APPLIED MECHANICS DEPARTMENT

AML705 FINITE ELEMENT METHODS

Time: 2hrs) Major Test – 22/11/08 (Max. marks 40

Answer any five questions

1. Use the quadratic shape functions given below for a bar element
$$N_1 = (1-3\xi+2\xi^2); N_2 = -\xi+2\xi^2; N_3 = 4\xi-4\xi^2$$
over the range x =0 to x = l with three nodes and derive
   a) the stiffness matrix of the element
   b) the equivalent load vector for a uniform traction w/unit length
   c) the mass matrix

2. a) Write down the shape functions for a bilinear quadrilateral iso-parametric element.
   b) Given the nodes are (-1/2,0);(0,-1);(1,0);(0,1) for such an element compute the Jacobean at the four Gauss points
   d) Hence compute the stiffness matrix numerically

3. a) Derive the consistent mass matrix for a bar element using $N_1 = (1-\xi); N_2 = \xi$ And also write down the stiffness matrix.
   b) What is the lumped mass matrix for this element
   c) Consider a two bar assembly and determine the eigen-pairs of the system. Assume the two elements to be of length 'l' and area 'A'

4. a) Derive the stiffness matrix and equivalent load vector expression for an axisymmetric toroidal element with a three noded triangular cross section.
   b) Assemble two such elements giving rise to a thick cylinder and set up the boundary conditions for a cylinder under internal pressure.

5. Consider a simply-supported beam pinned at the left and on rollers at the right Subjected to an axial load of P at the right end and a lateral load of W at mid-span. Assume EI and EA to be flexural and axial deformation rigidities. Determine the deflection components at mid-span.

6. Determine the Galerkin approximation solution of the differential equation
$$A\frac{d^2\phi}{dx^2}+B\frac{d\phi}{dx}+C=0$$
with $\phi(0)=\phi(l)=0$

	$(1-3\xi+2\xi^2)$	$-\xi+2\xi^2$	$4\xi-4\xi^2$
$\xi=0$	1	0	0
$\xi=1/2$	$1-\frac{3}{2}+\frac{1}{2}=0$	$-\frac{1}{2}+\frac{1}{2}=0$	$2-1=1$
$\xi=1$	$1-3+2=0$	$-1+2=1$	0