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Reg. No. :

Code No. : 9073

Sub. Code : PMAM 15

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2017.

First Semester

Mathematics

NUMERICAL ANALYSIS

(For those who joined in July 2017 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Gauss forward Interpolation formula involves
 - (a) Odd differences below the Central line and even differences below the central line
 - (b) Odd differences above the central line and even differences above the central line
 - (c) Odd differences below the central line and even differences on the central line
 - (d) None

2. The value of $\delta^3 y_{\frac{1}{2}}$ is

- (a) $\Delta^3 y_1$
- (b) $\Delta^3 y_{-1}$
- (c) $\Delta^2 y_0$
- (d) $\Delta^3 y_0$

3. $\left(\frac{d^2 y}{dx^2}\right)_{x=0}$ is

- (a) $\frac{1}{h^2} \left[\Delta^2 y_0 - \Delta^3 y_0 + \frac{11}{12} \Delta^4 y_0 - \dots \right]$
- (b) $\frac{1}{h^2} \left[\Delta^2 y_0 + \Delta^3 y_0 + \frac{11}{12} \Delta^4 y_0 + \dots \right]$
- (c) $\frac{1}{h} \left[\Delta y_0 + \Delta^2 y_0 + \Delta^3 y_0 + \Delta^4 y_0 + \dots \right]$
- (d) none

4. $\left(\frac{dy}{dx}\right)_{x=0}$ is

- (a) $\frac{1}{h} \left[\nabla y_0 + \frac{1}{2} \nabla^2 y_0 + \frac{1}{3} \nabla^3 y_0 + \dots \right]$
- (b) $\frac{1}{h} \left[\nabla y_0 - \frac{1}{2} \nabla^2 y_0 - \frac{1}{3} \nabla^3 y_0 \right]$
- (c) $\frac{1}{h} \left[\nabla y_0 + \frac{1}{2!} \nabla^2 y_0 + \frac{1}{3!} \nabla^3 y_0 + \dots \right]$
- (d) none

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5. Simpson's $\frac{1}{3}$ rule is

- (a) $\frac{h}{3} [(y_0 + y_n) + 2(y_1 + y_3 + \dots) + 4(y_2 + y_4 + \dots)]$
 (b) $\frac{h}{3} [(y_0 + y_n) + 2(y_1 + \dots + y_{n-1})]$
 (c) $\frac{h}{3} [(y_0 + y_n) + 2(y_1 + y_3 + \dots) + 4(y_2 + y_4 + y_6 + \dots)]$
 (d) none

6. The principal error in the trapezoidal rule in the interval of (x_1, x_2) is

- (a) $-\frac{h^3}{12} y''$ (b) $\frac{h^3}{12} y_1''$
 (c) $-\frac{h^3}{12} y_1'$ (d) $\frac{h^3}{12} y_1'$

7. The Euler's algorithm is

- (a) $y_{n+1} = y_n + hf(x_n, y_n) \quad n = 0, 1, \dots$
 (b) $y_{n+1} = y_n - hf(x_n, y_n) \quad n = 1, 2, \dots$
 (c) $y_{n+1} = y_n + hf(x_0, y_0) \quad n = 0, 1, 2, \dots$
 (d) $y_{n+1} = y_n - hf(x_0, y_0) \quad n = 0, 1, 2$

8. For the equation $\frac{dy}{dx} + \frac{y}{x} = \frac{1}{x^2}$ $Y(1) = 1$, $y_1^{(1)}$ is

- (a) 0.0959 (b) 0.9959
 (c) 1 (d) 0.9

9. Milne's predictor formula is

- (a) $y_{n+1,p} = y_{n-3} + \frac{4h}{3} [y'_{n-2} - y'_{n-1} + 2y'_n]$
 (b) $y_{n+1,p} = y_{n-3} - \frac{4h}{3} [y'_{n-2} - y'_n + 2y'_{n-1}]$
 (c) $y_{n+1,p} = y_{n-3} + \frac{h}{3} [y'_{n-2} - y'_n + y'_{n-1}]$
 (d) None

