Code No: R31031 **R10** **Set No: 1**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

FINITE ELEMENT METHODS

(Com to Mechanical Engineering and Automobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
*****

1. (a) Differentiate between FEM and FDM.
   (b) Explain the method involving in FEA in determination of perimeter of circle.

2. Solve the differential equation $\phi''-\phi = x^2$ with boundary conditions $\phi(x=0) = and\ \phi(x=1) = 0$ by point collation and Galerkin Method and compare the results.

3. (a) Derive the element stiffness matrix for truss element.
   (b) Calculate nodal displacement and element stresses for the truss shown in Fig.1. E=700Pa, Cross sectional area A=3 cm^2 for all truss members.

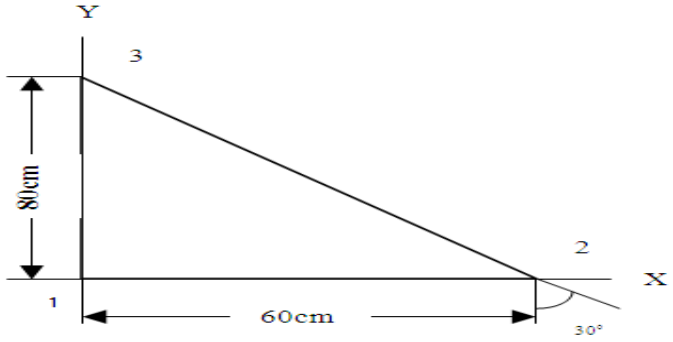

Fig.1

4. The beam and loading shown in Fig.2. Determine the slopes at nodes 2 and 3 and the vertical deflection at the mid-point of the distributed load. E=200 GPa and I=4x10^6 mm^4

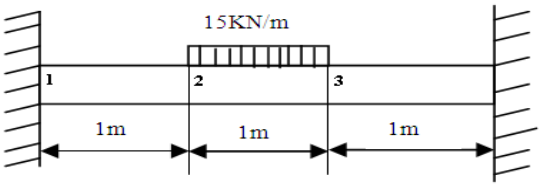

Fig.2

5. (a) Explain the concept of axisymmetric stress analysis in the formulation of finite element
   (b) Explain about natural boundary condition and essential boundary condition.

Code No: R31031 **R10** **Set No: 1**

6. Write short notes on the following terms.
   (a) Patch test
   (b) Isoparametric element
   (c) Serendipity elements
   (d) Sub parametric element

7. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convective heat transfer coefficient shown in Fig.3. The ambient temperature is -5°C

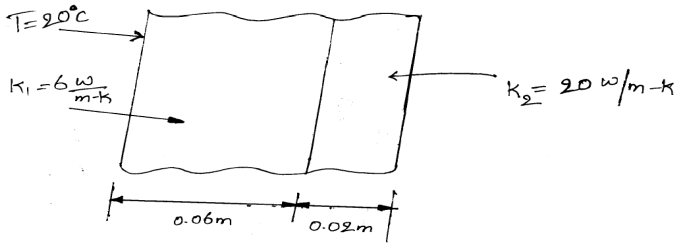

Fig.3

8. Discuss the methodology to solve the eigen value problem for the estimation of natural frequencies for a stepped bar.

*****

Code No: R31031 **R10** **Set No: 2**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

FINITE ELEMENT METHODS

(Com to Mechanical Engineering and Automobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

*****

1. (a) Explain the principle of minimum potential energy and principle of virtual work.
   (b) Explain the basic steps in FEM.

2. (a) what are the polynomial forms of interpolation function? Explain simplex, complex and multiplex elements.
   (b)Obtain variational form and also compute quadratic function for

$$= \frac{d}{dx}\left[a\frac{du}{dx}\right] - cu + x^2 = 0, \quad for\ 0 < \times < 1$$

$$u(0) = 0, \left|a\frac{du}{dx}\right|_{x=1} = 1$$

3. (a) Consider the truss element as given below. The x, y coordinates of the two nodes are indicated in fig.1, if q=[1.8,1.3,2.4,4.6]^{T}x10^{-2} inches, determine:
   (i) the vector q'
   (ii) stress in element
   (iii) K matrix;

Given E=80x10^6 psi A=4.1 inch^2

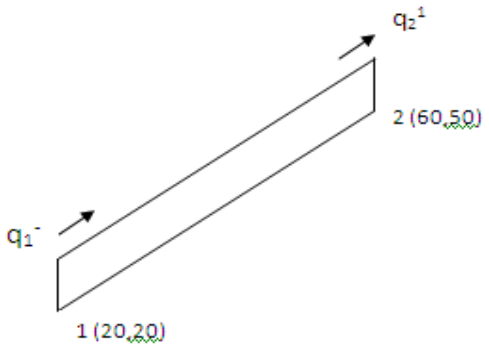

Fig.1

(b) Obtain shape function for a 2-D simplex element.

4. (a) Derive the stiffness equation for the beam element. Consider the beam is subjected to UDL, point loads and bending moments. State the assumptions clearly.
   (b) Derive the Hermite shape functions for a beam element.

