(vii) Isoparametric element is one in which
(a) Both geometry & displacement of element are described by a specific Shape Function
(b) Both geometry & displacement of element are described by same Shape Function
(c) Geometry & displacement of element are described by different but related Shape Function.
(d) Shape function for Geometry & displacement of element are completely different.

(viii) The sequence of the numerical simulation in any FEA software is
(a) Pre-processing → Solution → Post-processing
(b) Post-processing → Solution → Pre-processing
(b) Pre-processing → Post-processing → Solution
(d) Solution → Pre-processing → Post-processing.

(ix) A plate with in plane loading and having thickness very much smaller than other two dimensions of the plate will be treated as
(a) plane stress (b) plane strain
(c) both (a) and (b) (d) principal stress.

(x) Which one of the following software is a FEA dedicated software
(a) CATIA (b) CRO Parametric
(c) ANSYS (d) UG NX.

Group – B

2. A simply supported beam is subjected to a uniformly distributed load as shown in figure 1 below. Given
The strain energy $U = \int_0^L \frac{1}{2} EI \left(\frac{d^2v}{dx^2}\right)^2 dx$
And potential of the external force is $V = -\int_0^L q_0 v dx$
Solve the displacement field assuming it as $V(x) = C_1 \times sin\frac{\pi x}{L}$ by Rayleigh-Ritz method.

Figure 1

12

3. Using Galerkin's Method of Weighted Residual, obtain a one term solution of the differential equation $\frac{d^2y}{dx^2}$ + y(x) = 4x; 0 ≤ x ≤1 and boundary conditions y(0) = 0, y(1) = 0. Use trial function $N_1(x)$ = x(x - 1).

12

Group – C

4. For the assembly of springs shown in figure 2 below, determine the stiffness matrix using the system assembly procedure and using Princi Stationary Potential energy (Rayleigh-Ritz method).

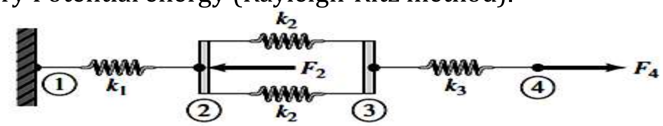

Figure 2

5 + 7

5. (a) The beam element shown in figure 3 below is subjected to a li varying load of maximum intensity q_0. Using the work-equiva approach, determine the nodal forces and moments.

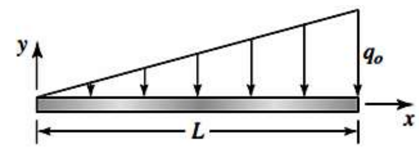

Figure 3

(b) Calculate nodal deflection of the above problem at free end, treati beam as a single element and considering E = 2 × 10^6 Kg/cm², I_z = L = 25 cm and q_0 = 1.8 Kg/cm.

5 + 7

Group – D

6. The two-element truss in figure 4 is subjected to external loading as sho figure 4. Using node and element numbering as in the figure, determi displacement components of node 3, the reaction force components at n and 2. The elements have modulus of elasticity $E_1 = E_2 = 0.7 \times 10^6$ Kg/cn cross-sectional areas $A_1 = A_2 = 10$ cm².

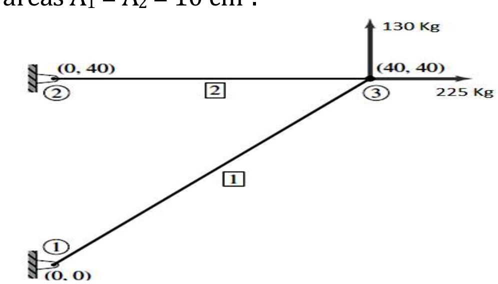

Figure 4

8 + 4

7. (a) Consider the isoperimetric quadrilateral element in Figure 5 below. Map the point $\xi = 0.5, \eta = 0$ in the parent element to the corresponding physical point in the quadrilateral element.

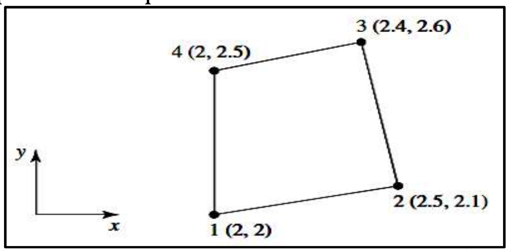

Figure 5

(b) Use Gaussian quadrature to obtain exact values for the following integral in two dimensions. Verify exactness by analytical integration. $\int_0^1 \int_0^2 xy\, dx\, dy$.

6 + 6 = 12

Group – E

8. (a) Figure 6 depicts an assembly of two bar elements made of different materials. Determine element stresses.

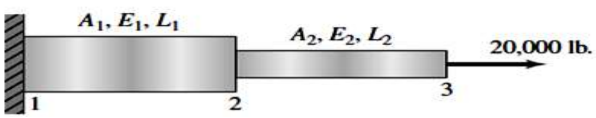

Figure: 6

Here A_1 = 25 cm^2; $E_1 = 1.0 \times 10^6$ Kg/cm^2; L_1 = 50 cm; A_2 = 14.5 cm^2; $E_2 = 0.7 \times 10^6$ Kg/cm^2; L_2 = 50 cm.

12

9. Write a detailed note on the following related to FEA:
   (i) Pre-processing
   (ii) Solution
   (iii) Post-processing

(5 + 3 + 4) = 12

FINITE ELEMENT METHOD
(MECH 3142)

Time Allotted : 3 hrs **Full Mark**

Figures out of the right margin indicate full marks.
Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.
Candidates are required to give answer in their own words as far as practica

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1**

   (i) If there are n nodes in a system and each node has 3 d.o.f, the s the global stiffness matrix will be
   (a) n × n (b) 2n × 2n (c) 3n × 3n (d) 4n

   (ii) Principle of stationary potential energy is based on the concept tl
   (a) potential energy is always stationary
   (b) potential energy is held stationary when the element deforms
   (c) potential energy is stationary w.r.t. small variations of displacem
   (d) potential energy is conserved.

   (iii) u = a + bx + cy is a deformation field in case of
   (a) constant strain field (b) linearly varying stra
   (c) parabolic variation of strain field (d) cubic variation of strai

   (iv) Rayleigh-Ritz method is based on
   (a) direct method
   (b) principle of stationary potential energy
   (c) weighted residual method
   (d) Galerkin method.

   (v) Stiffness of a bar under axial loading having length 'L', cross-sec area 'A' and Modulus of rigidity 'E' is
   (a) $\frac{AE}{3L}$ (b) $\frac{AE}{L}$ (c) $\frac{E}{AL}$ (

   (vi) A Four-Noded Rectangular element has four shape functions among those four shape functions has been expressed in n coordinate $\xi - \eta$ as below. Which one is correct?
   (a) $\frac{1}{6}(1+\xi)(1-\xi)$ (b) $\frac{1}{4}(1+\xi)(1-\xi)$
   (c) $\frac{1}{3}(1+\xi)(1-\xi)$ (d) $\frac{1}{2}(1+\xi)(1-\xi)$.