

國立臺灣科技大學

八十九學年度碩士班招生考試試題

系所組別：工程技術研究所自動化及控制學程甲組、工程技術研究所自動化及控制學程丙組

科目：工程數學

總分 100 分

1. (a) Solve the integral equation by the Laplace transformation method. (10%)

$$y(t) = \sin 2t + \int_0^t y(\tau) \sin 2(t-\tau) d\tau$$

- (b) Find the general solution of the differential equation (10%)

$$(x-2)^2 y'' + 2(x-2)y' - 6y = 0$$

2. Fig. 1 shows a system, which  $M_1, k_1, \omega$  are known. Please find  $M_2$  and  $k_2$  to make  $M_1$  keeping rest (i.e.  $y_1 = 0$ ), while the external force  $F_0 \cos \omega t$  acts on  $M_1$ . (15%)

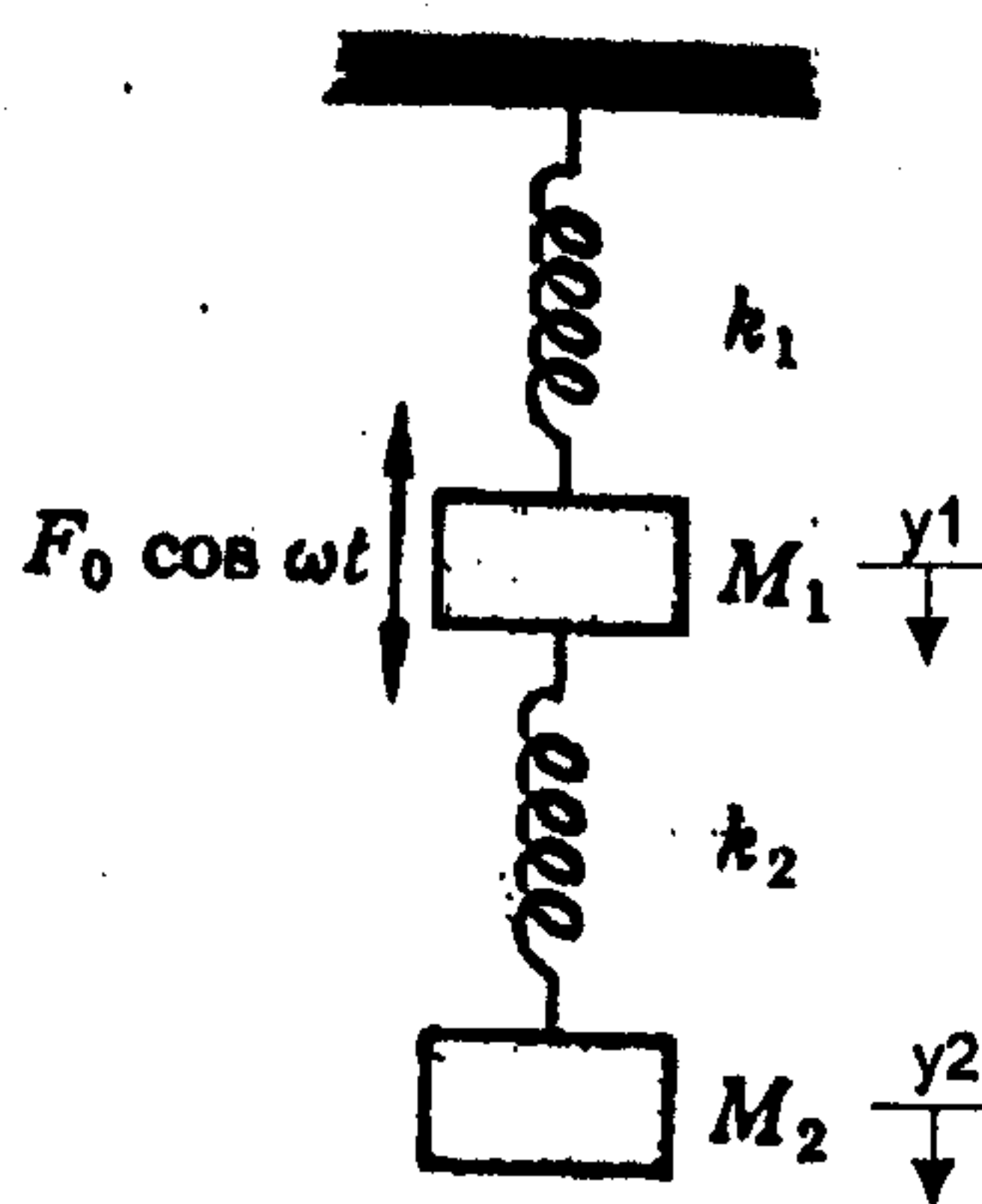


Fig. 1

3. (a) Expand the periodic function

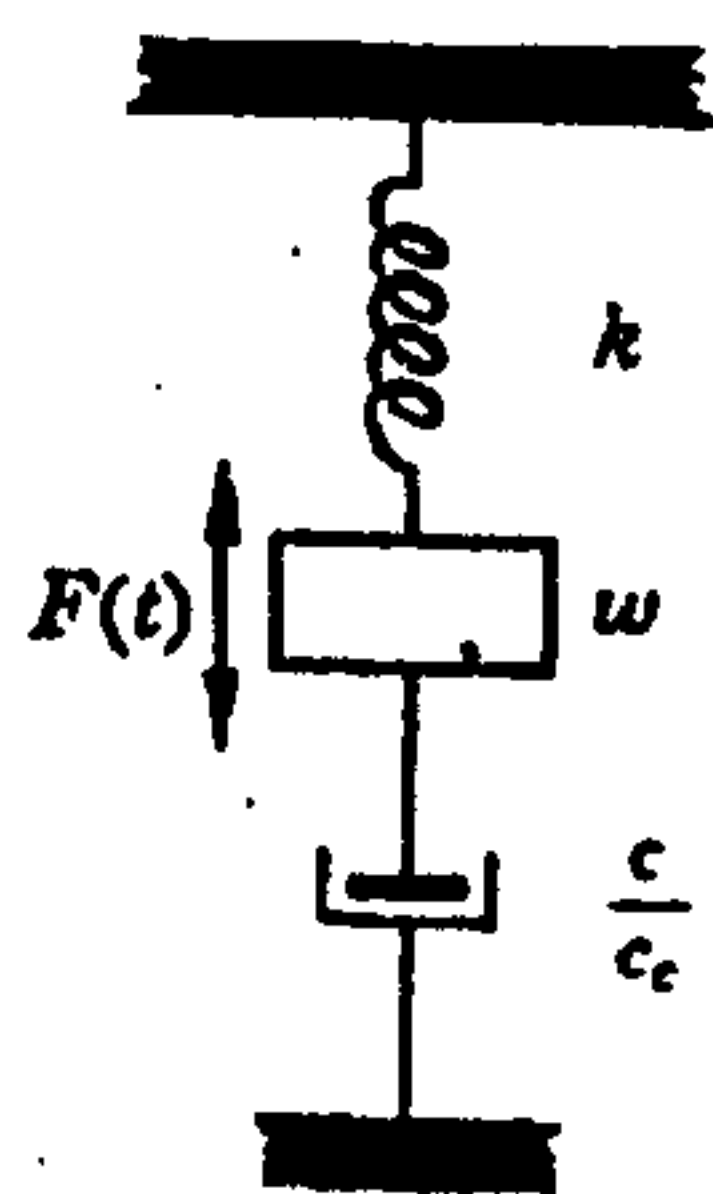
