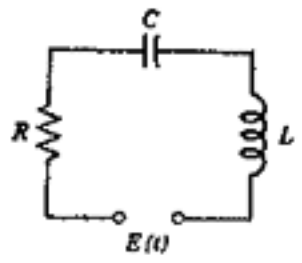
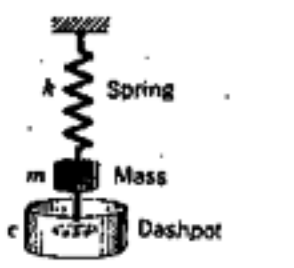
1. (20%) Explain the following terminology (2 points each)
   (a) Simple connected region
   (b) Generalized eigenvector
   (c) Nonsingular matrix
   (d) Green's theorem
   (e) Nullity
   (f) Rank
   (g) Simple curve
   (h) Linear transformation
   (i) Central limit theorem
   (j) Directional derivative

2. (20%) For any square matrix A;
   (a) Verify the eigenvectors associated with distinct eigenvalues are linear independent.
   (b) Under what conditions, we can (or can not) find a nonsingular matrix T such that $T^{-1} A T$ is a diagonal matrix.

3. (10%)(a) Write down a second-order constant coefficient equation for following RLC-circuit and Mass-spring mechanical system.



RLC-circuit



Mass–spring system

   (b) From the energy point of view, please explain the role of each component in those two systems.

(背面仍有題目,請繼續作答)

4. (10%) Evaluate the surface integral $\iint_S F \bullet n dA$

$F = (x+z)i + (y+z)j + (x+y)k$ S: $x^2 + y^2 + z^2 = 4, z \geq 0$

5. (20%) For a full-wave rectification of sinωt,

(a) Please find its Laplace transform.

(b) Please find its Fourier Series representation.

6. (20%) Solve the following equation,

$$y_1'' = -5y_1 + 2y_2$$

$$y_2'' = 2y_1 - 2y_2$$

and $y_1(0) = y_2(0) = 1$, $y_1'(0) = y_2'(0) = 0$