Code No: R31031 **R10** **Set No: 2**

5. (a) Give four applications where axisymmetric elements can be used.
(b) Explain the concept in one and two dimensional elements of higher order in terms of natural coordinates.

6. (a) An isoparametric parent element is shown in figure A below and a corresponding isoparametric distorted element is shown in figure B. Discuss the transformation that relates partial derivatives in the original x,y coordinates to the generalized ζ,η coordinates.

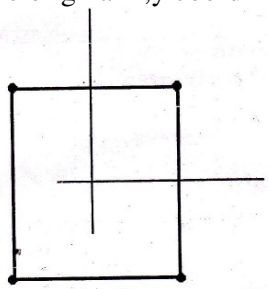

Fig. A Parent element

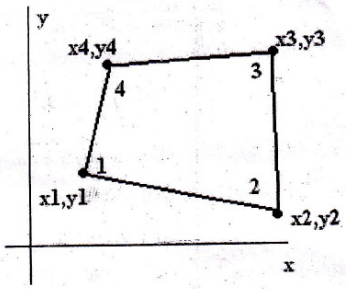

Fig. B distorted element

(b) Compute the integral

$I = \int_{-1}^{1} \int_{-1}^{1} \cos\left[\frac{\pi}{2}(\varphi+\eta)\right] d\varphi d\eta$ using 2 point gauss quadrature rules.

7. Explain the finite element formulation in one dimensional heat conduction equation with convection; specify the boundary conditions with neat sketches.

8. (a) Explain and derive the consistent mass matrices in global coordinate system.
(b) List the general rules of mesh generation for finite element formulation.

*****

Code No: R31031 **R10** **Set No: 3**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

FINITE ELEMENT METHODS

(Com to Mechanical Engineering and Automobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

*****

1. (a) Consider the problem of determine the area of circle of radius R, Explain the steps involved in determining the area of circle by finite element analysis
   (b) Explain the three steps involving in the development of the weak form of any differential equation, with suitable example.

2. (a) Explain convergence requirements of a polynomial displacement model.
   (b) Explain the discretization process. Sketch the different types of elements 1-D, 2-D and 3-D element used in the finite element analysis.

3. (a) Derive the shape function for a nine noded quadrilateral element.
   (b) Derive the shape function for a quadratic bar element using Lagrangian method.

4. (a) Determine the maximum deflection in the uniform cross section of cantilever beam shown in Fig.1 by assuming the beam as a single element.

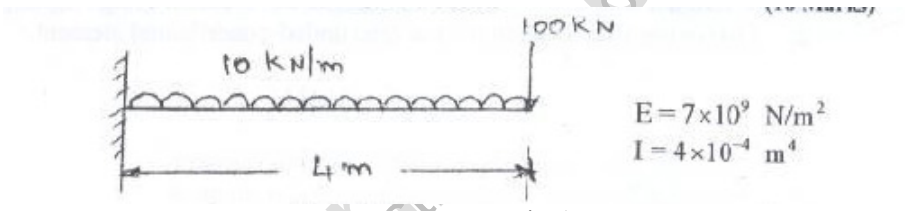

Fig.1

   (b) What are the disadvantages of lagranges family of shape functions over hermite shape functions?

5. (a) Explain the concept in one and two dimensional elements of higher order in terms of natural coordinates.
   (b) Explain about natural boundary condition and essential boundary condition.

Code No: R31031 **R10** **Set No: 3**

6. (a) Discuss briefly about sub parametric and isoparametric elements with suitable sketches.
(b) An isoparametric parent element is shown in Fig. A and a corresponding isoparametric distorted element is shown in Fig. B Discuss the transformation that relates partial derivatives in the original x, y coordinates to the generalized ζ, η coordinates.

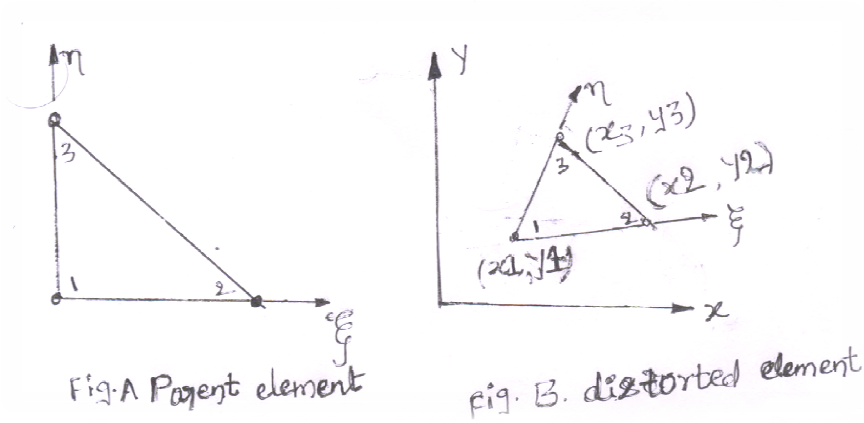

Fig. A Parent element Fig. B. distorted element

7. (a) Explain the type of boundary conditions in heat transfer problems.
(b) Discuss the Galerkin approach for 1-D heat conduction problem.

