B

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH. DEGREE EXAMINATION, MAY 2016

CIVIL ENGINEERING

SPECIALIZATION: COMPUTER AIDED STRUCTURAL ENGINEERING

10CE6104 FINITE ELEMENT METHOD

Max. Marks : 60 Duration: 3 Hrs

Part A

(Answer any two questions : 9 x 2 = 18 Marks)

1. a) Briefly explain the principle of minimum potential energy.
   b) Differentiate between variational method and weighted residual method. 9 Marks

2. Explain the various steps involved in Finite Element Analysis with the help of an example. 9 Marks

3. Using Galerkine's method to obtain an approximate solution for the following boundary value problem.

   $u''(x) + u(x) + x = 0 \; ; \; 0 < x < 1$

   $u(0) = 0; \quad u(1) = 0$

   Assume a) a quadratic polynomial as a trial solution.

   b) a cubic polynomial as a trial solution 9 Marks

Part B

(Answer any two questions: 9 x 2 = 18 Marks)

4. a) Explain the advantages of isoparametric formulation. Explain sub parametric and super parametric elements.
   b) Explain Lagrange and Hermitian methods of deriving interpolation function. 9 Marks

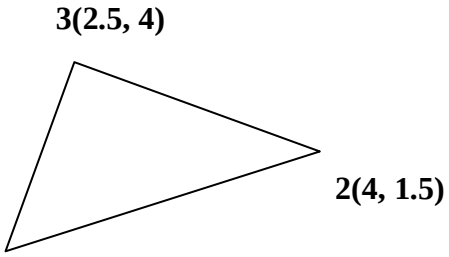
5. Derive shape functions for three noded bar element using Legrangian interpolation function. Also plot the variation of shape functions. 9 Marks

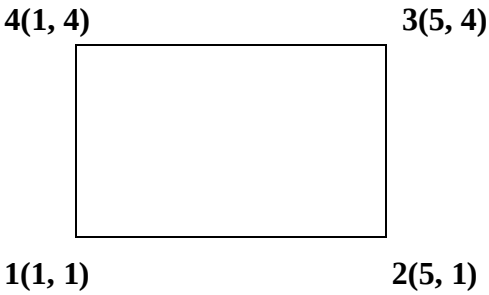
6. What are the prerequisites for the selection of displacement function in FEM ? 9 Marks

Part C

(Answer any two questions: 12 x 2 = 24 Marks)

7. Determine the interpolation functions for the following elements in Cartesian co-ordinates. Write the co-ordinate transformation also.





12 Marks

8. Explain briefly the formulation of axisymmetric solid element for axisymmetric loading case.

12 Marks

9. Using one and two Gauss-point numerical integration formula, evaluate the following integrals.

$$i) \quad 1 = \int_3^5 \frac{1}{x} dx$$

$$\text{ii)} \quad 1 = \int_{-1}^{1} cos\, \pi x/_2 \, dx$$

Compare the results with the exact integration

12 Marks

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, APRIL 2017

CIVIL ENGINEERING

COMPUTER AIDED STRUCTURAL ENGINEERING

10CE6104: FINITE ELEMENT METHOD

Max Marks : 60 Duration: 3 Hours

Part A (Modules I - II)

(Answer any twoquestions: 9 x2 = 18 Marks)

1 a) What do you mean by essential and natural boundary conditions. **(5)**

b) Explain Variational method of approximation **(4)**

2 a) Describe any three weighted residual methods with example **(9)**

3 a) Find the Nodal displacements for the system shown in Figure 1**.** **(9)**

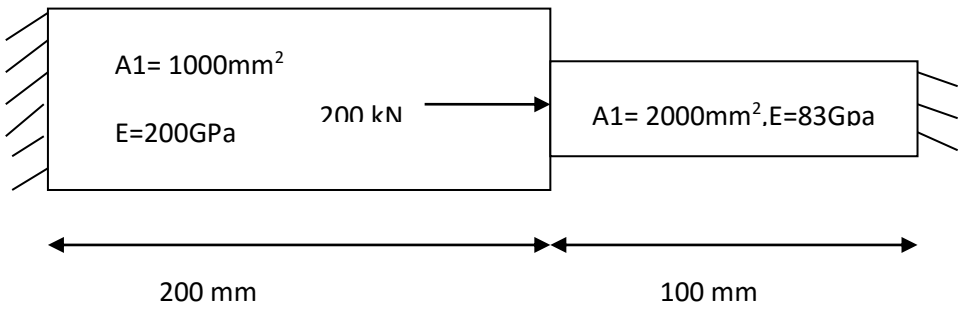


Figure 1

Part B (Modules III - IV)

