**Q. Code:355686**

**Reg. No.** | | | | | | | | | | | | | |

# B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Sixth Semester

## OC18002 – FUEL CELL CHEMISTRY

*(Common to CH & CS)*

**(Regulation 2018/2018A)**

**TIME: 3 HOURS** **MAX. MARKS: 100**

| COURSE OUTCOMES | STATEMENT | RBT LEVEL |
|---|---|---|
| **CO 1** | Describe the basic principles of fuel cells. | **2** |
| **CO 2** | Understand the way to fuel system design & optimization. | **2** |
| **CO 3** | Apply their learned knowledge to develop conventional technologies. | **2** |
| **CO 4** | Understand the importance of fuel cell applications. | **2** |
| **CO 5** | The students will acquire knowledge on various fuel cell techniques and their mechanism | **2** |

### PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

| | | CO | RBT LEVEL |
|---|---|---|---|
| **1.** | What is the difference between an IC engine and a fuel cell? | **1** | **2** |
| **2.** | List the components of fuel cells. | **1** | **2** |
| **3.** | What is the need for the second law of thermodynamics? | **2** | **2** |
| **4.** | Give an example of a spontaneous process. Explain why it's spontaneous. | **2** | **2** |
| **5.** | Define overvoltage. | **3** | **2** |
| **6.** | Differentiate between series and parallel circuits. | **3** | **2** |
| **7.** | List the four main parts of a PEM fuel cell. | **4** | **2** |
| **8.** | Explain the role of bipolar plates in a fuel cell. | **4** | **2** |
| **9.** | What is the key difference between a micro fuel cell and a larger fuel cell, in terms of size and power output? | **5** | **2** |
| **10.** | Differentiate between stationary and distributed power generation. | **5** | **2** |

### PART- B (5 x 14 = 70 Marks)

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **11. (a)** | Compare and contrast the fuel cell types based on the following criteria: Operating Temperature<br><br>1. Fuel Source<br>2. Efficiency<br><br>3. Applications | **(14)** | **1** | **2** |

4. Membrane

**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | Explain the working principle, components, and reactions involved in a Direct Methanol Fuel Cell (DMFC). | **(14)** | **1** | **2** |
| **12. (a)** | Explain the necessity of the second law of thermodynamics, considering the limitations of the first law. | **(14)** | **2** | **2** |

**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | Derive the Gibbs-Helmholtz equation, relating Gibbs free energy (G), Helmholtz free energy (A), temperature (T), and entropy (S). | **(14)** | **2** | **2** |
| **13. (a)** | Explain the different types of overvoltage encountered in electrochemical systems. Discuss the concepts of chemical and electrochemical overpotentials. | **(14)** | **3** | **2** |

**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | Explain the key components of an instrument used for Electrochemical Impedance Spectroscopy (EIS) and their functions. | **(14)** | **3** | **2** |
| **14. (a)** | Explain the importance of modeling a fuel delivery system. Discuss the advantages and limitations. | **(14)** | **4** | **2** |

**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | Discuss the concept of mass transport/concentration losses in fuel cells. Explain how these losses impact the voltage output of a fuel cell. | **(14)** | **4** | **2** |
| **15. (a)** | How do fuel cells address reliability and resilience concerns in stationary power supply? | **(14)** | **5** | **2** |

**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | What environmental benefits do portable fuel cells offer, and how do they mitigate carbon emissions? | **(14)** | **5** | **2** |

## PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **16.** | What are the examples of successful initiatives or projects aimed at reducing the costs of fuel cell technology? | **(10)** | **5** | **2** |

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