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

CLASS: M. TECH/PRE-PHD **SEMESTER : I**
BRANCH: MECHANICAL **SESSION : MO/2022**

SUBJECT: ME521 COMPUTATIONAL METHODS IN ENGINEERING

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) Solve the following equations by Gauss Jordon method : [CO1,BT 3] [5]

$$x + y + z = 9$$
$$2x - 3y + 4z = 13$$
$$3x + 4y + 5z = 40$$

Q.1(b) Find the eigen value and corresponding eigen vector (using inverse power matrix method only) for matrix [5]

$$A = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix} \quad \text{with} \quad v^{(0)} = [\,-1\,,\,1\,]^T \quad . \qquad [CO1,BT\ 6]$$

Q.2(a) Use Secant method to find the approximate value of $\sqrt{12}$, correct up to three decimal places. [5]
[CO2,BT3]

Q.2(b) Design a bivariate interpolating polynomial by Lagrange's method using following table: [5]

x	0	0	1	1	2	2
y	0	1	0	1	0	1
f(x, y)	1	2	3	5	5	10

Also, calculate the value of f (1.5, 0.75). [CO2,BT6]

Q.3(a) Find the value of $\frac{dy}{dx}$ at x=4 from the following data by using Lagrange interpolation formula : [5]
[CO3,BT3]

x	0	2	5	1
f(x)	0	8	125	1

Q.3(b) Using Romberg's integration rule, evaluate : [5]

$$\int_0^1 \frac{dx}{1+x^2}$$

correct to four decimal places by taking h=0.5,0.25 and 0.125. [CO3,BT4]

Q.4(a) Apply Adams- Bashforth Moulton method to find y(0.4) from following informations : [5]
$f(x,y) = \frac{dy}{dx} = 0.5\ xy$

y(0)=1, y(0.1)=1.01, y(0.2)=1.022 & y(0.3)=1.023 . [CO4,BT3]

Q.4(b) Find the value of y(0.1) & z(0.1) by applying Runge – Kutta Method of fourth order from the system of equations : [5]

$\frac{dy}{dx} = x+z$, $\frac{dz}{dx} = x-y^2$ if y(0)=2 and z(0)=1 is given, [CO4,BT5]

PTO

Q.5(a) Solve numerically, 4 $u_{xx} = u_{tt}$ with the boundary conditions u(0, t) = 0, u(4,t) = 0 and the initial conditions $u_t(x, 0) = 0$ & u(x, 0) = x (4-x), taking h = 1 (for 4 time steps) [CO5,BT6] [5]

Q.5(b) $$\frac{\partial^2 u}{\partial x^2} - 2\frac{\partial u}{\partial t} = 0$$ [5]

Given :
u(0,t) = 0 , u(4,t) = 0 and u(x,0) = x (4-x). Assuming h = 1, find the values of u up to t=5. [CO5,BT5]

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