B.TECH.
(SEM. VII) THEORY EXAMINATION 2019-20
FUEL CELL TECHNOLOGY

Time: *3 Hours*   **Total Marks: 70**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. **Attempt *all* questions in brief.**   **2×7=14**
   a. Give advantages and disadvantages of Fuel Cell Technology.
   b. What is the importance of Nernst equation?
   c. Write a note on stack clamping.
   d. What are the uses for fuel cells?
   e. Write the cell reaction of alkaline fuel cell.
   f. What does fuel cell indicates?
   g. What are the advantages of internal steam reforming?

SECTION B

2. **Attempt any *three* of the following:**   **7×3=21**
   a. Explain the following
       i) Butler Volmer Equation ii) Tafel Equation
   b. Explain the design of a fuel cell stack.
   c. Derive expressions for temperature dependence of the reversible voltage obtained from a fuel cell.
   d. Differentiate between Batteries and Fuel Cells. Discuss the relation between activation energy and reaction rate.
   e. Write a note on the characteristics of fuel cell charge transport resistance

SECTION C

3. **Attempt any *one* part of the following:**   **7×1=7**
   a. Derive Nernst equation for calculating open circuit potential of SOFC using H_2 as a fuel and O_2 as an Oxidize.
   b. Gibbs free energy for the formation of water vapor is – 54.635 cal/mole at STP condition. In the typical SOFC, the partial pressures of hydrogen, oxygen and water vapor are 0.8, 0.21 and 0.3 atm. Assume that activities of the components are proportional to their partial pressures. The cell is operated at 900 deg C. Calculate :
       i)   Standard open circuit potential.
       ii)   ii) Open circuit potential at the operating conditions. Faraday's constant is 96487 J/V.mol.

4. **Attempt any *one* part of the following:**   **7×1=7**
   a. Discuss the principle and working of PEM Fuel Cell.
   b. Explain the Water management and Voltage distribution for PEM fuel cells.

5. **Attempt any *one* part of the following:**   **7×1=7**
   a. Explain the four major steps in the generation of electricity within a fuel cell.
   b. Write the short note on
       i.   Temperature and humidification effect
       ii.   Electro-osmotic Drag effect.

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6.   **Attempt any *one* part of the following:**   **7×1=7**
   a.   Explain the Rate of mass transfer of reactants and products current collections and gas removal for PEM Fuel cell.
   b.   Explain the Bipolar plates and flow distribution for PEM Fuel cell.

7.   **Attempt any *one* part of the following:**   **7×1=7**
   a.   Explain various methods for production of Hydrogen. Explain the Train or Drive, Train Analysis.
   b.   Explain the PEMFC powered Bus and Flow Sheet, conceptual Design.