



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Mechanical Engineering (Thermal Engineering)

Course / Subject Code : ME01083041

Course / Subject Name : Hydrogen & Fuel Cell Technology

|                         |         |
|-------------------------|---------|
| w. e. f. Academic Year: | 2024-25 |
| Semester:               | 1       |
| Category of the Course: | PEC     |

|                      |   |
|----------------------|---|
| <b>Prerequisite:</b> | Nil   |
| <b>Rationale:</b>    | The course is designed to provide the fundamental concept of hydrogen and fuel cell and relevant engineering and technologies |

### Course Outcome:

After Completion of the Course, Student will able to:

| No | Course Outcomes   | RBT level            |
|----|---|----------------------|
| 1  | Compare hydrogen as fuel and explain about its production, storage and applications.                    | Understand           |
| 2  | Demonstrate and experiment with different types of fuel cells.  | Understand/<br>Apply |
| 3  | Select proper fuel cell technology for various applications and develop economic analysis for the same. | Apply                |

### Teaching and Examination Scheme:

| Teaching Scheme<br>(in Hours) |   |    | Total<br>Credits<br>L+T+<br>(PR/2) | Assessment Pattern and Marks |                |                      |         | Total<br>Marks |
|-------------------------------|---|----|------------------------------------|------------------------------|----------------|----------------------|---------|----------------|
| L                             | T | PR | C                                  | Theory                       |                | Tutorial / Practical |         |                |
|                               |   |    |                                    | ESE<br>(E)                   | PA / CA<br>(M) | PA/CA (I)            | ESE (V) |                |
| 3                             | 0 | 2  | 4                                  | 70                           | 30             | 20                   | 30      | 150            |

### Course Content:

| Unit<br>No. | Content   | No. of<br>Hours | % of<br>Weightage |
|-------------|---|-----------------|-------------------|
| 1.          | <b>Hydrogen – Fundamentals:</b> Hydrogen as a source of energy, physical and chemical properties, salient characteristics, relevant issues and concerns | 4               | 10                |



## GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Mechanical Engineering (Thermal Engineering)

Course / Subject Code : ME01083041

Course / Subject Name : Hydrogen & Fuel Cell Technology

|              |   |           |            |
|--------------|---|-----------|------------|
| 2.           | <b>Hydrogen Storage and Applications:</b> Production of hydrogen, steam reforming, water electrolysis, gasification and woody biomass conversion, biological hydrogen production, photo dissociation, direct thermal or catalytic splitting of water, hydrogen storage options, compressed gas, liquid hydrogen, hydride, chemical storage, safety and management of hydrogen, applications of hydrogen | 16        | 35         |
| 3.           | <b>Fuel Cells- Types:</b> Brief history, principle, working, thermodynamics and kinetics of fuel cell process, types of fuel cells; AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits, performance evaluation of fuel cell, comparison of battery Vs fuel cell  | 14        | 31         |
| 4.           | <b>Fuel Cells -Application and Economics:</b> Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells  | 11        | 24         |
| <b>Total</b> |   | <b>45</b> | <b>100</b> |

### Suggested Specification Table with Marks (Theory):

| Distribution of Theory Marks |         |         |         |         |         |
|------------------------------|---------|---------|---------|---------|---------|
| R Level                      | U Level | A Level | N Level | E Level | C Level |
| -                            | 50      | 50      | -       | -       | -       |

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

### References/Suggested Learning Resources:

#### (a) Books:

1. Viswanathan, B and M Aulice Scibioh, Fuel Cells – Principles and Applications, Universities Press
2. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma
3. Bent Sorensen (Sorensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier Academic Press, UK
4. Kordesch, K and G. Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany
5. Hart, A.B and G. J. Womack, Fuel Cells: Theory and Application, Prentice Hall, New York Ltd., London.
6. Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA



## GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Mechanical Engineering (Thermal Engineering)

Course / Subject Code : ME01083041

Course / Subject Name : Hydrogen & Fuel Cell Technology

---

**Suggested Activities for Students:** Students are required to download 3-5 research papers from reputed international journals on the recent advancement in the areas of hydrogen fuel and fuel cell technology. They need to go through the same and prepare a review for the research papers. The review should have three parts: Summary, Critical Evaluation and Creative synthesise

\* \* \* \* \*