*Total number of printed pages:***04** **PG/2nd/PGET202**

2021

NUMERICAL METHODS FOR ENERGY SYSTEM

Full Marks: 60

Time: 2 hours

The figures in the margin indicate full marks for the questions.

A. Multiple Choice Questions 1 x 10=10

1. If the equation $f(x) = 0$ *is such that* $g(x) = \emptyset(x)$ *and* $\emptyset'(x_0) = 3$, with the Newton-Raphson method is not convergent for the problem, then which of the following method is usable?
   a. Iteration Method
   b. Newton-Raphson Method
   c. Regula-False Method
   d. None of these
2. Gauss-Seidel iterative method can be used for solving a set of
   a. Linear differential equations only
   b. Linear algebraic equations only
   c. Both linear and nonlinear algebraic equations
   d. Both linear and nonlinear algebraic differential equations
3. If $f(x) = 0$ such that $g(x) = \emptyset(x)$, then iteration Method is convergent if
   a. $|f'(x)| < 1$
   b. $|\emptyset'(x)| < 1$
   c. $|f''(x)| < 1$
   d. $|\emptyset''(x)| < 1$
4. Rate of convergence value of Newton-Raphson method is
   a. 2.6
   b. 1.2

c. 2

d. 1

5. For the unequal interval, method use to interpolate is

   a. Newton Forward Interpolation

   b. Newton Forward Interpolation

   c. Lagrange interpolation

   d. Gauss Interpolation

6. Which of the following is not a closed formula for integration?

   a. Trapezoidal Rule

   b. Simpson's Rule

   c. Cubic Spline

   d. None of the above

7. "Quadrature" refers to

   a. A method to obtain roots of a nonlinear equation

   b. Quadratic approximation of a function

   c. Inner (dot) product with quadratic weighting functions

   d. Representing integral as a weighted sum of function values at certain points

8. Which of the following is true about a general ODE Boundary Value Problem (BVP)?

   a. Finite difference approximation leads to linear algebraic equations

   b. One can always find an analytical solution to any ODE-BVP Computational Techniques

   c. Neumann and mixed boundary conditions are handled using "ghost point" approach

   d. It can be solved using "method of lines"

9. The first and second derivatives of the function at the point x=1.2 from the following data

X:	1	2	3	4	5
Y:	0	1	5	6	8

   a. 14 and 17

   b. 15 and17

c. 17 and 14

d. 17 and 15

10. Value of $\Delta tan^{-1}x$ is

a. $tan^{-1}\left\{\frac{x}{1+hx+x^2}\right\}$

b. $tan^{-1}\left\{\frac{h}{1+hx+x^2}\right\}$

c. $tan^{-1}\left\{\frac{x}{1+x^2}\right\}$

d. $tan^{-1}\left\{\frac{h}{1+x^2}\right\}$

B. Answer any two(02) from the following questions: 4*2=8

1. Explain how you will use Trapezoidal method to numerically evaluate the integral $\int_0^{\alpha} f(x)dx$?

2. Calculate the value of the integral $\int_4^{5.2} log_e x dx$ by Simpson's 3/8 th rule taking h = 0.2 retaining the numerical values to 7 decimals. Compare the results with exact values.

3. Find the cubic polynomial which takes the following values:

x	0	1	2	3
f(x)	1	2	1	10

C Answer any six(06) from the following questions 7*6=42

1. Solve the non-linear equations, $2x^2 + 3xy + y^2 = 3, 4x^2 + 2xy + y^2 = 30$. Correct to three decimal places, using Newton-Raphson method, given that $x_0 = -3$ and $y_0 = 30$

In the Table below, the values of y are consecutive terms of a series of which 23.6 is the 6th term. Find the first and tenth terms of the series:

x	3	4	5	6	7	8	9
y	4.8	8.4	14.5	23.6	36.2	52.8	73.9

2. Consider the second order value problem $y'' - 2y' + 2y = e^{2t}\sin(t)$ with $y(0) = -0.4$ and $y'(0) = -0.6$. Using the fourth order Runge-Kutta method, find y(0.2)

3. Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ $in\ 0 < x < 5, t \geq 0$,

given that $u(x,0) = 20, u(0,t) = 0, u(5,t) = 100$. Compute u for the time-step with h=1 by Crank Nicolson method.

4. Show that the following four-point backward difference formula can be used to compute the second derivative:

$$f_2(x_i) = \frac{2f(x_i) - 5f(x_{i-1}) + 4f(x_{i-2}) - f(x_{i-3})}{h^2}$$

5. Use Romberg's method to compute I = $\int_0^1 \frac{1}{1+x} dx$ correct to three decimal places with Trapezoidal rule.

6. Evaluate the integral $\int_0^{\pi/2} sinxdx$ using two-terms Gaussian formula

7. Find $f'(5)$ from the following table:

x	f(x)	Δf(x)	Δ^2f(x)	Δ^3f(x)	Δ^4f(x)
0	4				
2	26	11	7		
3	58	32	11	1	0
4	112	54	16	1	0
7	466	118	22	1	
9	992	228			