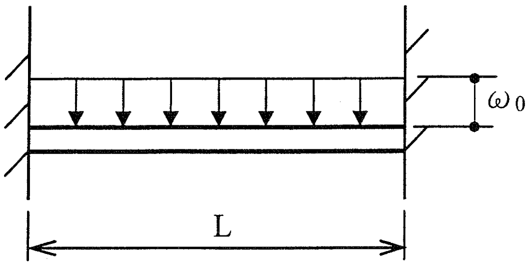
1. A beam of length L is clamped at both ends, and a uniform distributed load ω_0 is applied along its length. That is, $\omega(x) = \omega_0$, 0<x<L. If the deflection $y(x)$ satisfies the following equation:

$$EI\frac{d^4 y}{dx^4} = \omega(x)$$

Please find the deflection of the beam.



2. The pressure of material is p, specific volume is v and temperature is T, the relationship between three parameters is pv/T=constant, if one scale s, its deferential form is δS or $dS = \frac{dT}{T} - \frac{vdp}{T}\delta S$, please answer the following equations:

(1)The differential equation is an exact differential or non-exact differential equation? (Please approve it)

(2) Determine s is a state function or route function? (Approve it)

(3)What is the relation between state function and exact differential? (Please describe it)

3. Consider the system represented in state variable form

$$\dot{x} = Ax + Bu$$

$$y = Cx + Du$$

where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -k & -k & -k \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

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$C = [1 \quad 0 \quad 0], \quad D = [0].$

(a) What is the system transfer function?

(b) For what values of k is the system stable?

4. Try to estimate $\oint_C \bar{F} \bullet \overline{dR}$ by using Green's theorem, where $\bar{F} = y\hat{i} - x\hat{j}$ and c: circle $x^2 + y^2 = a^2$.

5. The model of the vibrating membrane for obtaining the displacement u(x,y,t) of a point (x,y) of the membrane from rest (u=0) at time t is $\frac{\partial^2 u}{\partial t^2} = c^2(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2})$,
And u=0 on the boundary, u(x,y,0)=f(x,y), $u_t(x,y,0) = g(x,y)$, this is the two-dimensional wave equation with $c^2 = \frac{T}{\rho}$. If a rectangular membrane (x length =a, y length =b), solve this PDE and give the final form of u(x,y,t).