Name: **Enrolment No:**	

UPES

End Semester Examination, May 2024

Course: Hydrogen and Fuel Cell Technology **Semester: II**

Program: M.Tech RE **Time : 03 hrs.**

Course Code: EPEC7075 **Max. Marks: 100**

Instructions: Assume a suitable value if the same is not provided in the problems.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Distinguish between ortho and para hydrogen. Of them which is more stable? Why?	**4**	**CO1**
Q 2	Name the fossil fuels and the respective processes by which hydrogen is produced.	**4**	**CO1**
Q 3	Write about any one physiological, physical, and chemical hazard associated with hydrogen storage and transport.	**4**	**CO2**
Q 4	Give the three causes of voltage loss in fuel cells with increase in cell current.	**4**	**CO3**
Q 5	Write any two opportunities and challenges each of implementing hydrogen fuel cells for electricity production from life cycle analysis view point.	**4**	**CO4**

SECTION B
(4Qx10M= 40 Marks)

Q 6	(i) Calculate the theoretical voltage of an electrolyser at 25°C & 50 atm, and voltage efficiency, if its actual voltage at 25°C and 50 atm is 1.82 V. E(25°C, 1 atm) = 1.23 V, F = 96,485 C, n = 2, R = 8.314 J/mol K, Over all reaction: $H_2O(l) \rightarrow H_2(g) + ½ O_2(g)$. (ii) An electrolyser is operated at a voltage of 1.9 V and 80% energy efficiency. Calculate the hydrogen produced in a day when a current of 5 A is passed through it. Higher heating value (HHV) of hydrogen is 286 kJ/mol. (Or) List the various electrolyzers and explain the working of any one of them in detail with the help of diagram.	**5** **5** **10**	**CO1**
Q 7	List the methods of hydrogen storage and explain any one of them in detail along with any one of its advantages and disadvantages.	**10**	**CO2**

Q 8	(i) Calculate the theoretical voltage of a hydrogen fuel cell at 85^{o}C & 1 atm, and its voltage efficiency if the actual voltage at 85^{o}C and 1 atm is 1.8 V. Given: ΔS (25^{o}C, 1 atm) = 163.25 J/mol K, E(25^{o}C, 1 atm) = 1.23 V, F = 96,485 C and n = 2. (ii) An alkaline fuel cell is supplied with hydrogen and oxygen at the flow rate of 3 x 10^{-5} mol/s, and it produces a current of 3.2 A. Calculate its fuel utilization efficiency. F = 96,485 C, and n = 2.	**5** **5**	**CO3**
Q 9	Write a comprehensive analysis on opportunities and future challenges in hydrogen economy for sustainable development	**10**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q 10	(i)With the help of diagram explain the production of hydrogen by steam reforming of methane. (ii) Give a comprehensive account of safety risks involved in hydrogen storage and their link to unique properties of hydrogen (Or) (i)List the challenges of thermolysis and explain how it is overcome with the help of anyone thermochemical water splitting cycle. ii) Discuss the various aspects of hydrogen transport and the associated safety risks	**12** **8** **12** **8**	**CO1** **CO2** **CO1** **CO2**
Q 11	(i)Describe the working of solid oxide fuel cell and give any one of its advantage and disadvantage. (ii) Analyze the advantages and disadvantages between electricity generation using fuel cells & thermal power generation and between electrolyzers & batteries for renewable electricity storage from LCA view point.	**10** **10**	**CO3** **CO4**