**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI 600086**
**(For candidates admitted during the academic year 2023 – 24 & thereafter)**

**B.SC. DEGREE EXAMINATION, APRIL 2026**
**BRANCH I – MATHEMATICS**
**SIXTH SEMESTER**

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|---|---|
| **COURSE** | **: MAJOR ELECTIVE** |
| **PAPER** | **: NUMERICAL METHODS WITH PROGRAMS IN C++ (THEORY)** |
| **SUBJECT CODE** | **: 23MT/ME/NM45** |
| **TIME** | **: 105 MINUTES** |

**MAX. MARKS: 60**

| **Q. No.** | **SECTION A (2 × 2 = 4)**<br>Answer any **TWO** questions | **CO** | **KL** |
|---|---|---|---|
| 1 | When do you apply Simpson's one-third rule? | 1 | 1 |
| 2 | State the Stirling's Interpolation formula. | 1 | 1 |
| 3 | State the Euler's Formula. | 1 | 1 |

| **Q. No.** | **SECTION B (8× 1 = 8)**<br>Answer **ALL** questions | **CO** | **KL** |
|---|---|---|---|
| 4 | Given $h = 1$, $\nabla y_n = 6$, $\nabla^2 y_n = 2$,<br>Using Newton's Backward Formula, $f'(x_n)$ is<br>a) 5 b) 6 c) 7 d) 8 | 2 | 2 |
| 5 | Forward differences are taken using:<br>a) Successive values of $x$<br>b) Previous values of $x$<br>c) Midpoint values<br>d) Randomly selected points | 2 | 2 |
| 6 | If the number of subintervals is 6, which rule can be applied directly?<br>a) Simpson's 1/3 rule<br>b) Simpson's 3/8 rule<br>c) Both Simpson's 1/3 and 3/8 Rule<br>d) Neither | 2 | 2 |
| 7 | Newton–Cote's quadrature formula is based on:<br>a) Finite difference method<br>b) Polynomial interpolation<br>c) Taylor series expansion<br>d) Differential equations | 2 | 2 |
| 8 | Bolzano's Bisection Method is applicable when:<br>a) $f(x)$ is always increasing<br>b) $f(x)$ has a derivative<br>c) The function changes sign over an interval<br>d) The equation is linear | 2 | 2 |
| 9 | Newton–Raphson method requires which of the following?<br>a) Only function values<br>b) Only interval endpoints<br>c) Derivative of the function<br>d) No function evaluation | 2 | 2 |

| | | | |
|---|---|---|---|
| 10 | Gauss–Seidel method differs from Jacobi's method because it:<br>a) Does not use iteration<br>b) Uses newly computed values immediately<br>c) Does not require initial guesses<br>d) Requires a derivative | 2 | 2 |
| 11 | In Newton's Forward Difference Formula, the variable $p$ is defined as:<br>a) $p = \frac{x-x_0}{h}$ b) $p = \frac{x_n-x}{h}$ c) $p = \frac{x-x_n}{h}$ d) $p = \frac{x_0-x}{h}$ | 2 | 2 |

| Q. No. | **SECTION C (6 × 8 = 48)**<br>Answer any **SIX** questions | **CO** | **KL** |
|---|---|---|---|
| 12 | Apply Newton's forward interpolation formula to find $y(12)$ using the following data | 3 | 3 |
| 13 | Compute the value of $\frac{dy}{dx}$ at $x = 1.15$ from the following table using differentiation formula based on Stirling's formula: | 3 | 3 |
| 14 | Compute the value of $\pi$ from the formula $\frac{\pi}{4} = \int_0^1 \frac{dx}{1+x^2}$ using trapezoidal rule with 10 sub-intervals. (Take $h = 0.1$) | 3 | 3 |
| 15 | Determine by Lagranges's method the percentage of number of patients over 40 years, using the following data: | 3 | 3 |
| 16 | Find the positive root of $3x^3 + 5x - 40$ , correct to two places of decimals, using the bisection method. | 3 | 3 |
| 17 | Solve the following system of equations by Gauss-Siedel's iteration method.<br>$10x_1+2x_2 + x_3 = 9$<br>$x_1+10x_2 - x_3 = -22$<br>$-2x_1 + 3x_2 + 10x_3 = 22$ | 3 | 3 |
| 18 | Compute the value of $y(0.2)$ by Runge-Kutta method of the fourth order with $h = 0.2$, given that $\frac{dy}{dx} = \sqrt{x^2 + y}$; $y(0) = 0.8$ | 3 | 3 |
| 19 | Find the root of the equation $x^x = 100$, correct to four places of decimals, using Newton-Raphson method. | 3 | 3 |

Table for Q.12:

| $x$ | 10 | 15 | 20 | 25 | 30 | 35 |
|---|---|---|---|---|---|---|
| $y$ | 35.3 | 32.4 | 29.2 | 26.1 | 23.2 | 20.5 |

Table for Q.13:

| $x$ | 1.00 | 1.05 | 1.10 | 1.15 | 1.20 | 1.25 | 1.30 |
|---|---|---|---|---|---|---|---|
| $y$ | 1.0000 | 1.0247 | 1.0488 | 1.0724 | 1.0954 | 1.1180 | 1.1402 |

Table for Q.15:

| Age over ( $x$) years | 30 | 35 | 45 | 55 |
|---|---|---|---|---|
| % number ($y$) of patients | 148 | 96 | 68 | 34 |

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