(Answer any twoquestions: 9 x2 = 18 Marks)

4. a) What are the convergence requirements of shape functions **(4)**

b) Derive the shape functions for two noded bar element **(5)**

5 a) A three noded triangular element is subjected to a uniformly distributed load along X direction on the side 2-3(the number represents the nodes). Compute the nodal load vector **(9)**

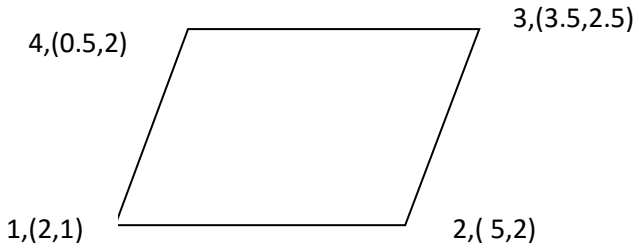
6 a) Explain isoparametric finite element formulation **(4)**

b) Using isoparametric formulation derive stiffness matrix for 1D bar element **(5)**

Part C (Modules V & VI)

(Answer any two questions : 12 x 2 = 24 Marks)

7 a) Obtain explicit expressions for isoparametric mapping for the element shown in Figure 2. Is the mapping fine?



(12)

Figure 2.

8 a) Develop the weak form of a plane strain problem starting from the equations of equilibrium. The fundamental unknowns in the problem should be the displacement components which are the functions of space variables x and y. General isotropic material may be assumed **(12)**

9 a) Using one and two Gauss-point numerical integration formula, evaluate the following integrals. **(12)**

i) $\mathbf{I} = \int_{-1}^{1} 8x^7 + 7x^6 dx$

ii) $\mathbf{I} = \int_{-2}^{2} \left(x + x^2 \right) dx$

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH. DEGREE EXAMINATION, APRIL 2018

Computer Aided Structural Engineering

10CE6104: FINITE ELEMENT METHOD

Max. Marks : 60 Duration: 3 Hrs

Part A (Modules I - II)

(Answer any two questions : 2 x 9 = 18 Marks)

1. Explain the various approximate methods for solving differential equations. (9)
2. Find the approximate solution for U(x) for the beam shown in Figure (1) using principle of minimum potential energy. Use (a) linear function as trail solution (b)Quadratic function as trail solution (9)

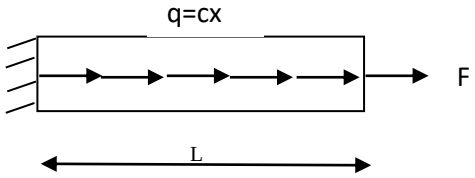
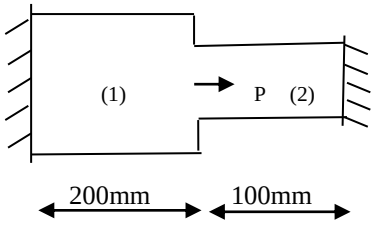


Figure (1)

3. Find the nodal displacement and reaction components of the system shown in Figure (2) (9)



$A_1=1000mm^2, A_2=2000mm^2, E_1=200Gpa, E_2=83Gpa$

Figure (2)

Part B (Modules III - IV)

(Answer any two questions : 2 x 9 = 18 Marks)

4. What are the prerequisites for the selection of displacement function in FEM? (9)
5. Derive the shape function of four noded rectangular element in Cartesian coordinate. Also plot the variation of shape function. (9)

6. (i)Define Interpolation Function. (3)
   (ii) Derive the shape function for a CST element. Also plot the variation of shape function. (6)

Part C (Modules V & VI)

(Answer any two questions : 2 x 12 = 24 Marks)

7. (i)Check the validity of isoparametric mapping for the element shown in Figure (3). (9)

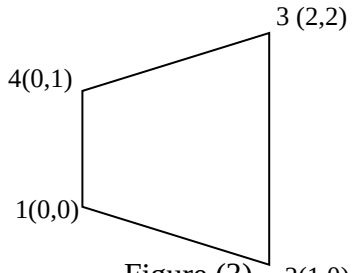


Figure (3)

(ii)Check the validity of isoparametric formulation of CST element shown in Figure (4) (3)

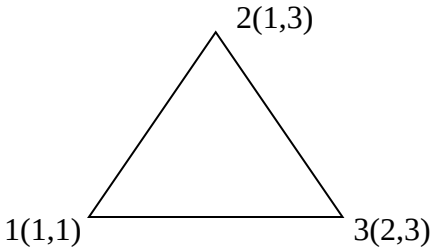


Figure (4)

