# INDIAN INSTITUTE OF TECHNOLOGY, PATNA

Mid Semester Examination-2023

Simulation Lab(MC 503)

Time: 2 hours Full Marks : 30

## Instructions

1. All questions are compulsory.
2. Here, you are not supposed to use any R packages.

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1. Write a program to find the sum of the following series up to 100 terms **(4)**

$$\sqrt{1+2\sqrt{1+3\sqrt{1+4\sqrt{1+5\ldots}}}}$$

2. If $f(x) = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1}(1-x)^{\beta-1}$, where $\alpha > 0, \beta > 0$ and $x \in (0,1)$. **(8)**

   (i) Solve $\int_0^1 f(x)dx$, using numerical method.

   (ii) Plot $f(x)$ for two different sets of parameter values and also add legends for the graph.

   (*Consider any specific parameter values of $\alpha$ and $\beta$.)

3. Solve $x^3 - 4x - 9 = 0$ using the given algorithm up to 4 decimal places. **(8)**

   **Algorithm**

   (i). start
   (ii). Define function $f(x)$
   (iii). Choose initial guesses $x_0$ and $x_1$ such that $f(x_0)f(x_1) < 0$
   (iv). Choose pre-specified tolerable error $e$.
   (v). Calculate new approximated root as:

$$x_2 = x_0 - \frac{((x_0 - x_1) * f(x_0))}{(f(x_0) - f(x_1))}.$$

   (vi) Calculate $f(x_0)f(x_2)$
   (a) if $f(x_0)f(x_2) < 0$ then $x_0 = x_0$ and $x_1 = x_2$
   (b) if $f(x_0)f(x_2) > 0$ then $x_0 = x_2$ and $x_1 = x_1$
   (c) if $f(x_0)f(x_2) = 0$ then goto (8)
   (vii). if $|f(x_2)| > e$ then goto (v) otherwise goto (viii).
   (viii). Display $x_2$ as root.
   (ix). Stop

4. Import data **imdb.csv** related to series and movies. Find the solution of the following questions.(* Use *dplyr, pipe operator* and *ggplot2* packages) **(10)**

   (i). Arrange the rows of imdb data by the *Released Year* and then arrange the rows by *IMDB Rating* and finally filter data with meta score is greater than 70.

   (ii). Find the series directed by *Howard Hawks* and *Joel Coen.*

   (iii). Find the top-10 voted movies.

   (iv). Draw a bar plot between the years 2010-2020 and the corresponding number of movies released in the years.