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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*A Constituent Institution of Manipal University*

**VII SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)**

**END SEMESTER EXAMINATIONS, NOV/DEC 2016**

SUBJECT: FINITE ELEMENT METHODS [AAE 405]

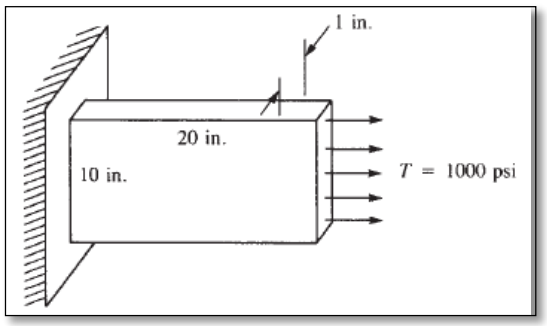
**REVISED CREDIT SYSTEM**
**(30/12/2016)**

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ANY FIVE FULL** questions.
- Missing data, if any, may be suitable assumed.

**1A.** For a thin plate subjected to the surface traction shown in figure, determine the nodal displacements. Assume plane strain condition. The plate thickness t = 1 in., E = 30 e6 psi, and v=0.30. **(07)**

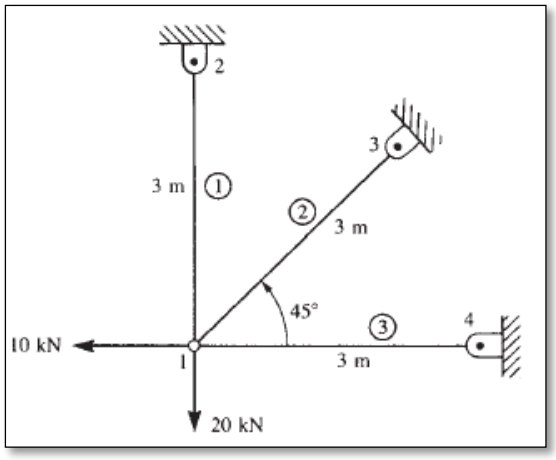



**1B.** Mention the assumptions and sign conventions used in beam theory. Also mention the equilibrium equations and draw a sample BMD, FD and SFD with all notations and sign convention. **(03)**

**2A.** For a 2 spring assemblage with stiffness $k_1$, $k_2$, with all notations, equilibrium equations, deduce the stiffness matrix and mention its reaction forces. **(06)**

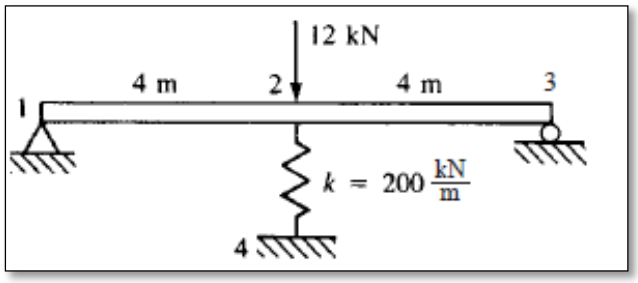
**2B.** Enumerate the applications of beam and truss elements in aircraft structure. **(04)**

**3A.** For the truss shown in figure below, solve for the horizontal and vertical components of displacement at node 1 and determine the stress in each element. All elements have A= 4 $in.^2$ and E = 210 GPa. **(08)**



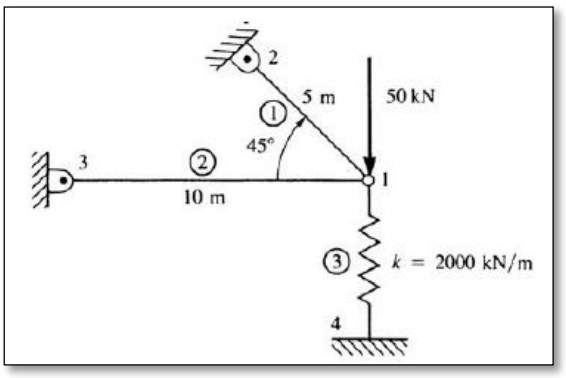

**3B.** For the above arrangement, verify force equilibrium at node 1 **(02)**

**4A.** For the beam shown below, using the principle of symmetry, determine the displacement at each node, forces in each element and reactions. Take E= 70 GPa and I= 2e-4 $m^4$ **(08)**




**4B.** For the above beam, draw the SFD, BMD and FD **(02)**

**5A.** For the plane truss supported by a spring, as show in the figure below, determine the nodal displacements and reactions. Take E=210 GPa, A= 5e4 $m^2$ **(07)**




**5B.** For the above arrangement, calculate the stress in each element. **(03)**

**6A.** With a neat sketch, deduce the relation for local coordinate conversion to a global coordinate. Consider a truss element. **(05)**

**6B.** For the bar elements, evaluate the stiffness matrix and the generalized stress- strain relation. **(05)**