Reg. No. : | | | | | | | | | | |

Question Paper Code: 91P02

M.E. DEGREE EXAMINATION, NOV 2019

First Semester

CAD / CAM

19PCD102 - ADVANCED FINITE ELEMENT ANALYSIS

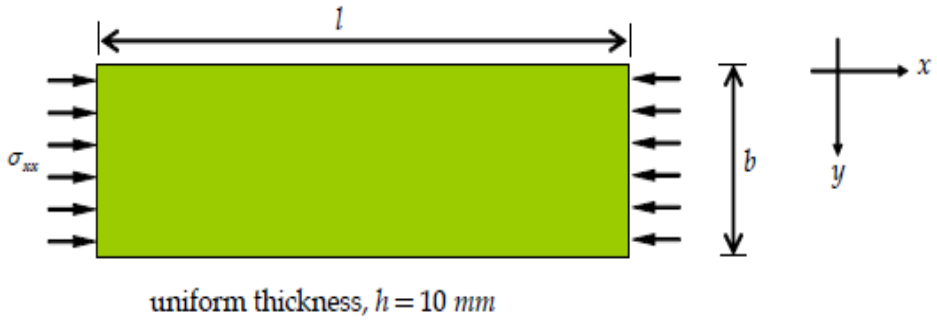
(Regulation 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART - A (5 x 20 = 100 Marks)

1. (a) A long rectangular simply supported plate is compressed between two rigid blocks. CO1- App (20)



uniform thickness, $h = 10\ mm$

The following data for the considered steel are provided:

$$\sigma = \begin{cases} E\varepsilon & \text{for } \varepsilon < \varepsilon_y \\ K\varepsilon^{0.3} & \text{for } \varepsilon \geq \varepsilon_y \end{cases}$$

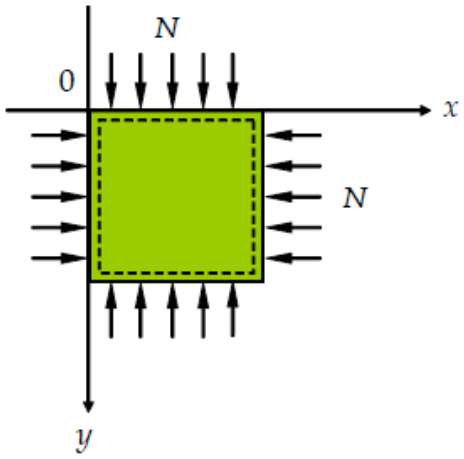
Where,

$$E = 210\ GPa; \quad \nu = 0.3$$
$$K = 2.141\ GPa$$
$$\varepsilon_y = \frac{\sigma_y}{E}; \quad \sigma_y = 300\ MPa$$

Note that σ and ε are respectively total stress and total strain.
(a) Calculate the effective width of the plate, b_{eff} .
(b) Assume the actual width of the plate is b = b_{eff} /2. Determine the plastic buckling stress σ_{cr} and the total buckling load P_{cr}.
(c) Compare the solution (σ_{cr} and P_{cr}) for b = b_{eff} and b = b_{eff} /2.
(d) Plot the stress distribution in both plates, σ_{xx} (y), at the point of buckling.

Or

(b) A simply-supported square (a × a) plate is subjected to biaxial compression of the intensity N. CO1- App (20)



(a) Prove that the following pre-buckling solution satisfy all equations in the in-plane direction:

$$N^{o}_{\alpha\beta} = \begin{vmatrix} N & 0 \\ 0 & N \end{vmatrix}$$

Given a and D, find the buckling load using:

(b) Finite difference method with 4 and 16 elements

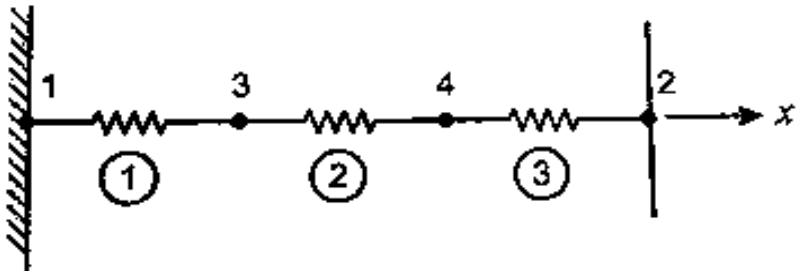
(c) Raleigh-Ritz quotient and compare the results.

2. (a) Spring assemblages with arbitrarily numbered nodes are shown in figure. The nodes 1 and 2 are fixed and a force of 500 kN is applied at node 4 in the x direction. Calculate the following: CO2- App (20)

(i) Global Stiffness Matrix

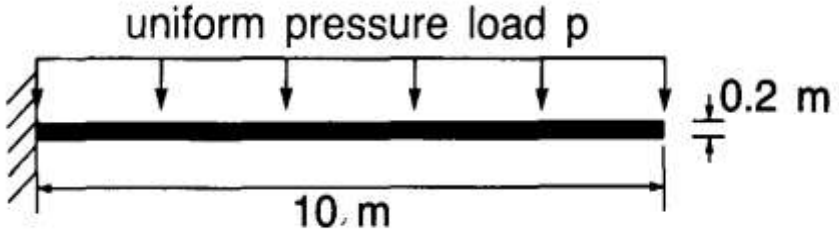
(ii) Nodal Displacements

(iii) Reactions at each Nodal Point



Or

(b) Determine the deformed shape of the cantilever beam for p=1MPa. CO2- App (20)
Take E=207000MPa, v=0.3, Plane strain, width=1.0m.



3. (a) Assembled stiffness matrix and mass matrix are given by, CO3-Ana (20)

$$[K] = 10^8 \begin{bmatrix} 0.36 & -0.18 & 0 \\ -0.18 & 0.36 & -0.18 \\ 0 & -0.18 & 0.18 \end{bmatrix} [m] = \begin{bmatrix} 0.052 & 0.013 & 0 \\ 0.013 & 0.052 & 0.013 \\ 0 & 0.013 & 0.026 \end{bmatrix}$$

Compare the eigen pairs & Natural Frequencies of this system using the simultaneous method.

Or

(b) For the One dimensional bar having Area, A = 600mm^2, Length L= 400m, Young's modulus E = 2 x10^5 N/mm^2, Density = 0.8 x 10^{-4} N/mm^2, Compare the natural frequencies of longitudinal vibration using two elements of equal length. CO3-Ana (20)

4. (a) An aluminium alloy fin of 7mm thick and 50mm long protrudes form a wall, which is maintained at 120°C. The ambient air temperature is 22°C. The heat transfer coefficient and thermal conductivity of the fin material are 140W/m2K and 55W/mK respectively. Determine the temperature distribution of fin. CO4- App (20)

Or

(b) A furnace wall is made up of 3 layers, inside layer with thermal conductivity 8.5W/mK, the middle layer with conductivity 0.25W/mK, the outer layer with conductivity 0.08W/mK. The respective thickness of the inner, middle and outer layer are 25cm, 5cm and 3cm respectively. The inside temperature of the wall is 600°C and outside of the wall is exposed to atmospheric air at 30°C with heat transfer coefficient of 45W/m^{2}K. Determine the nodal temperatures. CO4- App (20)

5.	(a)	Explain posteriori error estimation and adaptive mesh refinement.	CO5- U	(20)
		Or		
	(b)	Explain p-Refinement and hp-Refinement.	CO5- U	(20)