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ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER – 2008

NUMERICAL METHODS AND PROGRAMMING

SEMESTER – 3

Time : 3 Hours] [Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Which of the following relations is true ?

a) $E = 1 + \Delta$ b) $E = 1 - \Delta$

c) $E = 1/\Delta$ d) None of these. ☐

ii) By evaluating $\int_0^1 \frac{dx}{1+x^2}$ by a numerical integration method, we can obtain an approximate value of

a) $\log_e 2$ b) π

c) e d) $\log_{10} 2$. ☐

iii) If a be the actual value and e be its estimated value, the formula for relative error is

a) $\frac{a}{e}$ b) $\frac{|a-e|}{a}$

c) $\frac{(e-a)}{e}$ d) $\frac{|a-e|}{e}$. ☐

iv) in Trapezoidal rule, the portion of curve is replaced by

a) straight line b) circular path

c) parabolic path d) none of these. ☐

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v) The error involved in 4 th order *R-k* method is given by

a) $O(h^2)$ b) $O(h^4)$

c) $O(h^3)$ d) $O(h^5)$.

vi) An $n \times n$ matrix A is said to be diagonally dominant if

a) $|a_{ii}| \leq \sum_{\substack{j=1 \\ i \neq j}}^{n} |a_{ij}|$

b) $|a_{ii}| < \sum_{\substack{j=1 \\ i \neq j}}^{n} |a_{ij}|$

c) $|a_{ii}| > \sum_{\substack{j=1 \\ i \neq j}}^{n} |a_{ij}|$

d) $|a_{ii}| \geq \sum_{\substack{j=1 \\ i \neq j}}^{n} |a_{ij}|$.

vii) Find the output of the following program :

```
main( )
{
    char a, b ;
    a = 'b' ;
    b = a ;
    printf( "b = %c\n", b ) ;
}
```

a) *a* b) *b*

c) garbage value d) none of these.

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viii) Lagrange's interpolation formula is used for

a) equispaced arguments only

b) unequispaced arguments only

c) both equispaced and unequispaced arguments

d) none of these. ☐

ix) If $f(3) = 5$ and $f(5) = 3$, then the linear interpolation function $f(x)$ is

a) $f(x) = 8 - x$ b) $f(x) = 8 + x$

c) $f(x) = x^2$ d) $f(x) = x + x^2 + 8$. ☐

x) If $f(x) = \frac{1}{x}$, the divided difference $[a, b, c]$ is

a) $\frac{1}{a+b+c}$ b) $\frac{1}{abc}$

c) $\frac{1}{a^2+b^2}$ d) $\frac{1}{a+b-c}$. ☐

xi) If $\frac{dy}{dx} = x + y$ and $y(1) = 0$, then $y(1.1)$ according to Euler's method is $[h = 0{\cdot}1]$

a) 0·1 b) 0·3

c) 0·5 d) 0·9. ☐

xii) Which one of the following results is correct ?

a) $\Delta x^n = nx^{n-1}$ b) $\Delta x^{(n)} = nx^{n-1}$

c) $\Delta^n e^x = e^x$ d) $\Delta \cos x = -\sin x$. ☐

xiii) In the method of iteration the function $\phi(x)$ must satisfy

a) $|\phi'(x)| < 1$ b) $|\phi'(x)| > 1$

c) $|\phi'(x)| = 1$ d) $|\phi'(x)| = 2$. ☐

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xiv) The inherent error for Simpson's $\frac{1}{3}$ rd rule of integration is as (the notations have their usual meanings)

a) $-\frac{nh^5}{180} f^{II}(x_0)$ b) $-\frac{nh^5}{140} f^{iv}(x_0)$

c) $-\frac{nh^3}{12} f^{II}(x_0)$ d) none of these. ☐

xv) $(\Delta - \nabla) x^2$ is equal to (the notations have their usual meanings)

a) h^2 b) $-2h^2$

c) $2h^2$ d) none of these. ☐

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. From the following table find the values of $f(12)$ by Newton's divided difference interpolation formula :

x :	11	13	14	18	19	21
$f(x)$:	1342	2210	2758	5850	6878	9282

3. Solve the following system by Matrix Inversion Method :

$2x + y + z = 10$

$3x + 2y + 3z = 18$

$x + 4y + 9z = 16.$

4. a) Evaluate the missing terms in the following table :

x :	0	1	2	3	4	5
$f(x)$:	0	—	8	15	—	35

b) What is ternary operator ? Give an example.

5. a) Solve by Taylor's series method $\frac{dy}{dx} = 2x + 3y^2$ given $y = 0$ when $x = 0$ at $x = 0{\cdot}2$.

b) Using Euler's method obtain the solution of $\frac{dy}{dx} = x - y$, with $y(0) = 1$ and $h = 0{\cdot}2$ at $x = 0{\cdot}4$.

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6. Find the first approximation of the root lying between 0 and 1 of the equation $x^3 + 3x - 1 = 0$ by Newton-Raphson formula.

7. Find $y'(x)$, $y''(x)$, given

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

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following questions. $3 \times 15 = 45$

8. a) From the following table, estimate the number of students who obtained marks between 40 and 45 :

Marks :	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
No. of Students :	31	42	51	35	31

b) Using Newton divided difference formula, evaluate $f(8)$ and $f(15)$ given :

X :	4	5	7	10	11	13
$f(X)$:	48	100	294	900	1210	2028

7 + 8

9. a) Find the positive real root of $x^3 = 18$ using the bisection method of 4 iterations.

b) Find the root of the equation $x^3 + x^2 + x + 7 = 0$ using Regula Falsi method.

c) A curve passes through the points as given in the following table. Find the area bounded by the curve, x-axis, $x = 1$ and $x = 9$:

X	1	2	3	4	5	6	7	8	9
Y	0·2	0·7	1	1·3	1·5	1·7	1·9	2·1	2·3

5 + 5 + 5

10. a) Write a program in C to solve the equation $x^3 - 3x - 5 = 0$ within (1, 2) by Bisection method correct up to 3 places of decimal.

b) Write a program in C using recursive function to calculate the sum of all digits of any number. 8 + 7

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11. a) Evaluate $\int_0^1 xe^x \, dx$ by using Trapezoidal rule taking $n = 6$.

b) Use Lagrange's interpolation formula to find the value of $f(x)$ for $x - 0$, given the following :

x :	– 1	– 2	2	4
$f(x)$:	– 1	– 9	11	69

c) Prove that Newton-Raphson method has a quadratic convergence. 5 + 5 + 5

12. a) Solve the following system of equations by $L - U$ Factorization Method :

$$x_1 + x_2 - x_3 = 2$$
$$2x_1 + 3x_2 + 5x_3 = -3$$
$$3x_1 + 2x_2 - 3x_3 = 6.$$

b) Solve the following set of equations by Gauss-Seidel method correct to 2 places of decimal :

$$9x - 2y + z = 50$$
$$x + 5y - 3z = 18$$
$$-2x + 2y + 7z = 19.$$

c) Write a C program to approximate a real root of the following equation :

$4 * \sin(x) = e^x$ by Bisection method. 5 + 5 + 5

13. a) Write a C program to interpolate a given function at a specified argument by Lagrange's interpolation formula.

b) Find the value of $\log 2^{1/3}$ from $\int_0^1 \frac{x^2}{1+x^3} \, dx$ using Simpson's $\frac{1}{3}$ rd rule with $n = 4$.

c) Calculate the approximate value of $\int_0^{\pi/2} \sin x \, dx$ by Composite Trapezoidal Rule by using 11 ordinates. Also compare it with the actual value of the integral.

5 + 5 + 5

END

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