Name: Enrolment No:	UPES

End Semester Examination, December-2017
Course: Introduction to Numerical Analysis-MATH-203

Programme: B.Tech (ET+IPR) **Semester: III (ODD-2017-18)**
Time: 03 hrs. **Max. Marks:100**

Instructions:
Attempt all questions from **Section A** (each carrying 4 marks); attempt all questions from **Section B** (each carrying 8 marks)**;** attempt all questions from **Section C** (each carrying 20 marks)**.**

Section A
(Attempt all questions)

1.	If 0.333 is the approximate value of $\frac{1}{3}$. Find the absolute and relative errors.	**[4]**	**CO1**
2.	Evaluate $\Delta \cos 2x$	**[4]**	**CO1**
3.	Use Simpson's 1/3 rule to evaluate $\int_0^1 \frac{1}{1+x^2}dx$ considering four subintervals.	**[4]**	**CO2**
4.	Show that $(1+\Delta)(1-\nabla) \equiv I$	**[4]**	**CO3**
5.	Using Hessian matrix determine whether the following function is convex or concave. $$f(x_1, x_2) = 3x_1^3 - 6x_2^2$$	**[4]**	**CO4**

SECTION B
(Q6-Q9 are compulsory and Q10 has internal choice)

6.	Using bisection method find out the positive square root of 30 correct to 4 decimal places.	**[8]**	**CO1**
7.	Use Gauss Seidel method to find the solution correct to 3 decimal places of following system of linear equations $$12x_1 + 3x_2 - 5x_3 = 1$$ $$x_1 + 5x_2 + 3x_3 = 28$$ $$3x_1 + 7x_2 + 13x_3 = 76$$ Use $\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$ as the initial guess.	**[8]**	**CO3**
8.	Find $\frac{dy}{dx}$ at *x*=0.1from the table *x*: 0.1, 0.2, 0.3, 0.4 *f(x)*: 0.9975, 0.9900, 0.9776, 0.9604	**[8]**	**CO2**

x	0.1	0.2	0.3	0.4
f(x)	0.9975	0.9900	0.9776	0.9604

9.	Apply Euler's method to obtain y(1) from the following initial value problem $$\frac{dy}{dx} = x + y, \quad y(0) = 0 \quad \text{(take step size of 0.2)}$$	**[8]**	**CO3**
10.	Obtain the dual of the following LPP: $Maximize \ z = 2x_1 + 3x_2 + x_3$ subject to the constraints: $4x_1 + 3x_2 + x_3 = 6$ $x_1 + 2x_2 + 5x_3 = 4$ $x_1, x_2, x_3 \geq 0$ **OR** Show that the following system of equations has a degenerate solution: $2x_1 + x_2 - x_3 = 2$ $3x_1 + 2x_2 + x_3 = 3$	**[8]**	**CO4**
SECTION C **(Q11 is compulsory and Q12A, Q12B have internal choice)**			
11.A	Find y(32) by using Gauss forward central interpolation formula from following data values <table><tr><td>*x*</td><td>25</td><td>30</td><td>35</td><td>40</td></tr><tr><td>*y*</td><td>0.2707</td><td>0.3027</td><td>0.3386</td><td>0.3794</td></tr></table>	**[10]**	**CO2**
11.B	Express $y = 2x^3 - 3x^2 + 3x - 10$ in factorial notation and hence show that $\Delta^3 y = 12$.	**[10]**	**CO2**
12.A	Using modified Euler's obtain $y(0.4)$ correct to 3 decimal places from the differential equation $\frac{dy}{dx} = x - y^2$ and $y(0.2)$=0.2. (take step size of 0.2). **OR** Solve the system of linear equations by using Gauss Elimination method $2x_2 + x_3 = -8$ $x_1 - 2x_2 - 3x_3 = 0$ $-x_1 + x_2 + 2x_3 = 3$	**[10]**	**CO3**
12.B	Find the maximum value using Simplex method of $z = 107x_1 + x_2 + 2x_3$ subject to the constraints:	**[10]**	**CO4**

	$14x_1 + x_2 - 6x_3 + 3x_4 = 7$ $16x_1 + x_2 - 6x_3 \le 5$ $3x_1 - x_2 - x_3 \le 0$ $x_1, x_2, x_3, x_4 \ge 0$ **OR** Use the graphical method to solve the following LPP: Minimize $z = -x_1 + 2x_2$; subject to the constraints: $-x_1 + 3x_2 \le 10$ $x_1 + x_2 \le 6$ $x_1 - x_2 \le 2$ $x_1, x_2 \ge 0$		

