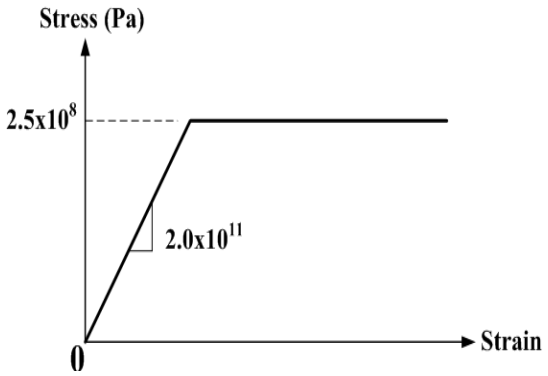
BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
Computer Application in Civil Engineering (CE F416)– Comprehensive Examination
PART B (Second Semester 2022-2023)

Duration: 2 hours (laptop-based exam) **Date: 16-05-2023** **Max. Marks: 21**

Note: Write all the results in your supplementary copy. Also, submit all CAE files (please make separate CAE files for each question). All CAE files save into one folder (Folder name: ID_Name_Compre_160523).

1. Model the cantilever beam with a rectangular cross-section using the B31 beam element in ABAQUS. Discretize the beam using 10 elements along the length of the beam. The beam's length, width and depth are 2.5 m, 50 mm, and 100 mm, respectively. The material properties are $E = 2 \times 10^{11}$ N/m^2. v = 0.3. The beam is subjected to a point load of 50 kN at the free end. Compare the numerical results with the analytical solution for the maximum deflection of a cantilever beam under point load at the free end. **[6 Marks]**

2. The same cantilever beam in question 1 is discretized using 10 shell elements (S4R elements) in ABAQUS. The material properties are $E = 2 \times 10^{11}$ N/m^2. v = 0.3. The beam is subjected to a uniformly distributed load of 20000 kN/m^2 at the top surface of the beam. Now incorporate plasticity (see **Fig**); in this plasticity model, we assume the material is perfectly plastic with a yield stress of 2.5×10^8 N/m^2. Solve this problem by using the Static General approach in ABAQUS/Standard. What is the maximum equivalent plastic strain? Where does it occur in the model? **[5 Marks]**



3. The rectangular aluminium plate is simply supported at all edges and modelled in ABAQUS using S8R shell elements. Discretize the plate with 12 shell elements along the x-direction and 4 shell elements along the y-direction. The material properties of aluminium are E = 75000 MPa and v = 0.3. The plate's length, width and thickness are 3 m, 1 m, and 0.01 m, respectively. Find the buckling load of the plate and the corresponding mode shape. **[5 Marks]**

4. Find the three consecutive frequencies and corresponding mode shapes of a square composite plate with fixed support at all the edges in ABAQUS platform. The plate is modeled using S4R shell element and discretized using 4 shell elements along the x-direction and 4 shell elements along the y-direction. The composite plate is made of 8 numbers of lamina with equal thickness for each lamina (layer). The fibers directions in each layer (i.e., lamina) of plate are $0^0/90^0/90^0/0^0/0^0/90^0/90^0/0^0$. The material properties of each layer (i.e., lamina) are E_{11}=200 GPa, E_{11}/E_{22} = 40, Nu_{12} = 0.3, $G_{12} = G_{13}$ = 0.5 E_{22}, G23 = 0.6 E_{22}. The plate's length, width and thickness are 1 m, 1 m, and 0.01 m, respectively. **[5 Marks]**