Task 5
Static deformation of a piezoceramic transducer with multi-electrode coating

Individual assignments

Write a program code in ANSYS APDL to compute a static deformation of a piezoelectric transducer with multi-electrode coating in a shape of a disk (axisymmetric problem) or a long cylinder with the cross section of the given shape (plane strain problem). Build a mapped finite element mesh. Analyze the convergence of results (displacements, electric potential and electric field vector magnitude) for various density of finite element mesh. Provide the resulting finite element mesh with element coordinate systems displayed. Plot the computation results (deformed shape, distribution of displacements, electric field vector, electric induction vector, von Mises stresses, graph of characteristic component of the electric field vector along the path with surface electrodes). Analyze the results and prepare a report.

Requirements to the report.
The report should contain the name of the student, the full description of the problem and the following results obtained in ANSYS:

- Mapped finite element mesh with boundary conditions and the element systems for each finite element (check the direction of the polarization vector)
- Deformed shape of the disk
- Distribution of the displacements UX
- Distribution of the displacements UY
- Distribution of the displacement vector
- Distribution of the electric potential
- Distribution of the electric field vector
- Distribution of the electric induction vector
- Distribution of the stress intensity (von Mises stresses)
- Graph along the path on the surface electrodes for the characteristic component of the electric field vector

Table 1. Suggestions for domain shape
The variants of individual tasks are presented in the table. All sections of piezoelectric transducers are made of piezoceramics PZT-4, which material properties are provided in the above example problem (see program code). The electrodized surfaces are shown in thick lines or dots, the values of electric potential or total electric charge are provided nearby. The rigidly fixed boundaries are marked by external hatching, the triangles outside the boundaries denote the fixation

conditions in the corresponding point of the 2D disk section (UX=0 or UY=0). The boundaries without any labels indicate homogeneous natural boundary conditions. For axisymmetric problems, the axis of rotation is shown on the left by a dashed line.

№	Scheme	Input data
1		Axisymmetric problem $a_1 = 0.3$ cm $a_2 = 0.2$ cm $h_1 = 0.5$ mm $h_2 = 0.5$ mm $V = 10$ V
2		Plain strain $a_1 = 0.5$ cm $a_2 = 0.6$ cm $h_1 = 0.5$ mm $h_2 = 1$ mm $V = 10$ V
3		Axisymmetric problem $a_1 = 0.4$ cm $a_2 = 0.3$ cm $h_1 = 1$ mm $h_2 = 1.5$ mm $V = 5$ V
4		Plain strain $a_1 = a_4 = 0.7$ cm $a_2 = a_3 = 0.6$ cm $H = 2$ mm $V = 5$ V
5		Axisymmetric problem $a_1 = a_3 = 2$ cm $a_2 = 3$ cm $H = 5$ mm $V = 10$ V

6		Plain strain $a_1 = a_3 = 3$ cm $a_2 = 4$ cm $H = 4$ mm $V = 10$ V
7		Axisymmetric problem $a_1 = a_3 = 0.6$ cm $a_2 = a_4 = 0.7$ cm $H = 2$ mm $V = 10$ V
8		Axisymmetric problem $a_1 = 1$ cm, $a_3 = 2$ cm $a_2 = 3$ cm $H = 5$ mm $V = 5$ V
9		Plain strain $a_1 = a_3 = 3$ cm $a_2 = 4$ cm $H = 6$ mm $V = 10$ V
10		Plain strain $a_1 = a_3 = 0.7$ cm $a_2 = a_4 = 0.8$ cm $H = 3$ mm $V = 10$ V
11		Axisymmetric problem $a_1 = a_2 = 0.8$ cm $a_2 = a_4 = 0.6$ cm $H = 3$ mm $V = 7$ V

Variant No.	Student name
1.	Бобовников Николай Алексеевич

2.	Габричидзе Лука	
3.	Гбамметон Шарль Жюдикаель (Charles Gbammeton)	
4.	Гладкова Ксения	
5.	Дремов Егор Алексеевич	
6.	Ермаков Марк Михайлович	
7.	Пересыпкин Станислав	
8.	Шевченко Мария	
9.	Цао Цзыхэн	
10.	Е Чэнпин	
11.	Зезекало Виктор Анатольевич	