USN | | | | | | | | | | 08MMD/MDE/MCM/MEA/MAR11

# First Semester M.Tech. Degree Examination, December 2010
## Applied Mathematics

22

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions.***



1 a. Explain in brief: i) Significant figures
ii) Round off errors
iii) Truncation errors
iv) Accuracy and precision
v) Absolute and percentage errors **(12 Marks)**

b. Round off the numbers 37.46235 and 625.483 to three significant digits and calculate the absolute relative and percentage errors in each case. **(08 Marks)**

2 a. Use both Secant and Regula false position methods to evaluate a real root of the equation $x^3 - 5x + 1 = 0$ which lies in the interval (0, 1) and perform four iterations correct upto six decimal places in each case. **(10 Marks)**

b. Use both the standard and the modified Newton-Raphson methods to evaluate the multiple root for $f(x) = (x-3)(x-1)^2$ with the initial value $x_0 = 0$ and carryout three approximations in each case. **(10 Marks)**

3 a. Perform two iterations of the Bairstow method to extract a quadratic factor $x^2 + px + q$ from the polynomial $x^3 + x^2 - x + 2 = 0$. Use the initial approximations $p_0 = -0.9$, $q_0 = 0.9$. (Here $p_0 = r$ and $q_0 = s$) **(10 Marks)**

b. Find all the roots of the polynomial $x^3 - 6x^2 + 11x - 6 = 0$, using the Graeffe's root squaring method. **(10 Marks)**

4 a. Use Romberg's method to compute $\int_0^1 \frac{dx}{1+x^2}$, correct to four decimal places, by taking $h = 0.5, 0.25$ and $0.125$. **(10 Marks)**

b. Given that :

| x : | 1 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 |
|---|---|---|---|---|---|---|---|
| y : | 7.989 | 8.403 | 8.781 | 9.129 | 9.451 | 9.750 | 10.031 |

Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at $x = 1.1$ and $1.6$. **(10 Marks)**

5 a. Solve the following system of equation by Cholesky method: **(10 Marks)**
$4x_1 - x_2 = 1$ ; $-x_1 + 4x_2 - x_3 = 0$ ; $-x_2 + 4x_3 - x_4 = 0$ ; $-x_3 + 4x_4 = 0$

b. Find the inverse of the matrix :

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix}$$

by partition method and hence solve the system $AX = b$ where $b = [1, 6, 4]^T$. **(10 Marks)**

6 a. Using the Jacobi method, find all the eigen values and the corresponding eigen vectors of the matrix $A = \begin{bmatrix} 1 & \sqrt{2} & 2 \\ \sqrt{2} & 3 & \sqrt{2} \\ 2 & \sqrt{2} & 1 \end{bmatrix}$ **(10 Marks)**

b. Find all the eigen values of the matrix $A = \begin{bmatrix} 4 & 3 \\ 1 & 2 \end{bmatrix}$ using the Rutishauser method. **(10 Marks)**

7 a. Define a linear transformation $T: R^2 \to R^2$ by $T(X) = AX = \begin{bmatrix} -x_1 \\ x_2 \end{bmatrix}$, where $A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$.

Then find the images under T of $u = \begin{bmatrix} 4 \\ 1 \end{bmatrix}$, $v = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$ and $u + v = \begin{bmatrix} 6 \\ 4 \end{bmatrix}$. **(06 Marks)**

b. Let $T: IR^n \to IR^m$ be a linear transformation. Then T is one-to-one if and only if the equation $T(X) = 0$ has only the trivial solution. **(06 Marks)**

c. In a certain region, about 5% f a city's population moves to the surrounding suburbs each year, and about 4% of the suburban population moves into the city. In 2000, there were 600,000 residents in the city and 400,000 in the suburbs. Set up a difference equation that describes this situation, where $x_0$ is the initial population in 2000. Then estimate the population in the city in the suburbs, two years later in 2002. **(08 Marks)**