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Section A

(Attempt all questions)

1.	Find the truncation error for e^x at x = $\frac{1}{5}$ if the first three terms are retained in expansion.	**[4]**	**CO1**
2.	Evaluate $\Delta \tan^{-1} x$	**[4]**	**CO1**
3.	Use Trapezoidal rule to evaluate $\int_0^1 x^3 dx$ considering five subintervals.	**[4]**	**CO2**
4.	Show that $E \equiv e^{hD}$	**[4]**	**CO3**
5.	Using Hessian matrix determine whether the following function is convex or concave. $f(x_1, x_2, x_3) = 4x_1^2 + 3x_2^2 + 5x_3^2 + 6x_1x_2 + x_1x_3 - 3x_1 - 2x_2 + 15$	**[4]**	**CO4**

SECTION B

(Q6-Q9 are compulsory and Q10 has internal choice)

6.	Find a real root correct to 3 decimal places of the equation $\cos x - 3x + 1 = 0$ by using method of iteration.	**[8]**	**CO1**
7.	Use Gauss Seidel method to find the solution correct to 3 decimal places of following system of linear equations $4x_1 + x_2 - x_3 = 3$ $2x_1 + 7x_2 + x_3 = 19$ $x_1 - 3x_2 + 12x_3 = 31$	**[8]**	**CO3**
8.	Use Lagrange interpolation formula to fit a polynomial to the following data <table><tr><td>*x*</td><td>-1</td><td>0</td><td>2</td><td>3</td></tr><tr><td>*f(x)*</td><td>-8</td><td>3</td><td>1</td><td>12</td></tr></table>	**[8]**	**CO2**

9.	Apply Euler's method to obtain y(1) from the following initial value problem $$\frac{dy}{dx} = x + y, \quad y(0) = 0 \quad \text{(take step size of 0.2)}$$	**[8]**	**CO3**
10.	Obtain the dual of the following LPP: $Minimize\ \ z = x_1 - 3x_2 - 2x_3$ subject to the constraints: $3x_1 - x_2 + 2x_3 \leq 7$ $2x_1 - 4x_2 \geq 12$ $-4x_1 + 3x_2 + 8x_3 = 10$ $x_1, x_2 \geq 0$ and x_3 is unrestricted. **OR** Obtain all the basic solutions to the following system of linear equation: $x_1 + 2x_2 + x_3 = 4$ $2x_1 + x_2 + 5x_3 = 5$	**[8]**	**CO4**

SECTION C
(Q11 is compulsory and Q12A, Q12B have internal choice)

11.A	The speed *v* meters per second of a car, *t* seconds after it starts, is given in the following table. Find distance travelled by a car in 2 minutes by using Simpson's 1/3 rule.	**[10]**	**CO2**

t	0	12	24	36	48	60	72	84	96	108	120
v	0	3.6	10.08	18.90	21.60	18.54	10.26	5.40	4.50	5.40	9.00

11.B	Obtain the function whose first difference is $9x^2 + 11x + 5$.	**[10]**	**CO2**
12.A	Using Runge -Kutta method of order four, obtain $y(1.2)$ from the differential equation $\frac{dy}{dx} = x^2 + y^2$ and $y(1)$=1.5. (take step size of 0.1). **OR** Solve the system of linear equations by using Gauss Elimination method $0.0002x + 0.3003y = 0.1002$ $2.0000x + 3.0000y = 2.0000$	**[10]**	**CO3**
12.B	Find the maximum value using Simplex method of $z = 4x_1 + 10x_2$ subject to the constraints:	**[10]**	**CO4**

	$2x_1 + x_2 \le 50$ $2x_1 + 5x_2 \le 100$ $2x_1 + 3x_2 \le 90$ $x_1, x_2 \ge 0$ **OR** Use the graphical method to solve the following LPP: Minimize $z = 2x_1 + 3x_2$; subject to the constraints: $x_1 + x_2 \le 30$ $x_1 - x_2 \ge 0$ $x_2 \ge 3$ $0 \le x_1 \le 20, \quad 0 \le x_2 \le 12$		