KUMARAGURU
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B.E/B.TECH DEGREE EXAMINATIONS: MAY 2018
(Regulation 2015)
Fourth Semester
U15MAT401: NUMERICAL METHODS
(Common to CIVIL/MECH/MCE/TXT/FT)

COURSE OUTCOMES
CO1: Solve a set of algebraic equations representing steady state models formed in engineering problems
CO2: Fit a smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables
CO3: Find the trend information from discrete data set through numerical differentiation
CO4: Estimate integrals from discrete data through numerical methods
CO5: Predict the system dynamic behavior through solution of ODEs modeling the system
CO6: Solve PDE models representing spatial and temporal variations in physical systems through numerical methods

Time: Three Hours   **Maximum Marks: 100**
Answer all the Questions:-
PART A (10 x 1 = 10 Marks)

1. Match list I with list II and select the correct answer using the codes given below.   CO1 [K_2]

List I	List II
A. $x^3 - x - 1 = 0$	i. Root lies between 0 and 1
B. $x^3 - 9x + 1 = 0$	ii. Root lies between 1 and 2
C. $x - \cos x = 0$	iii. Root lies between 3 and 4
D. $x^2 - 11 = 0$	iv. Root lies between 2 and 3

	A	B	C	D
a)	ii	i	iii	iv
b)	iii	iv	ii	i
c)	ii	iv	i	Iii
d)	iii	i	ii	Iv

2. In Gauss elimination method, the coefficient matrix is transformed to ------ matrix.   CO1 [K_1]
    a)   Upper triangular matrix   b)   Lower triangular matrix
    c)   Diagonal matrix   d)   Unit matrix

3. Consider the statements   CO2 [K_2]
    1. The nth divided differences of a polynomial of degree n are constants.
    2. The nth divided differences of a polynomial of degree n are zero.
    3. Lagrange's interpolation formula can be used whether the arguments are equally spaced or not.
    4. Lagrange's interpolation formula cannot be used when the base points are equally spaced.
    Which of these statements are correct?
    a)   1,3   b)   1,4
    c)   1,2   d)   2,3

4. Choose the correct sequence for straight line fitting for tabular values of x & y. CO2 [K_1]
   1. Obtain the normal equations
   2. Find the constant a and b
   3. Assume straight line equation y =ax+b
   4. Find $\sum x, \sum y, \sum xy, \sum x^2$
   a) 3-1-4-2   b) 2-3-4-1
   c) 1-2-3-4   d) 3-2-4-1

5. Examine the two statements carefully and select the answer using the codes given below: CO4 [K_2]
   Assertion (A): To use both Simpson's $1/3^{rd}$ and Simpson's $3/8^{th}$ rule, the number of ordinates should be of the form 6n+1, where n = 1,2,3,….
   Reason (R) : Simpson's $1/3^{rd}$ rule can be used when the number of intervals is even, and Simpson's $3/8^{th}$ rule is used when the number of intervals is odd.
   a) Both A and R are Individually true and   b) Both A and R are Individually true but
      R is the correct explanation of A   R is not the correct explanation of A
   c) A is true but R is false   d) A is false but R is true

6. By evaluating $\int_0^1 \frac{dx}{1+x^2}$ by a numerical integration method, we can obtain an approximate value of CO4 [K_3]
   a) π b) $\log_{10}^2$
   c) $\log_e^2$ d) E

7. Arrange in a sequence, to solve one dimensional heat equation using Crank-Nicholson difference method. CO6 [K_1]
   1. Set finite difference scheme for u_t and u_{xx}
   2. Set $\lambda = 1$
   3. Obtain difference scheme
   4. Apply the simplified formula
   a) 2-3-4-1   b) 1-3-2-4
   c) 3-4-2-1   d) 4-1-3-2

8. Consider the statements CO5 [K_2]
   1. Improved Euler's method is a multi step method.
   2. Euler's method is a special case of Taylor's series of I^{st} three terms.
   3. To apply Milne's method, we need at least 4 values of y prior to the required values of y.
   4. Euler method is a particular case of Runge-Kutta formula of the second order.
   Which of these statements are correct?
   a) 1,3   b) 2,4
   c) 2,3   d) 3,4

9. Examine the two statements carefully and select the answer using the codes given below: CO6 [K_1]
   Assertion (A) : The equation $x f_{xx} + y f_{yy} = 0, x > 0, y > 0$ is Elliptic.
   Reason (R) : $B^2 - 4AC < 0$ where A, B and C are the co efficient of r, s and t, where $r = f_{xx}, s = f_{xy}, t = f_{yy}$
   a) Both A and R are Individually true and   b) Both A and R are Individually true but
      R is the correct explanation of A   R is not the correct explanation of A
   c) A is true but R is false   d) A is false but R is true

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10.