10. For solving differential equation in milnes predictor formula the required number of initial values are

- (a) 4 (b) 3
 (c) 2 (d) 1

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) For the following data find $f(9)$ using Newton's forward interpolation formula.

x	8	10	12	14	16
$f(x)$	1000	1900	3250	5400	8950

Or

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- (b) Find the value of y from the following data at $x = 2.65$.

x	-1	0	1	2	3
y	-21	0	15	12	3

12. (a) Find $y'(x)$ given

x	0	1	2	3	4
$y(x)$	1	1	15	40	85

Hence find $y'(x)$ at $x = 0.5$.

Or

- (b) Obtain an approximate value of $u'(0)$ where $u(x)$ is given by the following table.

x	0	1	2	3	4	5
$u(x)$	43	40	38	42	45	50

13. (a) Evaluate $\int_0^{\frac{\pi}{2}} \sin x \, dx$ by Simpson's $\frac{1}{3}$ rule dividing the range into six equal parts.

Or

- (b) Evaluate $\int_{1.0}^{1.3} \sqrt{x} \, dx$ taking $h = 0.05$ by Trapezoidal rule.

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14. (a) Find the value of $y(0.1)$ by Picard's method

given $\frac{dy}{dx} = \frac{y-x}{y+x}$ $y(0) = 1$.

Or

- (b) Using Euler's method solve $\frac{dy}{dx} = 1 + xy$ with $y(0) = 2$. Find $y(0.1)$, $y(0.2)$ and $y(0.3)$.

15. (a) Given $\frac{dy}{dx} = \frac{1}{x+y}$ $y(0) = 2$. If $y(0.2) = 2.09$ $y(0.4) = 2.17$ and $y(0.6) = 2.24$ find $y(0.8)$ using milnes method.

Or

- (b) Evaluate $y(1.4)$ given that $y' + \frac{y}{x} = \frac{1}{x^2}$ and $y(1) = 1$, $y(1.1) = 0.996$, $y(1.2) = 0.986$, $y(1.3) = 0.972$ by using Adam's Predictor corrector method.

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PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Derive Gauss backward Interpolation formula.

Or

- (b) The values of $u(x)$ are known at a, b, c . Show that maximum or minimum of Lagrange's interpolation polynomial is attained at

$$x = \frac{\sum u_a (b^2 - c^2)}{2 \sum u_a (b - c)}.$$

17. (a) Find $y'(0)$ and $y''(0)$ from the following table.

x	0	1	2	3	4	5
y	4	8	15	7	6	2

Or

- (b) From the following data obtain the first and second derivatives of $y = \log_e x$ (i) at $x = 500$ (ii) at $x = 550$ (iii) at $x = 520$.

x	500	510	520	530	540	550
$y = \log x$	6.2146	6.2344	6.2538	6.2729	6.2916	6.3099

18. (a) Evaluate $\int_0^2 \frac{dx}{x^2 + 4}$ using Romberg's method.

Hence obtain the approximate value for π .

Or

- (b) Evaluate $\int_0^1 \int_0^1 e^{x+y} dx dy$ using Trapezoidal rule and Simpson's rule with $h = k = 0.5$.

19. (a) Compute $y(0.1)$ and $y(0.2)$ by Runge kutta method of 4th order for the differential equation $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$.

Or

- (b) Solve the following initial value problem using Runge kutta second order method

$$\frac{dy}{dx} = (1 + x^2) y, \quad y(0) = 1, \quad x = 0 \quad (0.2) \quad 0.6.$$

20. (a) Derive milnes corrector formula.

Or

- (b) Using Adam's Bashforth method find $y(4.4)$ given $5x y^1 + y^2 = 2$, $y(4) = 1$, $y(4.1) = 1.0049$, $y(4.2) = 1.0097$ and $y(4.3) = 1.0143$.

