※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Consider the following system transfer function:

$$G_p(s) = \frac{1}{s+0.1}$$

(a) An open-loop control is shown in Fig. 1(a). Design the control, $G_c(s)$, so that the combined plant and controller $G_c(s)G_p(s)$ has a pole at p=-2, and the output $y(t)$ tracks a constant reference signal $r(t)=r_0\mu(t)$ with zero steady-state error, where $e_{ss}=r_0-y_{ss}$. (10%)

(b) Now, suppose that the plant pole at p=-0.1 was modeled incorrectly and that the actual pole is p=-0.2. Apply the control design in part (a) and the input $r(t)=r_0\mu(t)$ to the actual plant, and compute the resulting steady-state error. (10%)

(c) A feedback controller $G_s(s)=2(s+0.1)/s$ is used in place of open-loop control, as shown in Fig. 1(b). Verify that the closed-loop pole of the nominal system is at p=-2. (The nominal system has the plant pole at p=-0.1.) Let the input to the closed-loop system be $r(t)=r_0\mu(t)$. Verify that the steady-state error $e_{ss}=r_0-y_{ss}$ is zero. (10%)

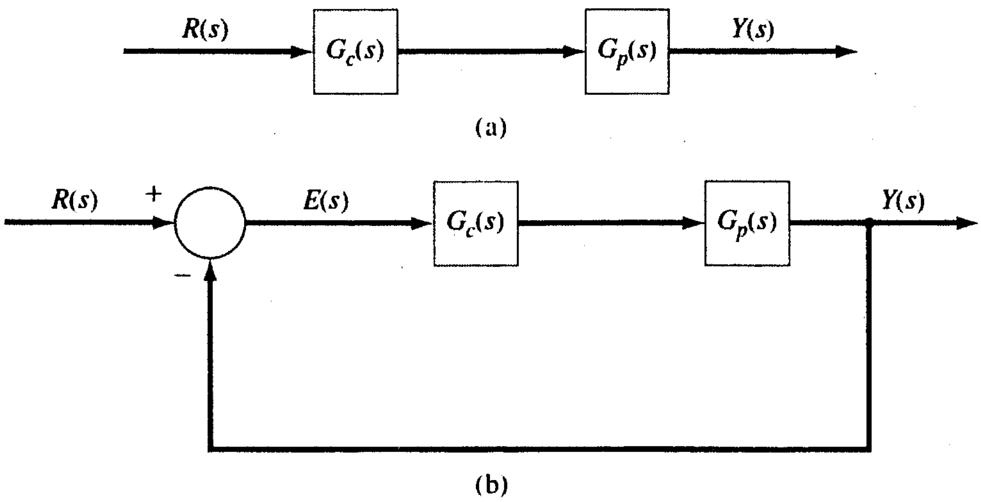

Fig. 1.

2. Consider a feedback connection as shown in Fig. 1(b). The impulse response of the system with transfer function $G_p(s)$ is $h(t)=(\sin t)\,\mu(t)$.

(a) Determine the transfer function $G_c(s)$ so that the impulse response of the feedback connection is equal to $(\sin t)e^{-t}\,\mu(t)$. (15%)

(b) For $G_c(s)$ equal to your answer in part(a), compute the step response of the feedback connection. (15%)

背面仍有題目，請繼續作答

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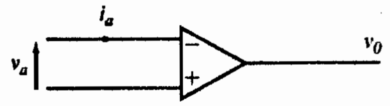
3. A proportional controller can be implemented by the use of a simple amplifier. However, PD, PI, and PID controllers require a compensating network. Often, this is achieved in analog with the use of operational amplifier (op amp) circuits. Consider the ideal op amp in Fig. 2(a). This op amp is an infinite impedance circuit element, so that v_a=0 and i_a=0. These relationships also hold when the op amp is embedded in a circuit, as shown in Fig. 2(b).

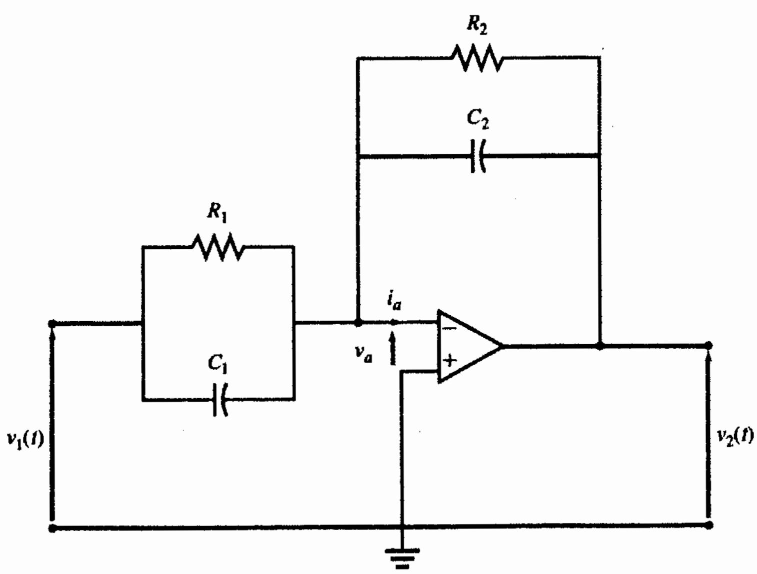
(a) Suppose that R_1=1000Ω, R_2=2000Ω, C_1=C_2=0 in Fig. 2(b). Compute the transfer function between the input v_1 and output v_2. (This circuit is known as an inverting circuit.). (10%)

(b) Suppose that R_1=10kΩ, R_2=20kΩ, C_1=10μF, and C_2=0 in Fig. 2(b). The resulting circuit is a PD controller. Compute the transfer function of the circuit. (15%)

(c) Suppose that R_1=10kΩ and R_2=∞ (removed from circuit), C_1=200μF and C_2=10μF in Fig. 2(b).the resulting circuit is a PI controller. Compute the transfer function of the circuit. (15%)



(a)



(b)

Fig. 2