Total No. of Questions : 8]

SEAT No. :

P5288

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[5562]-140

M.E. (Civil- Structures Engineering)

NUMERICAL METHODS IN STRUCTURAL ENGINEERING

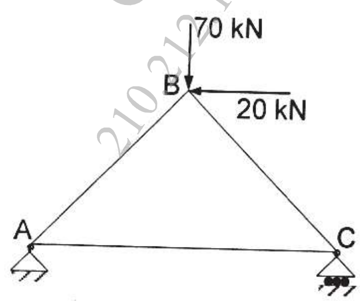
(501004) (2017 Course) (Semester-I)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6 and Q7 or Q8.***
2) ***Figures to the right side indicate full marks.***
3) ***If necessary, assume suitable date and indicate clearly.***
4) ***Use of electronic pocket calculator is allowed.***

Q1) a) A simply supported equilateral truss ABC is loaded as shown in figure. Using stiffness matrix method of analysis, determine the horizontal and vertical displacements at B. Assume flexibility of each member uniform. **[5]**



b) Solve the linear system step by step by Gauss Seidal Method. **[4]**

$4x_1 + x_2 - x_3 = 3$

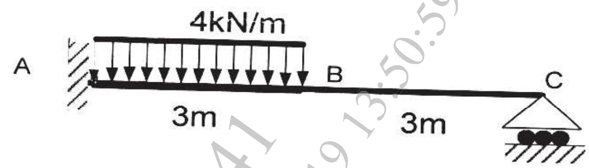
$2x_1 + 7x_2 + x_3 = 19$

$x_1 - 3x_2 + 12x_3 = 31$

OR

P.T.O.

Q2) a) Using member stiffness matrix method, determine the deflection and rotation at B. **[5]**



b) Explain the difference in Gauss elimination, Gauss Seidel and Gauss Jordan method for the solution of linear equations. Explain the convergence criteria and diagonal dominance with reference to above methods. **[4]**

Q3) a) Complete six iterations of the power method to approximate a dominant eigenvector of $[A]=\begin{bmatrix}2 & -12\\ 1 & -5\end{bmatrix}$. Begin with an initial nonzero approximation of $[x_0]=\begin{bmatrix}1\\ 1\end{bmatrix}$ **[4]**

b) Derive the 1-point and 2-point Gauss Quadrature formula. Explain the advantage of Gauss Quadrature formula over the trapezoidal and Simpson's rule. **[5]**

OR

Q4) a) Explain Euler's method or Runga kutta method showing the flow chart for the numerical analysis. **[4]**

b) Use two-point Gauss quadrature rule to approximate the distance covered by a rocket from t = 8 to t = 30 as given by **[5]**

$$x=\int_{8}^{30}\left(2000\ln\left[\frac{140000}{140000-2100\,t}\right]-98\,t\right)dt$$

Also, find the absolute relative true error.

Q5) a) Derive the biharmonic finite difference net for a plate simply supported at its edges. Explain how boundary conditions are incorporated. How are the shear forces and bending moments calculated? **[8]**

b) Estimate the lowest buckling load of a uniform pin ended column of length L and flexural rigidity EI using three subintervals. Compare the approximate value obtained with the exact value given by Euler's critical load theory. **[8]**

OR

Q6) a) A propped cantilever beam of 6 m span is subjected to an uniformly distributed load of 12 kN/m. Applying central difference formula dividing the beam in four equal parts, find the deflection at the nodal points, rotation at the simply supported end and bending moment at its fixed end. **[8]**

b) A simply supported uniform square plate is subjected to an uniformly distributed load q. Dividing the plate into 4×4 mesh, find the deflection at the interior nodal points using finite difference method. Comment on the changes to be made in the formulation if, **[8]**

i) The support condition is changed to fixed.

ii) The plate is subjected to concentrated load at the center instead of uniformly distributed load q.

Q7) a) Explain interpolation using spline functions. What are linear, quadratic and cubic splines? Explain the necessity condition for the spline to be cubic. **[8]**

b) Derive the expression for the linear fit in curve fitting method of least squares. **[8]**

Using this method, find an equation of the form y=ax+b, that fits the following data:

x	0	1	2	3	4
y = f(x)	1	5	10	22	38

OR

Q8) a) Interpolate $f(x) = x^4$ on the interval $-1 \le x \le 1$ by the cubic spline g(x) corresponding to the nodes $x_0 = -1$, $x_1 = 0$, $x_2 = 1$ and satisfying the clamped conditions g'(-1)=f'(-1), g'(1)=f'(1) **[8]**

b) Explain regression analysis with suitable examples. **[8]**