# CHEM 415
## Electrochemistry and Electrocatalysis

### General Course Information

| Course instructor | Dr. Gregory Jerkiewicz  
|                  | CHE 311, Chernoff Hall  
|                  | Phone: 533-6413  
|                  | E-mail: gregory.jerkiewicz@queensu.ca  
| Web site | Available through onQ  
| Lectures | Schedule:  
|          | Mondays 9:30  
|          | Room: CHE 117  
|          | Wednesdays 8:30  
|          | Room: CHE 117  
|          | Thursdays 10:30  
| Room: CHE 117  
| Office hours | Office hour that suits the class and the course instructor will be established at the beginning of the course  
| Marking | Quiz (2 × 20%): 40% (dates TBD)  
|         | Final examination: 60% (date TBD)  
|         | Total 100%  

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*CHEM 415, Electrochemistry and Electrocatalysis Course Outline 2019*
COURSE OUTLINE

Equilibrium Electrochemistry (review of second-year material and its expansion)
Electrodes and half-reactions
Complete electrochemical cells and electrochemical reactions
Types of electrochemical cells (galvanic and electrolytic)
Reactions quotient and the Nernst equation; Gibbs energy of half-cell and complete cells;
application of the Nernst equation
Cell potential (electromotive force); standard and non-standard cell potentials
Application of cell potentials
Reference Electrodes

Electrode-Electrolyte Interface
Components of the electric double layer
Inner and outer Helmholtz layer
Gouy-Chapmann, Stern and Grahame models
Potential distribution at the electrode-electrolyte interface

Dynamic Electrochemistry
Rate of charge transfer and the activation energy of the charge transfer
Derivation of the Butler-Volmer equation
Low and high overpotential limiting cases of the Butler-Volmer equation
Tafel relation
Electro-adsorption and adsorption isotherms

Electrocatalysis
Hydrogen oxidation and oxygen reduction reactions
Rechargeable and non-rechargeable batteries
Corrosion reactions
Water electrolysis
Metal electrodeposition
Electrocatalytic hydrogenation
Electrosynthesis

Laboratory Procedures in Electrochemistry and Electrocatalysis
Components of an electrochemical setup and their roles
Cleanliness in electrochemical measurements
Electrodes
Electrochemical cells and the two-electrode and three-electrode configurations
Reference electrodes
Safety in electrochemistry and electrocatalysis research

Electrochemical Experimental Techniques
Chrono-amperometry
Coulometry
Cyclic voltammetry
Polarization curves
Tafel plots
Electrochemical quartz-crystal nanobalance