# University of Asia Pacific
## Department of Civil Engineering
## Final Examination Spring 2013 (Section A)
## Program: B. Sc. Engineering (Civil)

Course Title: Numerical Analysis and Computer Programming — Course Code: CE 205
Time: 3 hours — Full Marks: 90 (= 9 × 10)

There are **02 (TWO)** parts, **PART A** and **PART B**. Answer **BOTH** parts. The figures in right margin indicate full marks of the questions. Assume reasonable values for missing data only, if any.

**PART A (Numerical Analysis)**

[Answer any **06 (SIX)** of the following **08 (EIGHT)** questions.]

1. Using Cramer's rule find the solution of the following system of linear equations. **(10)**

$$3x + y + z = 3$$
$$2x + 2y + 5z = -1$$
$$x - 3y - 4z = 2$$

2. (a) Determine the root of the following equation

$$e^{x^2-1} + 10\sin(2x) - 5 = 0$$

using the bisection method between the interval [0,1] with ε = 0.00001. **(5)**

(b) Figure 1(b) shows distribution of force due to wind load on a 30' tall building. The ordinates of the force diagram are given below. **(5)**

| Ordinate | $y_0$ | $y_1$ | $y_2$ | $y_3$ | $y_4$ | $y_5$ | $y_6$ |
|---|---|---|---|---|---|---|---|
| Force (kip) | 35 | 32 | 27 | 21 | 13 | 5 | 0 |

Using Simpson's 1/3rd rule find the moment M at the bottom of the base.

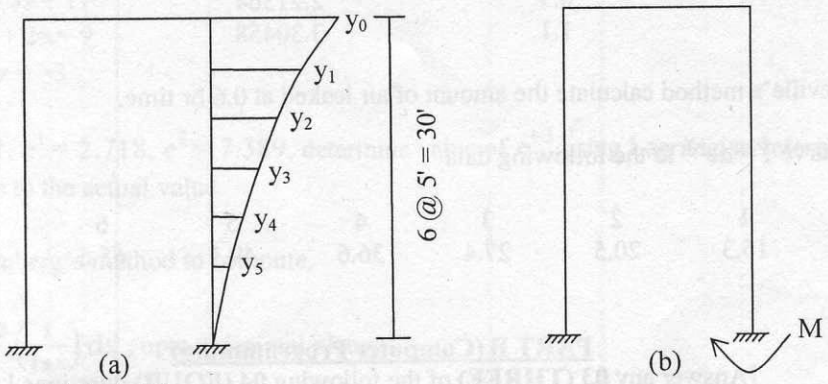


Figure 1

3. (a) Using Newton-Raphson method find a solution of the following equation between the interval [1990,2000] with ε = 0.00001. **(5)**

$$5x + \ln x = 10000$$

(b) Evaluate the integral of the function using Trapezoidal rule **(5)**

$$I = \int_1^3 F(x)dx$$

| x | 1 | 1.25 | 1.5 | 1.75 | 2 | 2.25 | 2.5 | 2.75 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| *F(x)* | 0.3679 | 0.2344 | 0.1291 | 0.0619 | 0.0259 | 0.0095 | 0.0031 | 0.0009 | 0.0002 |

4. Using Romberg's quadrature method integrate **(10)**

$$I = \int_1^2 \frac{1}{x} dx$$

Take at least up to eight intervals for better accuracy.

5. When a space shuttle leaves earth's atmosphere, during ascend, its decrement in the outside surface temperature can be expressed by the following ordinary differential equation **(10)**

$$\frac{dy}{dt} = y - t^2 + 1$$
$$y(0) = 0.5$$

Where $y$ is temperature and $t$ is time.
Find the temperature decrement from $t = 0$s to $t = 2$s with step size 0.5. Use Runge-Kutta method.

6. A spring system has resistance to motion proportional to the square of the velocity, and its motion is described by **(10)**

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

if the spring is released from a point that is unit distance above its equilibrium $x(0) = 1$, $x'(0) = 0$, use Taylor's method to determine the value of $x$ for $t = 1.5$s with step size 0.25.

