



**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANIZATION OF ISLAMIC COOPERATION (OIC)**  
**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

Semester Final Examination

Winter Semester: 2022-2023

Course No.: GS 4353

Full Marks: 150

Course Title: Numerical Methods and Computer Programming

Time: 3.0 hours

There are 6 (six) questions, answer all the questions, Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO. Symbols convey their usual meanings. Assume reasonable values for any missing data/info.

		Marks	CO	PO
1.	(a) State the names of Open methods and Bracketing methods used to determine the roots of equation. How is the Open method different from the Bracketing method? Explain with diagrams.	5	CO1	PO1
	(b) Use Bisection method to find a root of the equation: $f(x) = x^2 - \sin x - 0.5$ within a range between 0 and 2. ( $\epsilon_s = 10^{-3}$ ) %	10	CO3	PO2
	(c) Use Newton-Raphson method to find the root of the equation: $f(x) = 2x^3 - 2.5x - 5$ Using an initial guess of $x = 2$ . ( $\epsilon_s = 10^{-6}$ ) %. Also, determine the true root of the equation.	10	CO3	PO2
2.	(a) Use Euler's method to numerically integrate $\frac{dy}{dx} = \frac{y \ln y}{x}$ from $x = 0$ to $x = 2$ using step size of 0.5. Find true errors for each step. Use initial value i.e., $y(0) = 1$ .	12	CO3	PO2
	(b) Use midpoint method to solve $\frac{dy}{dx} = -2y + 4e - x$ from $x = 0$ to 1 using a step size of 0.2 where $y(0) = 2$ . Find true error for each step.	13	CO3	PO2
3.	(a) Describe Declarative Knowledge and Imperative Knowledge in computational problem-solving using example of finding square root of a number.	5	CO1	PO1
	(b) Develop a python program that uses Bisection search algorithm to find the root of any number for any given power. Write the script as a function.	10	CO3	PO2
	(c) Now, write the output of algorithm considering the number is 0.55, power 3 and $\epsilon_s = 0.01$ . Describe at least two steps.	10	CO2	PO2
4.	(a) Graphically compare a low-level and a high-level programming language.	7	CO1	PO1
	(b) Define the following: (i) Objects, (ii) Expressions, (iii) Syntax & (iv) Semantics	8	CO1	PO1
	(c) Develop a python program that uses Newton-Raphson algorithm to find the root of the equation $f(x) = x^2$ . Consider an allowable error of 0.01.	10	CO3	PO2

A programmer with civil engineering background has created two python modules saving by the names "circular\_beam.py" and "square\_beam.py" in same folder naming "Python" regarding geometric properties of a circular beam and square beam as shown below:

i) circular\_beam.py

```
pi = 3.1416
length = 1
def circumference(radius):
    return 2*pi*radius

def area(radius):
    return pi*(radius**2)

def volume(radius, length):
    return area (radius) * length
```

ii) square\_beam.py

```
length = 4

def area(width_or_height):
    return width_or_height**2

def volume(width_or_height, length):
    return area(width_or_height)*length
```

Write down the output of each expression given below in a sequential manner by writing beside the expression.

- |                                  |  |
|----------------------------------|--|
| A. import circular_beam          | H. print(circular_beam.volume(7,length)) |
| B. print(pi)                     | I. from circular_beam import*            |
| C. print(circular_beam.pi)       | J. pi                                    |
| D. pi = 3.0                      | K. area(10)                              |
| E. import square_beam            | L. Square_beam.volume(3, length)         |
| F. print(circular_beam.area(5))  | M. length = 10                           |
| G. print(square_beam.volume(5,4) | N. volume(3,length)                      |

- 6 (a) Describe how to use Bubble Sort. Demonstrate graphically. 8 CO1 PO1
- (b) Define (i) Tuples, (ii) Debugging, (iii) List and (iv) Class 10 CO1 PO1
- (c) Write a short python code for calculating "Fibonacci Numbers" up to value x. The Fibonacci numbers is as follows: 0, 1, 1, 2, 3, 5, 8,..... 7 CO2 PO2