National University of Computer and Emerging Sciences

Lahore Campus

Simulation and Modeling (CS 4056)

Sessional-II Exam (Assignment)

Date: Before Midterm Exam

Course Instructor(s)

Dr. Mirza Mubasher Baig

Total Time (Hrs): 1

Total Weight: 5%

Total Questions: 7

Read Chapter 9 and Material on **Numerical Solution of Differential Equations**

Question No 1:

Use Euler's method to estimate y (0.2) for the initial value problem:

$$\frac{dy}{dx} = x + y, \quad y(0) = 1, \quad h = 0.1$$

Compute and compare the results after two steps.

Question No 2:

Solve the following using both Euler's method and RK4:

$$\frac{dy}{dx} = y - x^2 + 1, \quad y(0) = 0.5, \quad h = 0.2$$

Compute y(0.2) and y(0.4).

Compare your answers with the exact solution:

$$y(x) = (x+1)^2 - 0.5e^x$$

and compute the absolute error for both methods.

Question No 3:

Derive Euler's method using Taylor series expansion of ***f(x + h)***

Question No 4:

Will the Euler;s method give exact answer for a differential equation of the form for an arbitrary step size

$$\frac{dy}{dx} = \quad 1, \quad y(0) = 0.5, \quad h$$

In case your answer is YES, Give reason and give a counter example otherwise

Input Modeling

Question No 5: Theory:

i) What are the main steps involved in input data analysis and modeling for simulation?

ii) Differentiate between a theoretical and an empirical distribution giving one example of each.

iii) Name three different tests used to test the goodness of fit while modeling the inputs

iv) Which test uses cumulative distribution of sample with that of proposed model to check goodness of fit?

v) Which test uses observed sample frequencies with the expected frequencies to test goodness of fit?

Question No 6: Parameter Estimation:

i) Use MLE principle to derive an expression for estimating the value of parameter λ of the exponential distribution using a sample $\{x_1, x_2, ..., x_n\}$ of n number. The pdf of exponential distribution is

$$f(x;\lambda) = \lambda e^{-\lambda x}, \quad x \geq 0,$$

ii) Finally, use your expression to find the MLE of for the following sample {1, 1, 2, 3, 3}

Question No 7: Numerical:

i) A dataset of 30 service times (minutes) has the following frequency distribution:

Interval	0–2	2–4	4–6	6–8	8–10
Observed Frequency	5	10	9	4	2

A fitted exponential distribution has parameter λ =0.25s
Perform a Chi-square test at α=0.05 to check if this exponential model is appropriate.

ii) Given a sample of inter-arrival times: {1.2, 2.0, 2.2, 3.1, 3.4, 4.0, 4.8, 5.6} observed over a period of 30 seconds and a hypothesized exponential distribution with λ = 0.25, perform a K–S test to find the goodness of fit