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MCA Semester- II Examination, 2025
MASTER OF COMPUTER APPLICATIONS
PAPER: MCA 205
(NUMERICAL METHODS AND OPTIMIZATION TECHNIQUE)

Full Marks: 100 **Time: 3 Hours**

The figures in the right-hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Group-A

Answer any **FIVE** of the following questions: **2×5=10**

1. What is the difference between a feasible solution and an optimal solution?
2. Define Basic feasible solution.
3. What is meant by a bounded solution in linear programming?
4. Define degenerate solution.
5. Prove that $(1+\Delta)(1-\nabla) \equiv 1$.
6. Find the position of a positive real root of $x^3-3x+4=0$.
7. State an advantage and a disadvantage of the Bisection Method.
8. Why is the classical Fourth-Order Runge–Kutta method preferred over the Second-Order Runge–Kutta method? Give two short reasons.

Group-B

Answer any **FOUR** of the following questions: **15×4=60**

9. a) Solve graphically

$$\begin{aligned} \text{Max } Z &= 5x+7y \\ 3x+8y &\le 12 \\ x+y &\le 2 \\ 2x &\le 3 \\ x,y &\ge 0 \end{aligned}$$

b) Prove that dual of the dual is primal. 8+7

10. a) Solve using Simplex method

$$\begin{aligned} \text{Max } Z &= 60x1+50x2 \\ x1+2x2 &\le 40 \\ 3x1+2x2 &\le 60 \\ x1, x2 &\ge 0 \end{aligned}$$

b) Briefly describe Kuhn-Tucker conditions in non-linear programming. 8+7

(P.T.O)

11.a) Find the initial basic feasible solution using VAM

	A	B	C	a_i
F_1	10	9	8	8
F_2	10	7	10	7
F_3	11	9	7	9
F_4	12	14	10	4
b_j	10	10	8	

b) Using steepest descent method Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ with $\binom{0}{0}$ as a starting point. 8+7

12. a) The Head of the department has five jobs A, B, C, D, E and five sub-ordinates V, W, X, Y, Z. The number of hours each man would take to perform each job is as follows:

	V	W	X	Y	Z
A	3	5	10	15	8
B	4	7	15	18	8
C	8	12	20	20	12
D	5	5	8	10	6
E	10	10	15	25	10

How would each jobs be allocated to minimize the total time?

b) Solve the following LPP by Big M-method:

Minimize $z = 2x_1 + 9x_2 + x_3$

Sub. to $x_1 + 4x_2 + 2x_3 \geq 5$

$3x_1 + x_2 + 2x_3 \geq 4$

$x_1, x_2, x_3 \geq 0.$ 8+7

13. a) Define absolute, relative and percentage errors. If π is approximated as 3.14 instead of 3.14156, find the absolute, relative and percentage errors.

b) Obtain Lagrange's interpolating polynomial for $f(x)$ and find an approximate value of the function $f(x)$ at $x = 0$, given that $f(-2) = -5, f(-1) = -1$ and $f(1) = 1$. 7+8

14. a) Find a root of the equation $x^2 + x - 7 = 0$ by bisection method, correct up to two decimal places.

b) Prove that $\Delta\nabla \equiv \nabla\Delta$ and $\Delta \equiv E-1$ 10+5

15. a) Evaluate $\int_0^3 (2x - x^2)dx$, taking 6 intervals, by (i) Trapezoidal rule, and (ii) Simpson's 1/3 rule.

b) Find the values of $y(0.1)$ and $y(0.2)$ from the following differential equation $\frac{dy}{dx} = x^2 + y^2$ with $y(0) = 1$. 7+8

16. a) Given $\frac{dy}{dx} = -x^2 + y^2$ with $y(0) = 2$. Find $y(0.1)$ and $y(0.2)$ by second-order Runge-Kutta method by taking h=0.1.

b) Solve the equations by Gauss-Jordan elimination method. 8+7

$$2x_1 + x_2 + x_3 = 4,$$
$$x_1 - x_2 + 2x_3 = 2,$$
$$2x_1 + 2x_2 - x_3 = 3$$

(Internal Assessment: 30 Marks)

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