Multiple-Choice Test

Chapter 08.07
Finite Difference Method

1. The exact solution to the boundary value problem

$$\frac{d^2y}{dx^2} = 6x - 0.5x^2,\ y(0) = 0,\ y(12) = 0$$

for $y(4)$ is

(A) -234.67
(B) 0.00
(C) 16.000
(D) 37.333

2. Given

$$\frac{d^2y}{dx^2} = 6x - 0.5x^2,\ y(0) = 0,\ y(12) = 0$$

the value of $\frac{d^2y}{dx^2}$ at $y(4)$ using the finite difference method and a step size of $h = 4$ can be approximated by

(A) $\frac{y(8) - y(0)}{8}$
(B) $\frac{y(8) - 2y(4) + y(0)}{16}$
(C) $\frac{y(12) - 2y(8) + y(4)}{16}$
(D) $\frac{y(4) - y(0)}{4}$

3. Given

$$\frac{d^2y}{dx^2} = 6x - 0.5x^2,\ y(0) = 0,\ y(12) = 0,$$

the value of $y(4)$ using the finite difference method with a second order accurate central divided difference method and a step size of $h = 4$ is

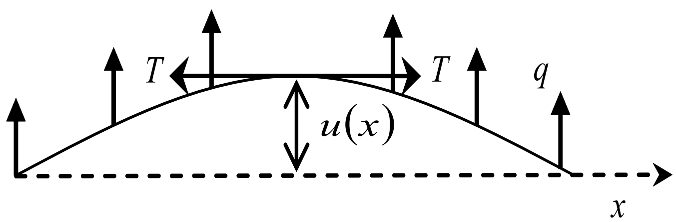
(A) 0.000
(B) 37.333
(C) -234.67
(D) -256.00

4. The transverse deflection u of a cable of length L that is fixed at both ends, is given as a solution to

$$\frac{d^2u}{dx^2} = \frac{Tu}{R} + \frac{qx(x-L)}{2R}$$

where

T = tension in cable
R = flexural stiffness
q = distributed transverse load



Given $L = 50"$, $T = 2000\ \text{lbs}$, $q = 75\ \frac{\text{lbs}}{\text{in}}$, and $R = 75\times10^6\ \text{lbs}\cdot\text{in}^2$

Using finite difference method modeling with second order central divided difference accuracy and a step size of $h = 12.5"$, the value of the deflection at the center of the cable most nearly is

(A) 0.072737″
(B) 0.080832″
(C) 0.081380″
(D) 0.084843″

5. The radial displacement u of a pressurized hollow thick cylinder (inner radius =″,5 outer radius = 8″) is given at different radial locations.

Radius (in)	Radial Displacement (in)
5.0	0.0038731
5.6	0.0036165
6.2	0.0034222
6.8	0.0032743
7.4	0.0031618
8.0	0.0030769

The maximum normal stress, in psi, on the cylinder is given by

$$\sigma_{\max} = 3.2967 \times 10^6 \left(\frac{u(5)}{5} + 0.3 \frac{du}{dr}(5) \right)$$

The maximum stress, in psi, with second order accuracy is

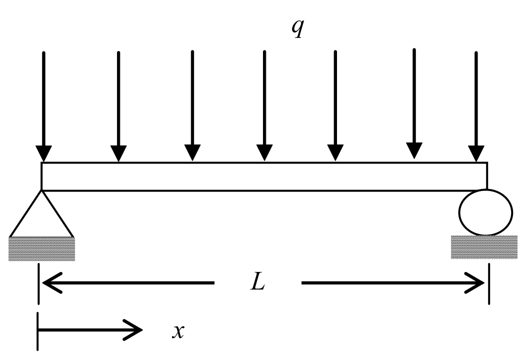
(A) 2079.6
(B) 2104.5
(C) 2130.7
(D) 2182.0

6. For a simply supported beam (at $x = 0$ and $x = L$) with a uniform load q, the vertical deflection $v(x)$ is described by the boundary value ordinary differential equation as

$$\frac{d^2v}{dx^2} = \frac{qx(x-L)}{2EI}, \quad 0 \le x \le L$$

where
E = Young's modulus of the beam
I = second moment of area

This ordinary differential equation is based on assuming that $\frac{dv}{dx}$ is small. If $\frac{dv}{dx}$ is not small, then the ordinary differential equation is given by



(A) $$\frac{\dfrac{d^2v}{dx^2}}{\sqrt{1+\left(\dfrac{dv}{dx}\right)^2}} = \frac{qx(x-L)}{2EI}$$

(B) $$\frac{\dfrac{d^2v}{dx^2}}{\left(1+\left(\dfrac{dv}{dx}\right)^2\right)^{3/2}} = \frac{qx(x-L)}{2EI}$$

(C) $$\frac{\dfrac{d^2v}{dx^2}}{\sqrt{1+\left(\dfrac{dv}{dx}\right)}} = \frac{qx(x-L)}{2EI}$$

(D) $$\frac{\dfrac{d^2v}{dx^2}}{1+\dfrac{dv}{dx}} = \frac{qx(x-L)}{2EI}$$

For a complete solution, refer to the links at the end of the book.