7. Following table shows the amount of air that is being leaked from a balloon with respect to time

| x(hr) | Amount of Air, f(x) ($m^3$) |
|---|---|
| 0.3 | 0.404958 |
| 0.5 | 0.824361 |
| 0.7 | 1.40963 |
| 0.9 | 2.21364 |
| 1.1 | 3.30458 |

using Neville's method calculate the amount of air leaked at 0.6 hr time.

8. Fit the curve $Y = ae^{bX}$ to the following data **(10)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *X:* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *Y:* | 15.3 | 20.5 | 27.4 | 36.6 | 49.1 | 65.6 | 87.8 | 117.6 |

## PART B (Computer Programming)

[Answer any **03 (THREE)** of the following **04 (FOUR)** questions.]

9. Write a program that can calculate the matrix summation of two n×n matrices. **(10)**

10. Write a program that calculates shear and moment at every 0.5 ft of a simply supported beam subjected to uniform load $w$. Moment and shear at $x$ unit from left support are $wlx/2\text{-}wx^2/2$, $wl/2\text{-}wx$ respectively, $l$ is the length of the simply supported beam. **(10)**

11. Write a program that calculates the summation **(10)**

$$S = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots\ldots\ldots\ldots + \frac{x^n}{n!}$$

12. Write a program that takes three integer variables as input and interchanges them. **(10)**

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### SECTION I

(There are **Nine** questions in this section. Answer any **Six** of them)

1. Observe that the following data seem to be fit by a curve $y = pe^{qx}$. Use least square method to determine the values of 'p' and 'q' for the following data. (10)

| x | 77 | 100 | 185 | 239 | 285 |
|---|---|---|---|---|---|
| y | 2.4 | 3.4 | 7.0 | 11.1 | 19.6 |

2. Solve the equation $\frac{dy}{dx} = x^2 - y^2$, with initial condition $y(0) = 1$ by Runge-Kutta method, from x=0 to x=0.3 with h=0.1 (10)

3. Using Regula-Falsi method, determine a root of the following equation within interval [1, 2]. Assume, $\varepsilon$=0.0001

   $e^x + 2^{-x} + 2\cos x - 6 = 0$ (10)

4. Solve the following system of linear equations by Gauss-Jordan method. (10)

   $4x + y - 3z = 11$
   $2x - 3y + 2z = 9$
   $x + y + z = -3$

5. If $e^0 = 1$, $e^1 = 2.718$, $e^2 = 7.389$, determine value of $e^{1.3}$ using Lagrangian Interpolation and compare to the actual value. (10)

6. Use Romberg's method to compute,

   $I = \int_0^{1.2} \left(\frac{1}{1+x}\right) dx$, upto 4 decimal places. (10)

7. In an examination the number of candidates who obtained marks between certain limits was as follows:

| Marks | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 |
|---|---|---|---|---|---|
| No. of Students | 31 | 42 | 51 | 35 | 31 |

   Calculate the number of candidates whose scores were between 45 and 50 by Newton Gregory Forward difference method. (10)

8. The non-linear first-order Ordinary Differential Equation (ODE) governing unsteady radiation heat transfer per unit time from a mass can be expressed as follows:

$$\frac{dT}{dt} = -\alpha(T^4 - T_a^4)$$

Where, $\alpha = 4 \times 10^{-12}$, $T_a = 250, T(0) = 2500$
Solve the ODE for t = 4 by Euler's method, using step-size of 1. (10)

9. Evaluate the following integral using Simpson's one-third rule,

$I = \int_0^1 e^{-x^2} dx$, considering ten equal subdivisions. (10)

## SECTION II

(There are **Four** questions in this section. Answer any **Three** of them)

10. Write a program that calculates the real roots of any quadratic equation $ax^2+bx+c=0$ for given values of a, b and c. The program should print a message on screen if a=0. (10)

11. Write a program that can find the root of the following equation by Bisection method. (10)

$$f(x) = e^{-x} - \sin(\pi x/2)$$

12. Write a program to generate the first n terms of the Fibonacci series (1, 2, 3, 5, 8, 13…) (10)

13. Write a program that reads an integer number representing seconds and converts it into hour, minute and seconds. (10)