8 a. Compute u.v and v.u when $u = \begin{bmatrix} 2 \\ -5 \\ -1 \end{bmatrix}$ and $v = \begin{bmatrix} 3 \\ 2 \\ -3 \end{bmatrix}$. **(06 Marks)**

b. Let w = span $\{u_1, u_2\}$ where $u_1 = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$, $u_2 = \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}$ and $y = \begin{bmatrix} -1 \\ 4 \\ 3 \end{bmatrix}$ then :

i) Verify that $\{u_1, u_2\}$ is an orthogonal set

ii) Find the orthogonal projection of y on to span $\{u_1, u_2\}$. **(06 Marks)**

c. Find a least-squares solution of the system $Ax = b$ where $A = \begin{bmatrix} 1 & 5 \\ 3 & 1 \\ -2 & 4 \end{bmatrix}$, $b = \begin{bmatrix} 4 \\ -2 \\ -3 \end{bmatrix}$. **(08 Marks)**

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# First Semester M.Tech. Degree Examination, December 2010

## Finite Element Methods

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions.***

**1** a. Describe the convergence criteria used for the displacement functions in FEM. **(05 Marks)**

b. Briefly explain the following :

i) Boundary value problems ii) Initial value problems **(05 Marks)**

c. Using Rayleigh-Ritz method, find the maximum deflection of a simply supported beam with uniformly distributed load $q_0$ per unit length. **(10 Marks)**

**2** a. Derive the shape functions for a two noded linear element and displacement strain matrix. **(08 Marks)**

b. A stepped bar is subjected to loading as shown in Fig.Q2(b). Taking it as bar element, determine :

i) Nodal displacement ii) Stress in each element iii) Reaction at the fixed support

$A_1 = 600\ mm^2$, $A_2 = 2400\ mm^2$, $L_1 = 400$ mm, $L_2 = 300$ mm, $E = 2 \times 10^5\ N/mm^2$

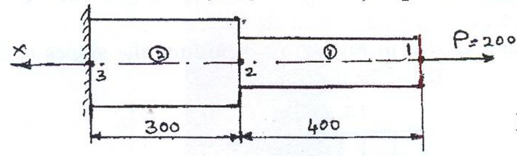


Fig.Q2(b)

**(12 Marks)**

**3** a. A bar is loaded as shown in Fig.Q3(a). $E = 2 \times 10^5\ N/mm^2$. Using the penalty method of boundary conditions, find :

i) Nodal displacement ii) Reaction at the supports iii) Stresses in each element

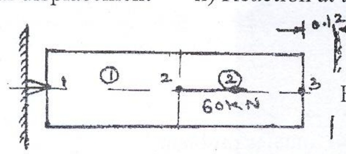


Fig.Q3(a)

$E = 2 \times 10^5\ N/mm^2$

$L_1 = L_2 = 150$ mm

$A_1 = A_2 = 250\ mm^2$

**(10 Marks)**

b. A truss shown in Fig.Q3(b) is made of 2 bars. Determine the nodal displacement, the stress in elements and reaction at the support. **(10 Marks)**

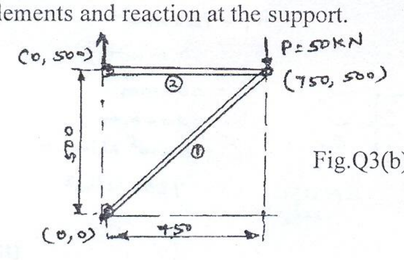


Fig.Q3(b)

$A_1 = 1200\ mm^2$

$A_2 = 1000\ mm^2$

$E = 2 \times 10^5\ N/mm^2$

**4** a. Derive the shape functions of a CST element and also the displacement and strain matrix for the CST element. **(14 Marks)**

b. Derive the stiffness matrix for a 2 D triangular element in plane stress condition. **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

5 a. Derive the stiffness matrix for an axi-symmetric plane triangular element. **(08 Marks)**

b. A long cylinder of inside diameter 80 mm and outside diameter 120 mm snugly fits in a hole over its full length. The cylinder is then subjected to an internal pressure of 2 MPa. Using two elements on the 10 mm length shown in Fig.Q5(b), find the displacements at the inner radius. **(12 Marks)**

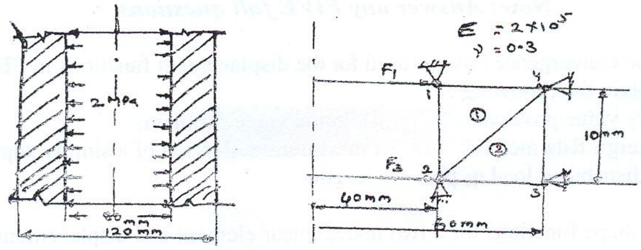


Fig.Q5(b)

