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## GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Eight Semester – Regular) Examinations, April – 2024

### BPEEL8020/BPEEE8020 – Hydrogen Energy and Fuel Cell (EE & EEE)

Time: 3 hrs

Maximum: 70 Marks

**The figures in the right hand margin indicate marks.**

#### PART – A: (Multiple Choice Questions)

(1 x 10 = 10 Marks)

##### Q.1. Answer *ALL* questions

		[CO#]	[PO#]
a. What is highlighted as a key advantage of hydrogen combustion?		CO 1	PO 1
(i) Low-cost	(ii) High energy density		
(iii) Minimal pollution	(iv) Easy availability		
b. What is emphasized as a requirement for a hydrogen economy?		CO 1	PO 1
(i) Abundant hydrogen resources	(ii) Efficient storage methods		
(iii) Renewable energy sources	(iv) Advanced combustion technologies		
c. What is mentioned as a challenge in implementing a hydrogen economy?		CO 1	PO 1
(i) Limited hydrogen reserves	(ii) Inefficient production methods		
(iii) Lack of societal support	(iv) Packaging and transportation		
d. Which of the following is not a challenge for widespread adoption of fuel cell technology?		CO 2	PO 1
(i) High efficiency	(ii) Cost		
(iii) Durability	(iv) Hydrogen infrastructure		
e. Which type of fuel cell is widely used in transportation applications such as fuel cell vehicles (FCVs)?		CO 2	PO 1
(i) Solid Oxide Fuel Cells	(ii) Proton Exchange Membrane Fuel Cells		
(iii) Molten Carbonate Fuel Cells	(iv) Phosphoric Acid Fuel Cells		
f. What characteristic makes fuel cells suitable for applications where noise pollution is a concern?		CO 2	PO 1
(i) High efficiency	(ii) Clean energy production		
(iii) Quiet operation	(iv) Reliability and durability		
g. What is the primary purpose of optimizing stoichiometric coefficients and utilization percentages in fuel cells?		CO 3	PO 2
(i) To increase the cell voltage	(ii) To minimize waste products		
(iii) To decrease the efficiency of electrochemical reactions	(iv) To reduce the mass flow rate of reactants		
h. How is the total voltage affected in fuel cells connected in series?		CO 3	PO 1
(i) The voltage remains constant	(ii) The voltage decreases		
(iii) The voltage increases	(iv) The voltage becomes zero		
i. What is a significant advantage of large-scale fuel cell power generation compared to traditional power plants?		CO 4	PO 1
(i) Lower energy conversion efficiency	(ii) Higher emissions of pollutants		
(iii) Less scalability	(iv) Higher efficiency & reduced emissions		
j. Which space application of fuel cells involves providing life support systems for crewed spacecraft?		CO 4	PO 2
(i) Spacecraft power generation	(ii) Life support systems		
(iii) Extended duration missions	(iv) Fuel cell vehicles		

**PART – B: (Short Answer Questions)****(2 x 10 = 20 Marks)**Q.2. Answer ALL questions

	[CO#]	[PO#]
a. How does the concept of a "Hydrogen Economy" address energy and environmental concerns?	CO 1	PO 1
b. What are some challenges associated with the practical aspects of a hydrogen economy?	CO 1	PO 1
c. Explain the significance of green hydrogen in reducing carbon emissions and transitioning to a low-carbon future.	CO 1	PO 1
d. How are fuel cells different from traditional combustion engines in terms of noise pollution?	CO 2	PO 2
e. What is the main advantage of combining heat and power in fuel cell systems?	CO 2	PO 2
f. What are some challenges hindering the widespread adoption of fuel cells?	CO 2	PO 2
g. What role does the electrolyte membrane play in DMFCs?	CO 3	PO 3
h. How do fuel cell stacks differ from single fuel cells in terms of mass flow rate calculation?	CO 3	PO 3
i. What is one major factor influencing the initial cost of fuel cell systems for domestic power generation?	CO 4	PO 3
j. What types of fuel cells are commonly used for large-scale power generation?	CO 4	PO 2

**PART – C: (Long Answer Questions)****(10 x 4 = 40 Marks)**Answer ALL questions

	Marks	[CO#]	[PO#]
3. a. What are the fundamental prerequisites for the transmission and infrastructure necessary for hydrogen fuel?	5	CO 1	PO 1
b. Could you outline the primary safety and environmental consequences associated with hydrogen fuel?	5	CO 1	PO 1
(OR)			
c. Provide a concise overview of the economics involved in transitioning to hydrogen systems.	5	CO 1	PO 1
d. Explain the concept of Electrolysis of water.	5	CO 1	PO 1
4. a. What are the advantages and disadvantages of fuel cells?	10	CO 2	PO 1
(OR)			
b. What types of fuel cells exist, and what are their applications?	10	CO 2	PO 1
5. a. Explain the operating conditions, and advantages and challenges associated with DMFC technology.	5	CO 3	PO 2
b. Examine the general issues of water flooding and water management in fuel cells, with a focus on proton exchange membrane fuel cells (PEMFCs)	5	CO 3	PO 2
(OR)			
c. Describe the different types of polarization in PEMFCs, including activation polarization, concentration polarization, ohmic polarization, and mass transport polarization.	10	CO 3	PO 3
6. a. Explain the modular design approach in large-scale power generation through fuel cells, highlighting its advantages in terms of scalability and flexibility to meet varying power demands.	10	CO 4	PO 2
(OR)			
b. Compare the environmental benefits of large-scale fuel cell power generation with conventional centralized power generation methods, emphasizing emissions reduction and resource efficiency.	10	CO 4	PO 2

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