Match the following for the given function $\dfrac{dy}{dx} = 3e^x + 2y$, y(0) = 0, h= 0.1

	List I	List II (Values of derivatives at y_o)
A.	$y' = 2y + 3e^x$	i. 45
B.	$y'' = 2y' + 3e^x$	ii. 9
C.	$y''' = 2y'' + 3e^x$	iii. 3
D.	$y'^v = 2y''' + 3e^x$	iv. 21

	A	B	C	D
a)	iii	ii	iv	i
b)	iii	ii	i	iv
c)	iii	i	ii	iv
d)	i	ii	iii	iv

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11. Write the iterative formula for finding the reciprocal of integer N by Newton's method.   CO1 [K₂]

12. Solve the linear system 4x – 3y = 11, 3x + 2y = 4 by Gauss Jordon method.   CO1 [K₃]

13. Given $y_3 = 2, y_4 = -6, y_5 = 8, y_6 = 9, y_7 = 17$. Find $\Delta^2 y_3$.   CO2 [K₄]

14. A curve passes through (0, 1), (0.25, 0.9412), (0.5, 0.8) (0.75, 0.64) and (1.0, 0.5). Find the area between the curve, x – axis and x = 0, x = 1 by Trapezoidal rule.   CO4 [K₄]

15. Find $y'(4)$ if   CO3 [K₄]

    x: 1   2   3   4
    y: 1   2   5   13

16. Write the Lagrange Inverse Interpolation formula.   CO2 [K₂]

17. Given $y' = x^2 - y, y(0) = 1$, find the value of $y(0.1)$, by using improved Euler method.   CO5 [K₄]

18. List the disadvantages of Taylor's series method.   CO5 [K₁]

19. Classify the Partial differential equation: $(x+1)u_{xx} - 2(x+2)u_{xy} + (x+3)u_{yy} = 0$ CO6 [K₂]

20. Write the diagonal five – point formula to solve the Laplace equation $u_{xx} + u_{yy} = 0$.   CO6 [K₂]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. Given $y' = x^3 + y$, and y(0)=2, evaluate y(0.2) by Taylor series method, y(0.4) by Euler method, y(0.6) by R-K method of fourth order and y(0.8) by Milne's method.   CO5 [K₅]

22.   (7)   CO4 [K₅]

(i) Using the Simpsons rule, evaluate $\displaystyle\int_1^2 \int_3^4 \frac{1}{(x+y)^2}\, dx\, dy$ taking h=k=0.2.

(ii) Using Gauss-Jordan method, find the inverse of $\begin{pmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{pmatrix}$ (7)   CO1   [K$_3$]

23.   (i) Find the equation $y = f(x)$ of least degree and passing through the points (-1, -21), (1, 15), (2, 12), (3, 3). Find also y at x=0.   (7)   CO2   [K$_3$]

     (ii) From the table given below, find the best values of *a* and *b* in the law $y = a\,x^b$ by the method of least squares.   (7)   CO2   [K$_3$]

x:	1	2	3	4	5	6
y:	1200	900	600	200	110	50

24.   (i) Solve the following system of equations by Gauss-Seidel's iteration method: (7)   CO1   [K$_3$]

$$8x - 6y + z = 13.67 \;,\; 3x + 11y - 2z = 17.59 \;,\; 2x - 6y + 9z = 29.29$$

     (ii) Using Newton-Raphson method, find the root of $4x - e^x = 0$ that lies between 2 and 3.   (7)   CO1   [K$_3$]

25.   (i) When a train is moving at 30 m/sec, steam is shut off and brakes are applied. The speed of the train per second after t seconds is given by   (7)   CO4   [K$_5$]

Time(t) :	0	5	10	15	20	25	30	35	40
Speed(v):	30	24	19.5	16	13.6	11.7	10	8.5	7

Using Simpson's rule, determine the distance moved by the train in 40 seconds.

     (ii) The table given below reveals the velocity v of a body during the time 't' specified. Find its acceleration at t=1.1.   (7)   CO3   [K$_3$]

t:	1.0	1.1	1.2	1.3	1.4
v:	43.1	47.7	52.1	56.4	60.8

26.   (i) Solve $u_{xx} = u_{tt}$ up to t=0.5 with spacing of 0.1 given $u(0,t) = 0$, $u(1,t) = 0$, $u_t(x,0) = 0$ and $u(x,0) = 10 + x(1 - x)$ (7)   CO6   [K$_3$]

     (ii) Solve $u_{xx} = 2u_t$, $0 < x < 4, t > 0$ with the condition $u(0,t) = 0, u(4,t) = 0$, $u(x,0) = x(4 - x)$, taking h=1 and using Schmidt method. Get the solution through 5 time steps.   (7)   CO6   [K$_3$]

27.   (i) The population of a town is as follows.   (7)   CO2   [K$_5$]

Year x:	1941	1951	1961	1971	1981	1991
Population in lakhs y:	20	24	29	36	46	51

Estimate the population increase during the period 1946 to 1976.

     (ii) Using Lagrange's formula of interpolation, find y(9.5) given   (7)   CO2   [K$_3$]

x:	7	8	9	10
y:	3	1	1	9

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