

**HOME WORK 4 (hand in: April 26, 2018)**

**QUESTION 1:** For the 4-noded master element  $\hat{\Omega}$  of FIG. 2 and the sets of the nodal points coordinates given below, using bilinear isoparametric formulation, complete the following:

- a). Sketch the element  $\Omega_e$ , showing the node numbers and  $(\xi, \eta)$  axes,
- b). Calculate the mapping functions and the Jacobian  $|\mathbf{J}|$  of the maps  $T_e$ , check the invertibility of  $T_e$ .

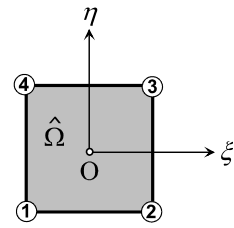


Figure 2

Coordinates of the nodal points are;

Node $i$	$(x_i, y_i)$
①	$(0, -2)$
②	$(1, -1)$
③	$(1, 2)$
④	$(0, -1)$

**QUESTION 2:** Consider the 4-noded quadrilateral element  $\Omega_e$  in FIG. 3. We wish to calculate the following element matrices numerically using the Gauss quadrature and the bilinear isoparametric formulation:

$$S_{ij} = \int_{\Omega_e} N_i N_j dx dy, \quad S_{ij}^{xy} = \int_{\Omega_e} \frac{\partial N_i}{\partial x} \frac{\partial N_j}{\partial y} dx dy$$

Coordinates of the nodal points are;

Node $i$	$(x_i, y_i)$
①	$(2, 2)$
②	$(3, 7)$
③	$(5, 1)$
④	$(8, 5)$

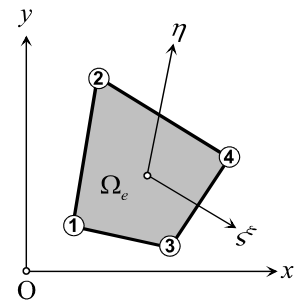


Figure 3

Note: Please perform all your calculations explicitly.