



B.E DEGREE EXAMINATIONS: NOV/DEC 2023

(Regulation 2018)

Seventh Semester

AUTOMOBILE ENGINEERING

U18AUE0011: Fuel Cell Technology

COURSE OUTCOMES

- CO1:** Identify the different components and materials used in a fuel cell.
- CO2:** Familiarize with the safety aspects and the recent advancements in field of fuel cells.
- CO3:** Apply the knowledge of thermodynamics and material science to understand the thermodynamic equations and electrochemical kinetics of the fuel cell.
- CO4:** Compare the different types of fuel cells and choose an appropriate fuel cell suitable for specific application.
- CO5:** Develop a single cell of PEM fuel cell / Microbial fuel cell on their own.
- CO6:** Estimate the performance of the fuel cell.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

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|--|-----|-------------------|
| 1. Identify the necessity of bipolar plates and cooling plates in fuel cells. | CO1 | [K ₃] |
| 2. Summarize the role of gas diffusion layer in a fuel cell. | CO1 | [K ₂] |
| 3. List few recent developments in materials used for electrode and bipolar plates. | CO2 | [K ₁] |
| 4. Explain the challenges and concerns posed while using fuel cell driven vehicles. | CO2 | [K ₃] |
| 5. Give the fuel cell reaction and the Nernst equation of a PEM fuel cell. | CO3 | [K ₂] |
| 6. Justify the reason of using Tafel's equation and plot in fuel cell. | CO3 | [K ₃] |
| 7. Identify and list the appropriate fuel cells for stationary applications, aerospace application and automobile applications. | CO4 | [K ₃] |
| 8. Specify any four-fuel cell-based vehicles available in the market. | CO4 | [K ₂] |
| 9. Make use of the components used to develop a single cell proton exchange membrane fuel cell and draw the complete fuel cell diagram based on the development. | CO5 | [K ₃] |
| 10. Outline the factors that affect the performance of a fuel cell. | CO6 | [K ₂] |

Answer any FIVE Questions:-

PART B (5 x 16 = 80 Marks)

(Answer not more than 400 words)

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|-----|----|--|----|-----|-------------------|
| 11. | a) | Apply the thermodynamic concepts and materials selection to explain the construction and working PEM fuel cells with the relevant equations. | 8 | CO3 | [K ₃] |
| | b) | Compare and analyze the different types of fuel cells based on the materials used, different operating conditions, contaminants, its applications, advantages, and disadvantages. | 8 | CO4 | [K ₄] |
| 12. | a) | Apply the concept of fuel cells to explain the architecture and working of a fuel cell driven vehicle. Elaborate on the different modes of the vehicle. | 12 | CO2 | [K ₃] |
| | b) | Identify the specifications of any one of the fuel cells driven vehicle available in the market. | 4 | CO2 | [K ₃] |
| 13. | | Illustrate the different over potentials in fuel cells based on the electrochemical kinetics with necessary explanation. | 16 | CO3 | [K ₂] |
| 14. | | Apply the concept of reformer technology in electric vehicles, clearly stating the different types, its construction, and working of different types of reformers. Also give the merits and demerits. | 16 | CO1 | [K ₃] |
| 15. | | Explain the pollutants that are harmful to fuel cells. With neat sketch, explain the different stages of removal of pollutants from the fuel. Also specify the level of tolerance of the pollutants as applicable to improve the performance of the different types of fuel cells. | 16 | CO6 | [K ₃] |
| 16. | | Analyze the role of NHERM in the implementation of fuel cell-based vehicles. Also explain the road map of fuel cells to market with clear focus on addressing the safety issues while adopting fuel cell driven vehicles. | 16 | CO2 | [K ₄] |
