RAMANASRI
IAS/IFoS Institute

Numerical Analysis & Computer Programming

IFoS (IFS) Previous Year Questions (PYQ) from 2025 to 2009

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IAS, UPSC, IFS, IFoS, CIVIL SERVICE MAINS EXAMS MATHS OPTIONAL STUDY MATERIALS

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2025

1. Find the interval in which the root of the equation $xe^x = 1$ lies between 0 and 1, obtained by using three iterations of bisection method. **[8 Marks]**

2. Perform the operations (i) (+42) + (-13) and (ii) (-42) - (-13) in binary using signed 2's complement representation for negative numbers in 8-bit system. Give the final answer in decimal. **[4+4 Marks]**

3. Write down the algorithm for finding the integral $I = \int_a^b f(x)\,dx$ using Simpson's $\frac{1}{3}$ rule. Hence, find $I = \int_0^1 (4x - 3x^2)\,dx$ taking 10 intervals. Also, find the relative error. **[7+8 Marks]**

4. In an examination, the number of candidates who secured marks between certain limits was as follows. Estimate the number of candidates getting marks less than 50. **[10 Marks]**

Marks	0-19	20-39	40-59	60-89	90-99
No. of candidates	41	62	65	50	17

5. Using Runge-Kutta method of fourth order, find y at x = 0.2, given that $\frac{dy}{dx} = 3e^x + 2y$, y(0) = 0 and h = 0.1, correct to four decimal places. **[15 Marks]**

2024

6. Obtain the following approximate quadrature formula: **[8 Marks]**

$\int_0^3 f(x)\,dx = \frac{3}{8}[f(0) + 3f(1) + 3f(2) + f(3)]$.

7. Answer the following number-system questions. **[4+4 Marks]**

(i) Convert $(523.0234375)_{10}$ into an equivalent octal number and then convert it to its binary form.

(ii) If $x = (1D2.2)_{16}$ and $y = (52E.02)_{16}$, then find the value of x + y in decimal system.

8. Write down the algorithm for solving the differential equation $\frac{dy}{dx} = f(x, y)$, $y(x_0) = y_0$ numerically by Euler's method with step length h up to $x = x_n = x_0 + nh$. Solve the following differential equation for x = 1 with step length h = 0.2 by using Euler's method: **[6+9 Marks]**

$\frac{dy}{dx} = x^2 + y$, y(0) = 1.

9. Show that the iteration formula for the Newton-Raphson method for finding the K^{th} root of a positive real number a is **[3+7 Marks]**

$x_{n+1} = \frac{1}{K}[(K - 1)x_n + \frac{a}{x_n^{K-1}}]$, where K > 0.

Use this formula to find $\sqrt[3]{13}$, correct up to three decimal places.

10. Use Gauss-Jordan elimination method to solve the following system of equations, correct up to 2 significant figures: **[15 Marks]**

$3x_1 + x_2 + x_3 = 7$,
$2x_1 + x_2 + 5x_3 = 13$,
$x_1 + 4x_2 + x_3 = 9.4$.

2023

11. A function f defined on [0, 1] is such that $f(0) = 0$, $f(\frac{1}{2}) = -1$ and $f(1) = 0$. Find the quadratic polynomial p(x) which agrees with f(x) for $x = 0, \frac{1}{2}, 1$. If $|\frac{d^3f}{dx^3}| \leq 1$ for $0 \leq x \leq 1$, show that $|f(x) - p(x)| \leq \frac{1}{12}$ for $0 \leq x \leq 1$. **[8 Marks]**

12. Draw the logic circuit which realises the Boolean function $L = (A + B)(A + C) + C(A + B \cdot C)$ and simplify it. Draw the simplified circuit also. **[8 Marks]**

13. Find a root of the equation $\sin x + \cos x = 1$, lying in (0, 2), by Regula-Falsi method, correct up to four significant digits. **[10 Marks]**

14. Write down the flow-chart of Runge-Kutta method of 4^{th} order to find y(0.8) for $\frac{dy}{dx} = xy$, $y(0) = 2$, taking $h = 0.2$. Also solve the above IVP to find y(0.4) by Runge-Kutta method (4^{th} order). **[15 Marks]**

15. State the sufficient condition for convergence of the Gauss-Seidel iteration method and solve the following system of equations by using this method, correct up to 3 significant digits: **[15 Marks]**

$6.7x_1 + 1.1x_2 + 2.2x_3 = 20.5$,
$2.1x_1 - 15x_2 + 8.4x_3 = 28.8$,
$3.1x_1 + 9.4x_2 - 15x_3 = 22.9$.

2022

16. Given $f(1) = 4$, $f(2) = 5$, $f(7) = 5$ and $f(8) = 4$. Find the value of f(6) and also the value of x for which f(x) is maximum or minimum. **[8 Marks]**

17. Answer the following. **[4+4 Marks]**

(i) If $x = 0 \cdot 101010101E0001010$ and $y = 0 \cdot 100010110E0000110$, then find x - y.

(ii) Draw the map of the Boolean function $F = x'yz + xy'z' + xyz + xyz'$. Also simplify the function.

18. Write down an algorithm for Simpson's $\frac{1}{3}$ rule. Hence, compute $\int_0^1 x^2(1 - x)\,dx$ correct up to three decimal places with step size $h = 0.1$ and compare the result with its exact value. **[6+9 Marks]**

19. Solve the following system of equations by Gauss-Jordan method: **[15 Marks]**
$2x + y - 3z = 11$,
$4x - 2y + 3z = 8$,
$-2x + 2y - z = -6$.

20. Find the real root of the equation $e^x - 3x = 0$, by Newton-Raphson method, correct up to four decimal places. **[10 Marks]**

2021

21. From the following table, estimate the number of students who obtained marks between 40 and 46: **[8 Marks]**

Marks	30-40	40-50	50-60	60-70	70-80
No. of students	32	43	55	40	30

22. Consider the following integers and their 8-bits binary representations: 13 = 00001101, 20 = 00010100. Perform the following bitwise operations and express the results in decimal system: **[2+2+2+2 Marks]**
(i) 13 & 20 (Bitwise AND)
(ii) 13 | 20 (Bitwise OR)
(iii) 13 ^ 20 (Bitwise XOR)
(iv) ~20 (Bitwise Complement)

23. Using Regula-Falsi method, find the fourth root of 28 correct to three decimal places. **[15 Marks]**

24. Write down the algorithm and flowchart of Runge-Kutta method of fourth order to find the numerical solution at $x = 0.8$ for $\frac{dy}{dx} = \sqrt{(2(x + y))}$, $y(0.4) = 0.2$. Assume the step length $h = 0.2$. **[7+8 Marks]**

25. Solve the following system of equations by Gauss-Seidel method, starting with the initial solution $x_0 = y_0 = z_0 = 0$: **[10 Marks]**
$20x + y - 3z = 16$,
$2x + 20y - z = -19$,
$3x - 2y + 20z = 25$.