$$\omega$$

$$f(t) = 1 \quad 0 \leq t \leq 1$$

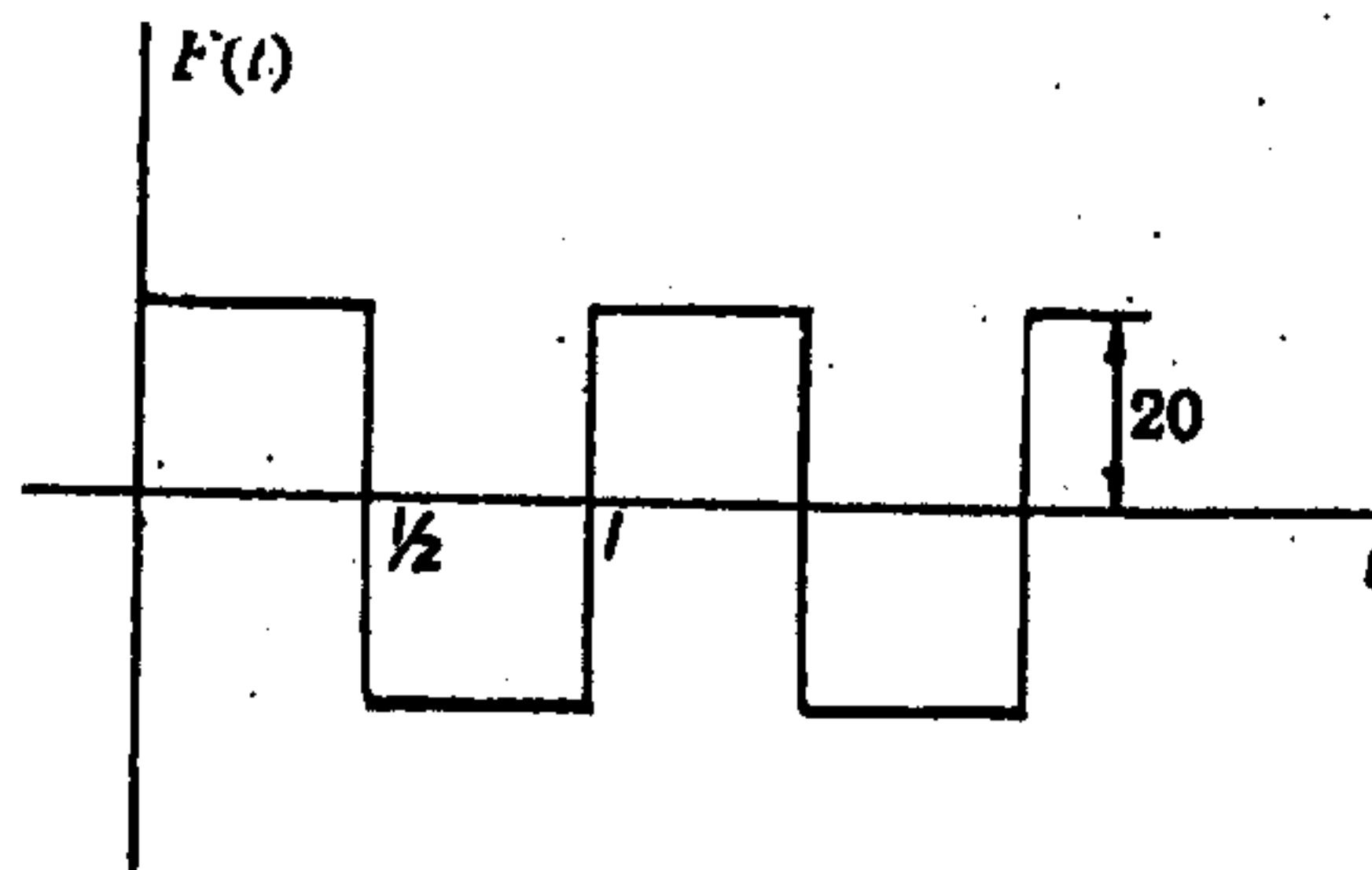
$$f(t) = -1 \quad 1 \leq t \leq 2$$

with period 2 in a Fourier Series in Complex Form (10%)

- (b) Fig. 2 shows a spring-mass forced vibration system with an external force  $F(t)$ . Please describe  $F(t)$  by Fourier Expansion. (10%)

