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

**CLASS: BTECH** **SEMESTER : III**
**BRANCH: BT/CHEMICAL/ME/PIE/CE** **SESSION : MO/2022**

**SUBJECT: MA203 NUMERICAL METHODS**

**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) If the number $\frac{\pi}{14} = 0.785398163$ is approximated by $\frac{11}{14}$, then [5]

(i) Find the number of digits up to which, this approximation is accurate

(ii) Find the absolute and percentage errors

Q.1(b) Perform four iterations of the Newton-Raphson method to obtain the approximate value of $(17)^{1/3}$ starting with the initial approximation $x_0$ = 2, correct upto 5 decimal places. [5]

Q.2(a) Solve the system of equations by gauss-Jordan method: [5]

$$x + y + z + u = 2$$
$$2x - y + 2z - u = -5$$
$$3x + 2y + 3z + 4u = 7$$
$$x - 2y - 3z + 2u = 5$$

Q.2(b) Using power method find the dominant eigen value and the corresponding eigen vector for the matrix [5]

$$A = \begin{pmatrix} -15 & 4 & 3 \\ 10 & -12 & 6 \\ 20 & -4 & 2 \end{pmatrix}$$

Correct results upto 3 decimal places at each iteration and proceed till 4th iteration.

Q.3(a) Find the value of $\frac{d^2y}{dx^2}$ and $\frac{d^3y}{dx^3}$ at $x = 1$, from the table given below: [5]

| x | -1 | 1 | 2 | 3 |
|---|---|---|---|---|
| F(x) | 7 | 5 | 19 | 51 |

Q.3(b) Using the following data, find the value of x corresponding to $y = f(x) = 100$ [5]

| *x* | 3 | 5 | 7 | 9 | 11 |
|---|---|---|---|---|---|
| *y* | 6 | 24 | 58 | 108 | 174 |

Q.4(a) Find the value of the integral $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's 1/3rd rule with step size $h = \frac{1}{4}$ correct to 5 decimal places. Further, estimate the value of $\pi$ from the integral. [5]

Q.4(b) If $\Delta$ is the forward difference operator, then find $\Delta^4 y_0$. Hence find the general expression for $\Delta^n y_0$ in terms of $y_0, y_1, \ldots, y_n$ that does not involve the difference operator [5]

Q.5(a) For the initial value problem $\frac{dy}{dx} = y, y(0) = \alpha$ . If $y(1) = 1$, find the value of $k_3$ obtained by Runge-Kutta fourth order method, correct to 4 decimal places. [5]

Q.5(b) Determine the value of y correct to 4 decimal places using Euler's method when x=0.04 given that $y' = x^2 + y$, $y(0) = 1$, when h=0.2 and compare with the exact answer. [5]

**:::::21/11/2022:::::M**