L-2/T-2/CE Date : 22/07/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CE 205** (Numerical Methods)

Full Marks: 140 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Explain Gauss-Elimination Method with required Expressions. **(11⅓)**

(b) Solve the following system using Crout's Method **(12)**

$$2.51x_1 + 1.48x_2 + 4.53x_3 = 0.05$$
$$1.48x_1 + 0.93x_2 - 1.30x_3 = 1.03$$
$$2.68x_1 + 3.04x_2 - 1.48x_3 = -0.53$$

2. (a) Explain Gauss – Quadrature method and derive the required parameters for n = 3. **(11⅓)**

(b) The deflection at various points on a normally loaded plate are shown in the table. Calculate the bending moments in the plate at points 1, 6, 11 and 16. **(12)**

Given: $D = \frac{Et^3}{12(1-v^2)}$; E = 30 × 10^6 psi

t = 5 inch

v = 0.15

$$M_x = -D\left[\frac{\partial^2 Z}{\partial x^2} + v\frac{\partial^2 Z}{\partial y^2}\right]$$

$$M_y = -D\left[v\frac{\partial^2 Z}{\partial x^2} + \frac{\partial^2 Z}{\partial y^2}\right]$$

Point	Deflection (in) × 10^{-4}	Point	Deflection (in) × 10^{-4}
1	2.5	9	3.8
2	1.5	10	4.5
3	4.1	11	4.1
4	5	12	3.6
5	4.2	13	4.2
6	4.7	14	4.5
7	3.7	15	4.0
8	3.2	16	3.9

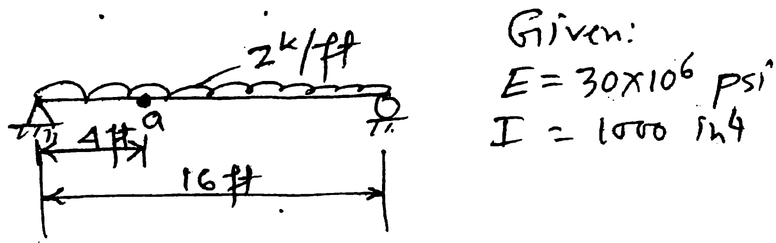
The spacing between the points is 12 inch in all directions.

Contd P/2

3. (a) Explain Difference Table. **(5)**

(b) Derive the general expression of $I = \int_a^b f(x)dx$ using Trapezoidal Rule. **(5)**

(c) Using Simpson's Method, find the deflection at point 'a'. **(13⅓)**



4. (a) Derive the final expression of Gregory–Newton Interpolation Formula. **(10⅓)**

(b) Set a polynomial equation passing through the points provided in the following table and use it to find the interpolated value for x = 1.5. **(13)**

x	1	–2	3	–1
$f(x)$	0	16	–2	1

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Find the root of the following function: **(17)**

$$f(x) = 2\sin\left(\sqrt{x}\right) - x$$

applying both (i) Fixed point iteration and (ii) Newton–Raphson Method.
Use an initial guess of $x_0 = 0.5$. For each case, perform 6 (six) iterations and calculate the approximate error (ε_a) for each iteration performed. Also check the convergence criteria for the fixed point iteration method.

(b) What is the difference between round–off error and truncation error? How can you estimate the local truncation error in Euler's method? How can this error be minimized? **(6⅓)**

6. (a) Use nonlinear regression to fit a parabola to the following data: **(14)**

x	0.2	0.5	0.8	1.2	1.7	2	2.3
y	500	700	1000	1200	2200	2650	3750

(b) Use zero to 4th order Taylor series expansion to predict $f(2.5)$ for **(9⅓)**

$$f(x) = \ln(x)$$

using a base point at x = 1. Compute the true percent relative error (ε_t) for each approximation.

Contd P/3

7. (a) Use Euler's method to solve **(12)**

$$\frac{dy}{dx} = -2y + 4e^{-x}$$

$$\frac{dz}{dx} = -\frac{yz^2}{3}$$

over the range $x = 0$ to 1 using a step size of 0.2 with $y(0) = 2$ and $z(0) = 4$.

(b) Solve the following equation for $y(0.2)$ **(7)**

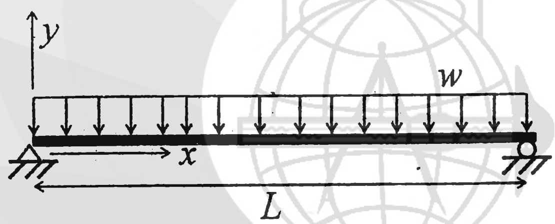
$$10\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 + 6x = 0$$

using a step size of 0.2 with y(0) = 1 and y′(0) = 0. Use Heun's method.

(c) What are the limitations of Newton–Raphson method? Explain with diagrams. **($4\frac{1}{3}$)**

8. (a) The basic differential equation of the elastic curve for a simply supported, uniformly loaded beam (shown in figure below) is given as **(18)**

$$EI\frac{d^2y}{dx^2} = \frac{wLx}{2} - \frac{wx^2}{2}$$



Where, E = 30,000 ksi, I = 800 in^4, L = 10 ft, w = 1 kip/ft.

Solve for the deflection of the beam using finite difference approach. Use $\Delta x = 2$ ft

(b) Write down the steps of solving the above beam problem using the Shooting Method. **($5\frac{1}{3}$)**