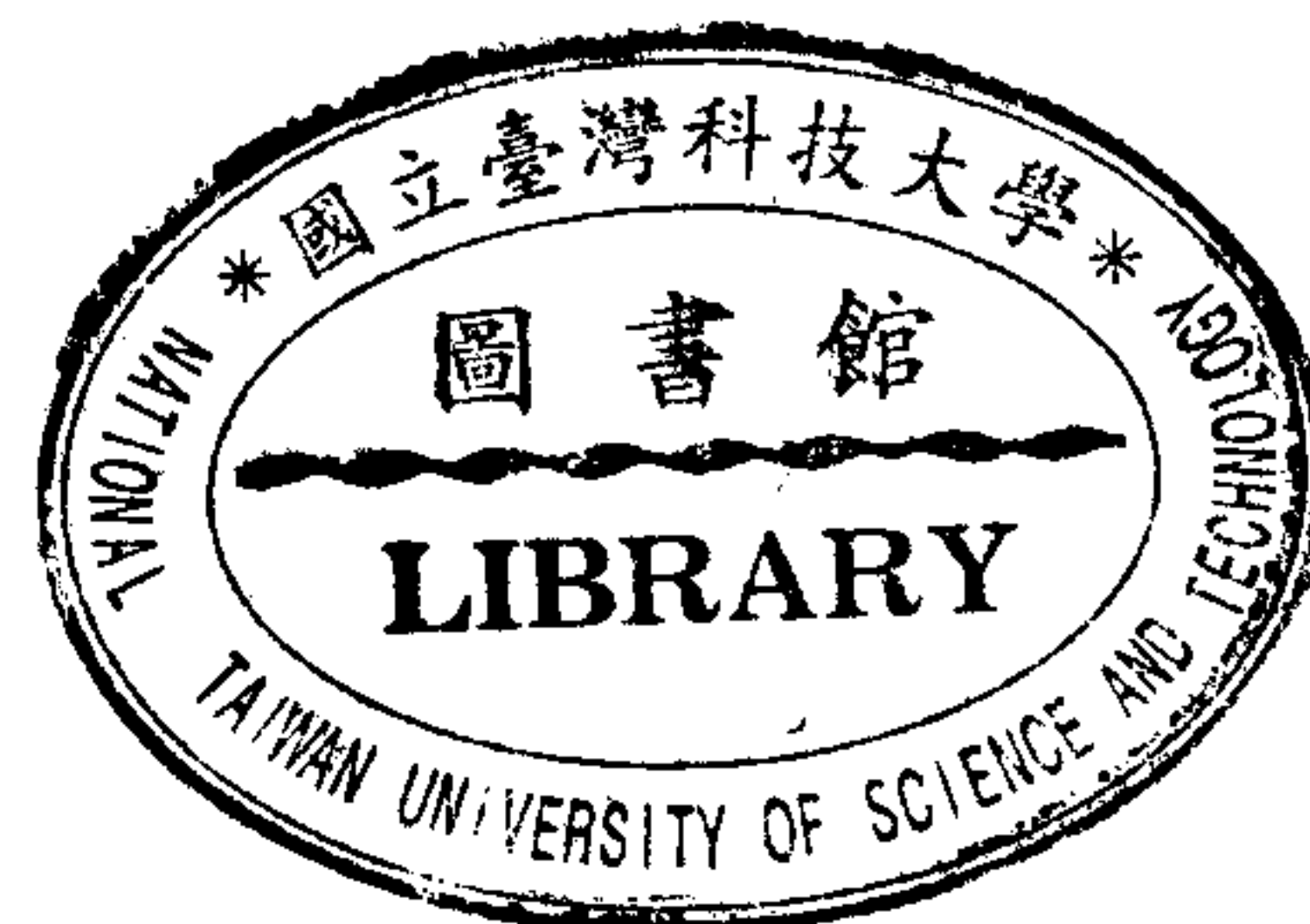


(a)



(b)

Fig. 2



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4. Find the complete solution set of the following system of linear equations by Gauss Elimination method. (10%)

$$x_1 + x_3 = 0$$

$$x_2 + x_3 + x_4 = 1$$

$$x_1 + 2x_3 + x_4 = 0$$

$$x_1 + x_2 - x_4 = 1$$

5. Given a matrix

$$A = \begin{bmatrix} 1 & 1 & -4 \\ 2 & 0 & -4 \\ -1 & 1 & -2 \end{bmatrix}$$

- (a) Find the eigenvalues and the corresponding eigenvectors of A. (5%)  
 (b) Find the matrix P such that  $P^{-1}AP = D$ , where D is a diagonal matrix. (10%)

6. (a) If C is a circle  $|z| = 2$ , please find (10%)

$$\int_C f(z) dz \quad \text{where} \quad f(z) = \frac{1}{z \sin(z)}$$

(b) Using the method of residues to evaluate the integral (10%)

$$\int_{-\infty}^{\infty} \frac{x \sin(mx)}{(x^2 + a^2)(x^2 + b^2)} dx$$

