

**CHG 8191L  
Electrochemical Engineering  
Winter 2016**

**Professor: Dr. Elena Baranova**

**March 16, 2016**

**DATE DUE: March 30, 2016 before the lecture at 8:30 am**

**Assignment 3**

**Problem 1**

Rotating disk electrode (radius = 0.2 cm,  $N^* = 16$  r.p.s) immersed in the solution of substance A ( $C_A^* = 10^{-2}$  M,  $D_A = 5 \times 10^{-6}$  cm<sup>2</sup>/s)

Knowing that A is reduced according to the one-electron reaction and that kinematic viscosity of liquid is  $\nu = 0.01$  cm<sup>2</sup>/s. Find what is the flow state (laminar, turbulent) and then calculate:

- Mass transfer coefficient  $k_d$
- Thickness of the diffusion layer
- Sh number

**Problem 2**

In electrolyser of a flow channel type (PFR type) (length = width = 100 cm, anode - cathode distance = 1 cm, anode is Cu and cathode is Fe), copper is deposited at the cathode made of Fe and copper is dissolved at the anode. Electrolyte: 1.5M H<sub>2</sub>SO<sub>4</sub> + 0.1M CuSO<sub>4</sub>; T = 25 °C. Flow is turbulent and fully developed.

Calculate the limiting cathodic current.

Data:  $Re = 20,000$ ;  $D_{Cu^{2+}} = 5 \times 10^{-6}$  cm<sup>2</sup>/sec;  $\nu = 0.01$  cm<sup>2</sup>/sec;  $Sh = 0.023Re^{0.8}Sc^{1/3}$

**Problem 3**

After one month (30 days) of operation a series ( $n = 150$ ) of continuously working aluminum electrolyzers produced 2090 tons of metal, which contain 99.5% of Al. Average voltage of the series is 718 V and current is 65 kA. What are the Faradic efficiency and the specific energy consumption (kWh/ton) of produced aluminum with 100% purity?

**Problem 4**

Zinc electroplating bath is operating at 80 A. We want to electroplate 15 kg of metallic parts with the specific surface area  $A_s = 19.2$  m<sup>2</sup>/kg. What is the electroplating time in order to obtain a layer of Zn with thickness of 15 μm.