**Model Question Paper**

**First Semester M.Sc Degree Examination (CSS)**

# ST1C05 - STATISTICAL COMPUTATIONAL TECHINIQUES

Time: 3 hours Total Weights: 30

## Part A

(***Answer any five questions. Weightage 1 for each question.***)

1. What is the difference between algebraic and transcendental equations?
2. What is the principle of Romberg integration?
3. Write down the Lagrange's interpolation formula.
4. What is meant by numerical integration?
5. Explain the principle of simulation?
6. Explain how to generate random numbers from a Cauchy distribution using uniform random numbers.
7. Explain the general form of 'Plot' command in R.
8. Describe the 'if else' command in R.

## Part B

(***Answer any* five *questions. Weightage* 2 *for each question.***)

9. Explain the Bisection method of finding solution to algebraic and transcendental equations?
10. Describe how to find the solution to a system of simultaneous equations using Gauss elimination method.
11. Derive Newton's forward difference formula.
12. Derive Simpsons $1/3^{rd}$ rule for numerical integration from the general Quadrature formula.
13. Explain Accept-Reject method for random number generation.
14. Explain the method of generating random numbers from a Binomial distribution.

15. Following is the frequency distribution of daily emission (in tons) of sulphur dioxide from an industrial plant.

Daily emission (in tons) of sulphur dioxide

| Mid point | 6.95 | 10.95 | 14.95 | 18.95 | 22.95 | 26.95 | 30.95 |
|---|---|---|---|---|---|---|---|
| Frequency | 3 | 10 | 14 | 25 | 17 | 9 | 2 |

Write the R code to find the three quartiles, skewness and kurtosis of the data

16. Using R functions, write a program to generate random sample of size 100 from a normal population with mean 10 variance 4 and then construct a frequency distribution, P-P plot and Q-Q plot of the generated sample.

## Part C

**(*Answer any* three *questions. Weightage* 5 *for each question.*)**

17. (a) Explain the difference between the Jacobi's method and Gauss-Seidel method.
    (b) Explain Gauss-Jordan method of solving a system of linear equations.

18. (a) Derive the general Quadrature formula and hence the Weddle's rule for numerical integration.
    (b) Calculate the value $\int_0^{0.6} \phi(x)dx$ numerically using Weddle's numerical integration formula, where $\phi(x)$ is the probability density function of a standard normal distribution.

19. (a) Explain how to generate a random number for a Beta distribution $B(\alpha,\ \beta)$.
    (b) Explain the Box-Muller transformation for normal random variable generation.

20. (a) Find the value of the integral $\int_0^{\pi/2} \sin x\ dx$ using Simpson's $(1/3)^{rd}$ rule.
    (b) Discuss the error in Simpson's $(1/3)^{rd}$ rule for numerical integration.

21. Write an R program to find the root of an equation using Newton-Raphson method and Iteration method.

22. (a) Write an R program using basic functions of R to find the value of an integral based on any numerical integration formula.
    (b) Give the R code to solve the system of linear equations given by

$$\begin{aligned} 10x_1 - 2x_2 - x_3 - x_4 &= 3 \\ -2x_1 + 10x_2 - x_3 - x_4 &= 15 \\ -x_1 - x_2 + 10x_3 - 2x_4 &= 27 \\ -x_1 - x_2 - 2x_3 + 10x_4 &= -19 \end{aligned}$$