6 Derive the shape functions for a four noded tetrahedral element (Tet 4). Write the element strain matrix and stiffness matrix for the Tet 4 element. **(20 Marks)**

7 a. Derive the Hermite shape functions for a beam element. **(10 Marks)**

b. For the beam and loading shown in Fig.Q7(b), determine the slopes at 2 and 3, and the vertical deflection at the midpoint of the distributed load. **(10 Marks)**

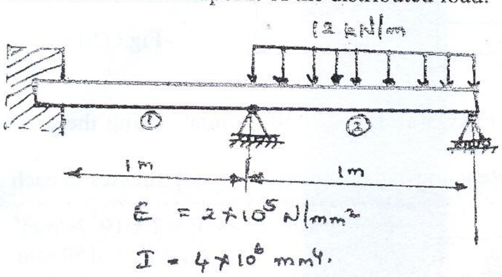


Fig.Q7(b)

8 a. Explain the finite element formulation for a heat transfer problem. **(10 Marks)**

b. Determine the eigen values and eigen vectors for the stepped bar shown in Fig.Q8(b).

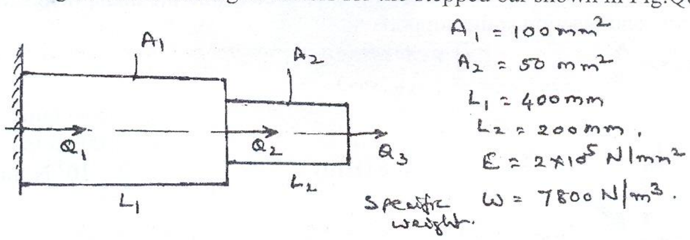


Fig.Q8(b) **(10 Marks)**

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# First Semester M.Tech. Degree Examination, December 2010

## Theory of Elasticity

24

Time: 3 hrs. Max. Marks:100

**Note: 1. *Answer any FIVE full questions.***
**2. *Assume missing data, if any, suitably.***

1 a. Derive Cauchy's stress relations for the resultant normal and shear stresses on an arbitrary plane. **(10 Marks)**

b. Define octahedral stresses. Derive expressions for octahedral normal and octahedral shear stresses in terms of stress invariants. **(10 Marks)**

2 a. For the following state of stress, determine the magnitudes of principal stresses.

$$[\sigma_{ij}] = \begin{bmatrix} 20 & 40 & 20 \\ 40 & -40 & -60 \\ 20 & -60 & 80 \end{bmatrix} \text{MPa}$$ **(10 Marks)**

b. Given the following state of stress, find the state of stress, with respect to an axis, obtained by rotating z-axis through 30° counter clockwise.

$$[\sigma_{ij}] = \begin{bmatrix} 100 & 80 & 0 \\ 80 & -60 & 0 \\ 0 & 0 & 40 \end{bmatrix} \text{MPa}$$ **(10 Marks)**

3 a. Write down the two sets of compatibility equations. **(04 Marks)**

b. Derive the equation for cubical dilation. **(06 Marks)**

c. For the state of strain specified below, determine the stress components at a point in a continuum, assuming the values of $E = 20 \times 10^6$ kN/m$^2$ and $\gamma = 0.3$.

$\in_x = 0.0005$, $\in_y = -0.003$, $\in_z = 0$, $\gamma_{xy} = 0.0002$, $\gamma_{yz} = -0.0004$, $\gamma_{zx} = 0.0001$ **(10 Marks)**

4 a. Explain the followings :

i) Principle of superposition ii) Saint-Venant's principle. **(10 Marks)**

b. The displacement field is given by $u = [(6x^2 + y^2 + 2)i + (3x + 4y^2)j + (2x^3 + 42)k]10^{-4}$.

i) What are the strain components at (1, 2, 3)?

ii) Determine the octahedral strains. **(10 Marks)**

5 a. Investigate what problem of phase stress is solved by the stress function :

$$\phi = \frac{3F}{4C}\left[xy - \frac{xy^3}{3C^2}\right] + \frac{P}{2}y^2.$$ **(10 Marks)**

b. Formulate the polynomial stress function for a Cantilever, loaded at the end. Obtain the expressions for stresses. **(10 Marks)**

