Student Exam No. _____

Ganpat University

M.Tech SEM II Mechanical Engineering (CAD-CAM)

Regular Examination April - June 2015

3ME211 – Engineering Analysis & Optimization

Duration: 3hr **Marks: 60**

Instructions:

1. Assume suitable data if necessary.
2. Write your answer to the point and precisely.
3. Draw neat and clean sketch.

SECTION - 1

Q.1 **Attempt following questions** **[10]**

(a) Minimize

$$f(x) = 0.65 - \left[\frac{0.75}{(1+x^2)}\right] - 0.65.x.\tan^{-1}\left(\frac{1}{x}\right)$$

In the interval [0, 3] by the Fibonacci method using n = 6.

OR

Q.1 **Attempt following questions** **[10]**

(a) Minimize

$$f(x) = 0.65 - \left[\frac{0.75}{(1+x^2)}\right] - 0.65.x.\tan^{-1}\left(\frac{1}{x}\right)$$

In the interval [0, 3] by the Golden Section method using n = 6.

Q.2 **Attempt following questions** **[10]**

(a) Find the minimum of $f(x) = x.(x - 1.5)$ in the interval (0.0, 1.0) to within 10% of the exhaust value by Interval Halving method.

OR

Q.2 **Attempt following questions** **[10]**

(a) Find the minimum of

$f = \lambda^5 - 5\lambda^3 - 20\lambda + 5$

By Quadratic Interpolation Method

Q.3 **Attempt following questions**

(a) Find the minimum of the function **[07]**

$f(x) = 10x^6 - 48x^5 + 15x^4 + 200x^3 - 120x^2 - 480x + 100$

(b) Indicate minimum six Mechanical Engineering Application of optimization. **[03]**

SECTION – II

Q.4 **Attempt following questions**

(a) Give the types of Boundary conditions. And explain them in details with appropriate example. **[05]**

(b) Define Potential energy approach. And derive the equations of approach. **[05]**

OR

Q.4 **Attempt following questions**

(a) What are the model selection criteria for FEA ? and explain two types of Co-ordinate systems. **[05]**

(b) Consider the four bar truss shown in figure -1. It is given that E= 29.5 x 10^6 Psi and Ae = 1 in.2 for all elements. Determine the element stiffness matrix for each element and assemble the structural stiffness matrix K for the entire truss. **[05]**

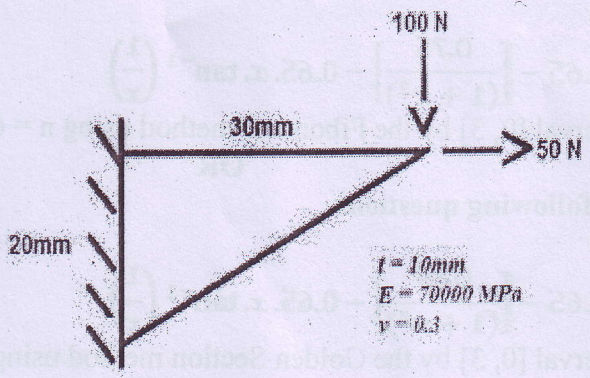

Figure - 1

Q.5 **(a)** Give the shape function equations for one dimensional problem. **[05]**

(b) Consider the thin (steel) plate in figure - 2. The plate has a uniform thickness t = 1 inch. E = 30x10^6 psi, weight density ρ = 0.2836 lb/ in^3. In addition to its self-weight, the plate is subjected to a point load P = 100 lb at its mid-point. **[05]**

1. Model the plate with two elements.
2. Write the expressions for the elemental stiffness matrices and element body force vectors.
3. Assemble the structural stiffness matrix K and global load vector F.
4. Solve the global displacement vector Q by elimination approach.
5. Evaluate the stresses in each element.

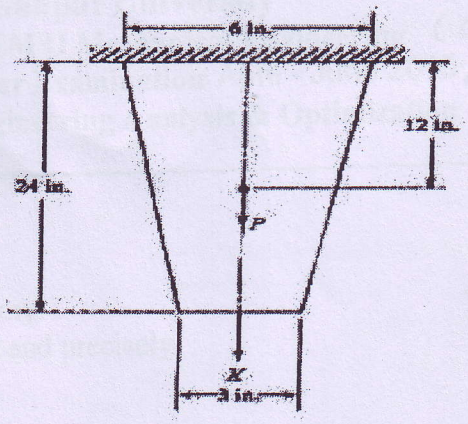

Figure - 2

OR

Q.5 **(a)** Explain the numbering scheme and element division for FEM **[05]**

(b) Derive the following : **[05]**

1. Element stiffness matrix (K).
2. Element load vector (f)

by direct method for one-dimensional bar element.

Q.6 **Attempt following questions** **[10]**

(a) Write properties of stiffness matrix K .Show the general node numbering and its effect on the half bandwidth.

(b) Write four properties of shape functions.

(c) Explain the descretization process. sketch the different types of lD, 2D, 3D elements used in the finite element analysis.

(d) Determine the nodal displacement and stresses in the element shown in figure – 3

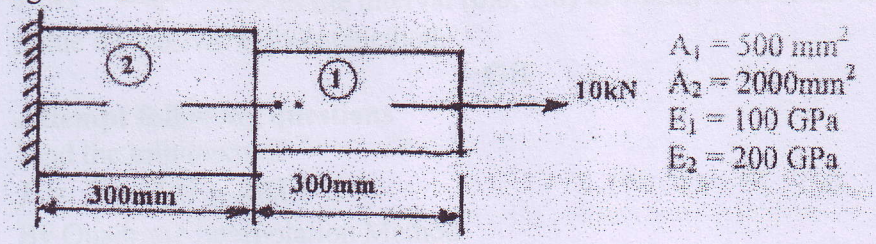

Figure - 3

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