



REDEEMER'S UNIVERSITY
P.O.BOX 230, Ede, Osun State
COLLEGE OF NATURAL SCIENCES
DEPARTMENT OF MATHEMATICAL SCIENCES

SECOND SEMESTER EXAMINATIONS

2017/2018 SESSION

COURSE CODE: MAT 212

COURSE TITLE: Numerical Computational Techniques

INSTRUCTIONS: Answer any Four (4) questions. TIME ALLOWED: 2½ Hours

Question One

- a). Discuss the error analysis of Bisection method.
- b). You are working for "SHIT IS A SERIOUS BUSINESS COMPANY" that makes floats for the ABCD Commodities. The floating ball has a specific gravity of 0.75 has a radius of 6.5cm. You are asked to find the depth to which the ball is submerged when floating in water as shown in the figure 1 below.

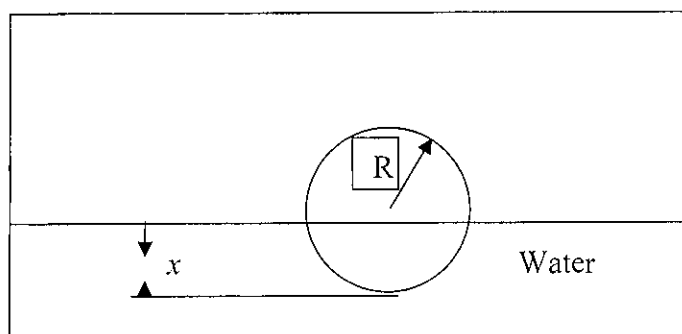


Figure 1.

The equation that gives the depth x in meters to which the ball is submerged under water is given by the equation

$$x^3 - 0.165x^2 + 3.993 \times 10^{-4} = 0$$

use the Secant method of finding roots of equations to find:

- i). The depth x to which the ball is submerged under water. Conduct three iterations to estimate the root of the above equation
- ii). The percentage approximate error at the end of each iteration, and
- iii). The number of significant digits at least correct at the end of each iteration.

Question Two

- a). Briefly describe the Lagrange Interpolation of the function $f(x)$ on an interval $[a, b]$ with a $n+1$ distinct points x_0, x_1, \dots, x_n .
- b). Construct a table for the data $(0,2), (1,3), (2,10), (3,29), (4,66), (5,127),$ and $(6, 218)$ and hence find the interpolating polynomial using forward difference formula of Newton-Gregory's interpolating method.

Question Three

- a). Discuss the basic concepts of numerical differentiation
- b). With the aid of Taylor's expansion, derive the forward, backward and central difference schemes for the following:
 - i). first ordinary derivative of a function f
 - ii). Second ordinary derivative of a function f .
- c). Use the false position method to find the root of $2x \sin x = 1$ that is located in the interval $[0, 2]$ (the function $\sin(x)$ is evaluated in radius).

Question Four

- a). Round off the following numbers 976361 and 48.57346 to four significant figures and compute :
 - i). Absolute Error, E_a
 - ii). Percentage Error, E_p
 - iii). Relative Error, E_r
- b). Use the false position method to find the root of $x \sin x = 1$ that is located in the interval $[0, 2]$ (the function $\sin(x)$ is evaluated in radius). You may wish to stop at the fourth approximation.
- c). Use the Bisection Method to find the root of the equation $e^x = \sin x$ within the interval $[-4, -3]$ closest to zero (0). You may wish to stop at the fourth approximation.

Question Five

- a). Enumerate the features of Simpson's $1/3$ (one-third) rule.
- b). List the error term that may be committed when this Simpson's rule is used to solve a given problem.
- c). Given the integral

$$\int_0^{\frac{\pi}{4}} \sin x dx$$

- i). Evaluate the integral within the interval $[0, \frac{\pi}{4}]$ using the Simpson's $1/3$ (one-third) rule.
- ii). Determine the error committed in (i) above.

Question Six

- a). Use Rectangle and Trapezium methods to integrate

$$\int_1^{10} \frac{1}{x} dx$$

- b). Determine the error term committed in solving the above integral using Trapezium Method.