6 a. Derive the equations for radial and tangential stresses for a thick cylinder, subjected to internal and external pressure. **(10 Marks)**

b. For the rotating disk of uniform thickness using stress function, derive the following equations at the centre of solid disk.

$$\sigma_r = \sigma_\theta = \frac{3+\gamma}{8}\rho\omega^2 b^2 .$$ **(10 Marks)**

7 a. Derive expressions for shearing stresses, induced in a bar of elliptical cross section subjected to a twisting moment and show that the maximum stress occurs at the ends of the minor axis of ellipse. **(10 Marks)**

b. A thin-walled box section of dimensions "2a × a × t" shown in Fig.Q7(b), is to be compared with a solid section of diameter "a". Find the thickness "t" so that the two sections have,

i) The same maximum stress for the same torque.

ii) The same stiffness. **(10 Marks)**

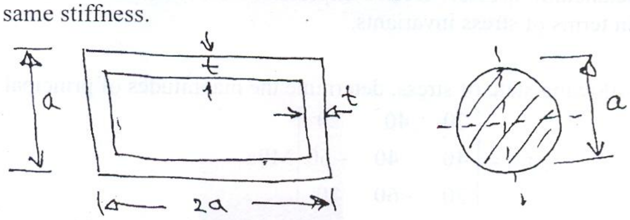


Fig.Q7(b)

8 a. Write and explain the thermo elastic stress-strain relations. **(08 Marks)**

b. For elastic stability analysis of a straight, slender column, with pinned-ends, under the action of a compressive load P.

i) Derive the buckling equation.

ii) Obtain the expression for critical loads.

iii) Calculate the buckling load. **(12 Marks)**

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**08MMD/MDE151**

## First Semester M.Tech. Degree Examination, December 2010
## Computer Graphics

27

Time: 3 hrs. Max. Marks:100

**Note:** ***1. Answer any FIVE full questions.***
***2. Draw neat sketches wherever necessary.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. What is parametric representation? List the advantages. **(04 Marks)**
b. Write the parametric equation of B – spline curve and list its properties. **(06 Marks)**
c. Using hyperbolic trigonometric functions for x and y, generate eight points on the hyperbolic segment in II quadrant with a = 2 and b = 1 for $2 \le y \le 4$. **(10 Marks)**

2 a. Explain the generation of a ruled surface parametrically. **(05 Marks)**
b. Briefly explain any four synthetic surfaces. **(10 Marks)**
c. Consider a line segment formed by end points [2 0 0] and [2 3 0]. Determine the point at t = 0.5 and $\phi = \pi$ on the surface of revolution generated by rotating the line about y – axis. **(05 Marks)**

3 a. Explain B – rep and CSG in solid representation. **(12 Marks)**
b. What is half space representation? List its advantages and disadvantages. Represent various half space entities used in CAD systems. **(08 Marks)**

4 a. Find the transformation matrix from a window with x – extent 3 to 12 and y – extent 2 to 10 onto a view port with both x and y – extents 1/4 to 1/2 in normalized device space. **(08 Marks)**
b. Explain Cohen – Sutherland line clipping algorithm. **(06 Marks)**
c. Digitize a line from (10, 12) to (20, 18) on a raster screen using Bresenham's line algorithm. **(06 Marks)**

5 a. Explain the need for use of homogeneous coordinates, with examples. **(04 Marks)**
b. Consider the square formed by the two opposite corners (2, 6) and (6, 2). Find the transformation matrix to reflect the square first about y – axis and then about the line x – y +1 = 0. Plot the original and the transformed square on graph sheet. **(10 Marks)**
c. List the steps involved in rotating a plane surface about an arbitrary point $(x_o, y_o)$ on it by an angle θ. Write the combined transformation matrix for the same. **(06 Marks)**

6 a. Explain how the containment test and the silhouettes help in hidden line removal. **(10 Marks)**
b. Explain - i) Warnock's algorithm ; ii) Ray tracing algorithm. **(10 Marks)**

7 a. Explain Gourand and Phong shading. List their differences. **(10 Marks)**
b. Explain CMY and HSV colour models. **(10 Marks)**

8 a. List various data exchange standards used in CAD/CAM systems. Explain any two. **(08 Marks)**
b. Explain the following in relation to animation :
i) Skeleton algorithm
ii) Engineering animation
iii) Animation problems. **(12 Marks)**



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