8. Using two and three Gauss point numerical integration formula, evaluate the following integrals

(i) $I = \int_{-1}^{1} \cos\frac{\pi x}{2}\, dx$ (6)

(ii) $I = \int_{-2}^{2} (x + x^2)\, dx$ (6)

9. Briefly explain the formulation of axisymmetric solid element for axisymmetric loading case (12)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, MAY 2019

CIVIL ENGINEERING

(Structural Engineering and Construction Management & Computer Aided Structural Engineering)

10CE6104 FINITE ELEMENT METHOD

Max. Marks: 60 Duration: 3 Hours

Part A (Modules I - II)

(Answer any two questions: 9 x2 = 18 Marks)

1) The following differential equation is available for a physical phenomenon.

$$\frac{d^2y}{dx^2} + 50 = 0; 0 \leq x \leq 10$$

The trial function is $y = a_1 x(10 - x)$

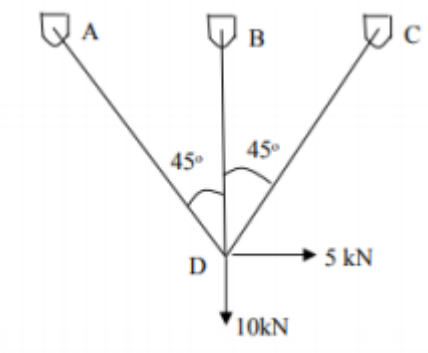
The boundary conditions are: $y(0) = 0$, $y(10) = 0$

Find the value of the parameter a_1 by the following methods.

(i). Least Square Method

(ii). Galerkin's method

2) State and illustrate Principle of Stationary Total Potential. By potential energy approach, determine the forces in the structure shown in figure.



3) Using Rayleigh-Ritz method, determine the expression for deflection and bending moment in a simply supported beam subjected to uniformly distributed load over the entire span. Find the deflection and moment at the midspan.

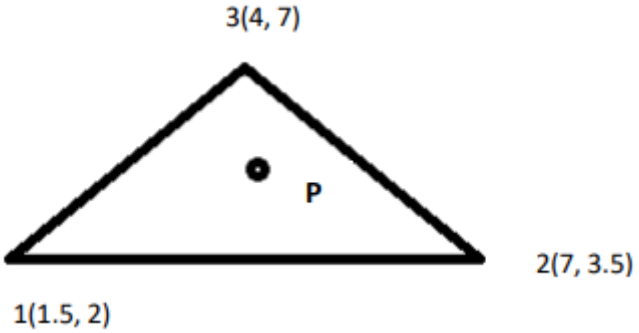
Part B (Modules III - IV)

(Answer any two questions: 9 x2 = 18 Marks)

4) a. Explain convergence requirements in finite element analysis.

   b. Derive the shape functions for a 4 noded quadrilateral element in natural coordinates**.** *(4+5 mark)*

5) Derive the shape functions N1, N2 and N3 for a CST element using polynomial functions and evaluate the shape functions at the interior point P (3.85, 4.8) for the triangular element shown in figure**.**

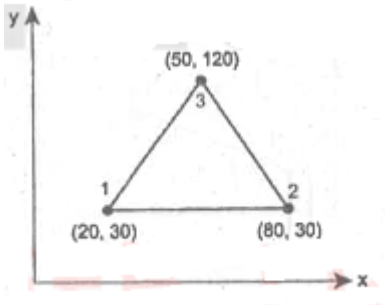


6) Derive the stiffness matrix for a beam element.

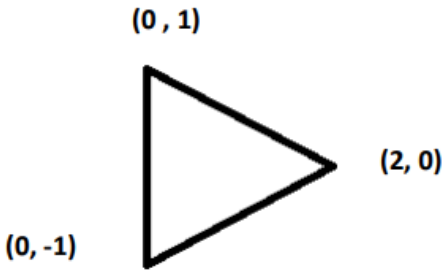
Part C (Modules V & VI)

(Answer any two questions: 12 x 2 = 24 Marks)

7) Determine the stiffness matrix for the CST element shown in fig. The co-ordinates are given in mm. Assume plane strain conditions E= 210GPa, $\mu = 0.25$ and $t = 10mm$.



8) Assuming plane stress conditions, evaluate stiffness matrix of the element shown in fig. Assume E=200GPa, Poisson's ratio is 0.3



9) Evaluate $\int_{-1}^{1}\int_{-1}^{1}(r^3-1)(s-1)^2\,drds$ using Gauss Quadrature method and check analytically.