8. (a) Explain and derive the consistent mass matrices in global coordinate system.
(b) Find the natural frequency of axial vibrations of a bar of uniform cross section of 20 mm^2 and length 1m. Take E = $2x10^5$ N/mm^2 and ρ=800 kg/m^3. Take 2 linear elements.

*****

Code No: R31031 **R10** **Set No: 4**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

FINITE ELEMENT METHODS

(Com to Mechanical Engineering and Automobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

*****

1. (a) Explain how does the finite element method works.
   (b) What are the applications of the finite element method?

2. Solve by Rayleigh Ritz method $\frac{d^2\varphi}{dx^2}+\varphi+x=0 \quad 0\le x\le 1$

   $$\varphi(0)=\varphi(1)=0$$

   The weak form corresponding to the above equation is given by $I=\frac{1}{2}\int_0^1\left[\left[-\frac{d\varphi}{dx}\right]^2+\varphi^2+2\varphi x\right]dx$; Solve the above by taking 2 elements.

3. (a) For the truss shown in Fig.1 below, fin the assembled stiffness matrix.
   $E_1=E_2=200$ GPa

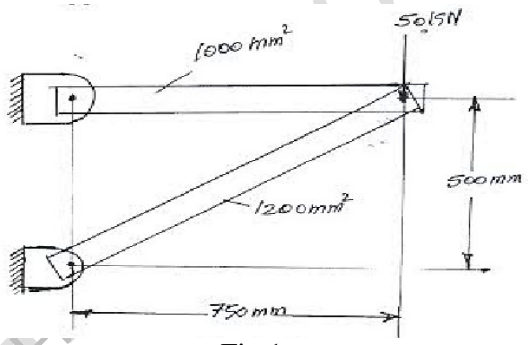

Fig.1

(b) Using the direct stiffness method, determine the nodal displacements of stepped bar shown in Fig.2.

$E_1=200$ GPa, $E_2=70$ GPa, $A_1=150\text{mm}^2$, $A_2=100\text{mm}^2$, $F_1=10$ kW and $F_2=5$ kW

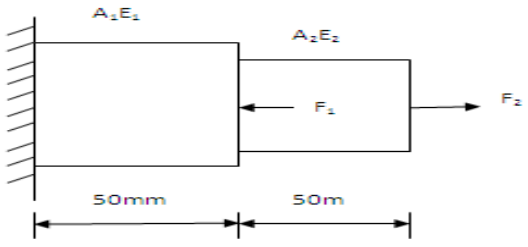

Fig.2

Code No: R31031 **R10** **Set No: 4**

4. (a) what are the disadvantages of Lagranges family of shape functions over Hermite shape functions.
(b) Solve for vertical deflection and slopes, at points 2 and 3, using beam elements, for the structure shown in Fig.3. Also determine the deflection at the center of the portion of the beam carrying UDL.

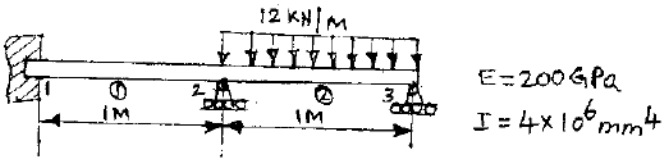

Fig.3

5. (a) Explain the concept of axisymmetric stress analysis in the formulation of finite element.
(b) Give different applications where axisymmetric elements can be used.

6. (a) Explain the concept of iso, sub and super parametric elements.
(b) Compute the integral $I = \int_{-1}^{1}\int_{-1}^{1} \cos\left[\frac{\pi}{2}(\varphi=\eta)\right] d\varphi d\eta$ using 2 point gauss quadrature rules.

7. (a) Find the temperature distribution in the one dimensional fin as shown in Fig.4.

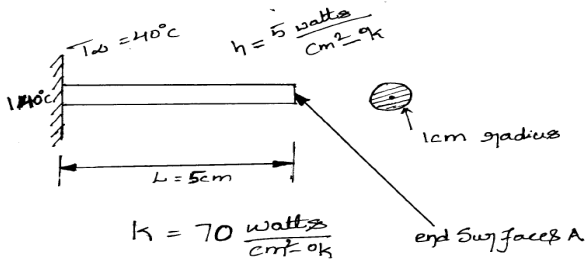

Fig.4

(b) Discuss the Galerkin approach for 1-D heat conduction problem.

8. Find the natural frequencies of longitudinal vibration of the unconstrained stepped bar shown in Fig.5.

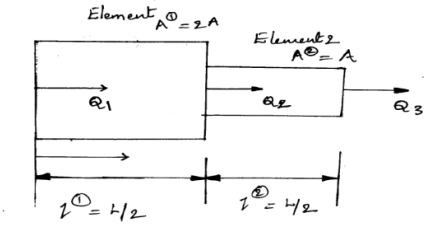

Fig.5

*****