

B.E. (Chemical) – 8th Semester
(Mid Term Examination- June 2021)

Time: 1 hours

Max. Marks = 35

Note: All questions are compulsory.

- Q1. (a) Describe the four major steps in the generation of electricity within a fuel cell. Describe the potential reasons for loss in fuel cell performance for each step.
- (b) A residential solid-oxide fuel cell is operated on methane (CH₄) and is designed to provide the household with both heat and electricity. Assuming 100% fuel utilization, how much water (in liters) would be produced during 24 hours of operation at $P_{elec} = 3$ kW? (Given: molar mass of water = 18 g/mol, density of water = 1 g/cm³.)
- 7,5
- Q2. (a) In the Tafel equation, how is the Tafel slope b related to α ? (Remember that the Tafel equation is defined using log instead of ln.) How is the intercept a related to the exchange current density?
- (b) What are the two main goals of fuel cell characterization? Discuss the relative advantages and disadvantages of EIS versus current interrupt measurement.
- 5,5
- Q3. (a) Define Nernst-Einstein relation. Define resistance, specific resistance, conductivity conductance, and specific conductivity.
- (b) Hydrogen gas fully saturated with water vapor at 1 atm and 80 °C flows over an anode electrode, parallel to the anode surface, at a velocity of 1 m/s. If the anode is rectangular and the length along the flow direction is 10 cm, determine the following; (i) the limiting current density profile corresponding to the rate of convective mass transfer, (ii) the hydrogen concentration variation at the electrode surface and its average value, if the current density drawn from the electrode is 0.5 A/cm².
- 7,6