BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC/MSC/PRE-PHD **SEMESTER : VII / I**
BRANCH: PHYSICS **SESSION : MO/2022**

SUBJECT: PH405 MODERN COMPUTATIONAL TECHNIQUES & PROGRAMMING

TIME: 3:00 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. **The question paper contains 5 questions each of 10 marks and total 50 marks.**
2. **Attempt all questions.**
3. **The missing data, if any, may be assumed suitably.**
4. **Before attempting the question paper, be sure that you have got the correct question paper.**
5. **Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

Q.1(a) Define absolute and relative errors. [CO1, BT1] [2]

Q.1(b) The approximate values of the number ⅓ are given as 0.30, 0.33 and 0.34. Which one of these is the best approximation? [CO1, BT3] [3]

Q.1(c) Find a real root of the function $f(x) = 2cos(x) + 3sin(x) - exp(x)$ such that the percentage error $\epsilon_p \leq 5\%$. [CO1, BT3] [5]

Q.2(a) What is the criterion for a square matrix to be singular? [CO2, BT1] [2]

Q.2(b) Discuss the matrix inversion method for solving a set of linear equations. [CO2, BT2] [3]

Q.2(c) Solve the following set of linear equations using the Gauss elimination method, [CO2, BT3] [5]

$$2x + 3y + z = -1,$$
$$x + 2y + 3z = 6,$$
$$3x + y + 2z = 7.$$

Q.3(a) Define interpolation. [CO3, BT1] [2]

Q.3(b) Find the quadratic splines joining the points (1, 3), (2,-1), (3,2). Determine $y(2.5)$. [CO3, BT3] [3]

Q.3(c) Construct a polynomial passing through the data points: (1, -1), (2, 15), (4, 161) & (7, 935). [CO3, BT5] [5]

Q.4(a) Define the term numerical differentiation. [CO4, BT1] [2]

Q.4(b) Evaluate the first and second derivative of *y* w.r.t. *x* at *x=1.2* using the data points: (1, 0.3012), (1.2, 0.5697), (1.4, 0.8155) , (1.6, 1.0288), (1.8, 1.2010) & (2.0, 1.3254). [CO4, BT3] [3]

Q.4(c) Evaluate the integral provided below with eight subdivisions to four decimal places. [5]

$$\int_2^4 \frac{1}{ln(x)} dx$$

Justify the rule you follow to evaluate the integral. [CO4, BT5]

Q.5(a) Write down the Laplace's equation. [CO5, BT1] [2]

Q.5(b) Use the Jacobi's method to solve the equation $u_{xx} + u_{yy} = 0$ for the Fig. 1. Perform 3 iterations to evaluate $u_1, u_2, u_3 \& u_4$. [CO5, BT3] [3]

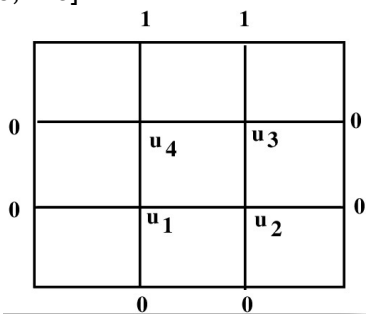

Fig. 1

Q.5(c) Solve the question given in 5(b) using Gauss-Seidel method by performing three iterations again. Which method gives better approximation: Jacobi or Gauss-Seidel? Justify your answer. [CO5, BT5] [5]

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