)

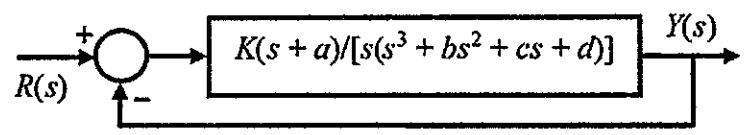

Fig. 2(a)

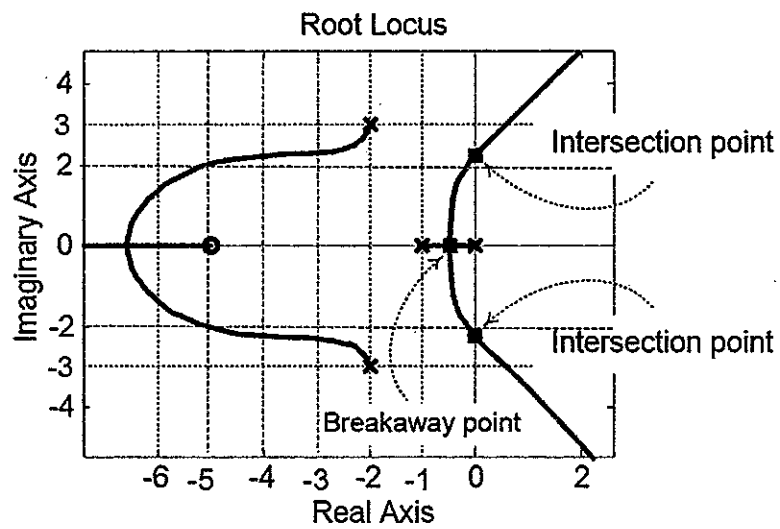

Fig. 2(b)

3. Consider a second-order position control system shown in **Fig.3** with the transfer functions of the plant G(s)= $\frac{1}{s(s+1)}$ and D(s)= $K\frac{s+a}{s+b}$

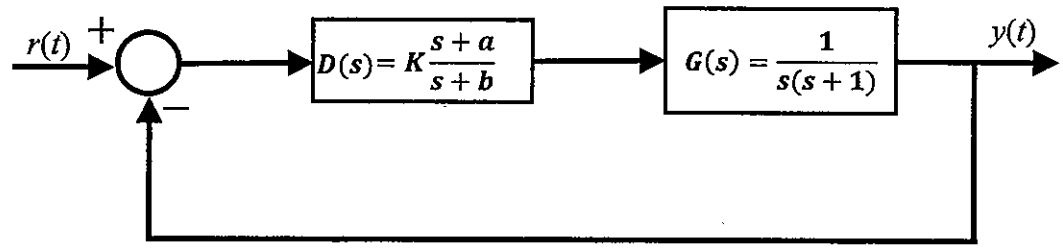

Fig. 3

(a) Please calculate the steady state error for a unit-ramp input r(t) if K=10 (10%)
(b) Please draw the Bode plot of G(s) and find the phase margin of G(s) (10%)
(c) Please design a lead compensator D(s) so that the phase margin is larger than 45° (20%)

4. Consider a plant is described as $\frac{d}{dt}\begin{bmatrix}x_1\\x_2\end{bmatrix} = [1 \quad -1]u$, please design a state feedback so that the poles of the closed loop system are located at -20 and -10. (10%)

試題隨卷繳回