Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, NOV/DEC 2024

MATERIAL SCIENCE AND ENGINEERING
Semester V
ML 5017 Energy Storing Devices and Fuel Cells

(Regulation 2019)

Time: 3 hrs | Max. Marks: 100

CO1	To remember and understand the basic characteristics of a battery.
CO2	To understand and appreciate the fuel cell technology.
CO3	To understand the need for green energy and sustainable technology developments
CO4	To analyse the cost effectiveness and eco-friendliness of hydrogen technology.
CO5	To develop models of renewable energy systems.

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART - A (10 x 2 = 20 Marks)

(Answer all Questions)

Q.No	Questions	Marks	CO	BL
1	Define C-rate. What is 1 C?	2	1	1
2	Determine the cost of electricity for running 50 LED bulbs of capacity 18 Watt for 10 days. Consider the unit cost of electricity as Rs. 6/kWh.	2	1	2
3	What is dendrite growth? How does it occur?	2	2	1
4	Illustrate the effect of shadowing on solar cell performance?	2	2	2
5	What is the difference between battery and a fuel cell?	2	3	1
6	What is electrode roughness? What is its effect?	2	3	2
7	Nafion is not suitable for MFC. Justify.	2	4	1
8	Compare PEMFC and DMFC.	2	4	2
9	What is water gas shift reaction? What is its importance?	2	5	1
10	State the limitations associated with hydrogen as fuel for ICE.	2	5	2

PART- B (5 x 13 = 65 Marks)

Q.No	Questions	Marks	CO	BL
11 (a)	(i) Define: (1) Storage capacity (2) Calendar life (3) Trickle charging (4) Primary battery (5) SoC (6) Prismatic cell (7) Specific energy (8) Current density (9) Self discharge (10) Over charging.(10) (ii) Write a note on thermal runaway. (3)	13	1	4
	OR			

11 (b)	(i) Define: (1) Available power (2) Shelf life (3) Random charging (4) Secondary battery (5) DoD (6) Pouch cell (7) Specific power (8) Power density (9) Memory effect (10) Deep discharge .(10) (ii) Write a note on BMS.(3)	**13**	1	4
12 (a)	(i) Explain the construction and working of a Li ion battery. (10) (ii) Write a short note on batteries for electric vehicles. (3)	**13**	2	5
	OR			
12 (b)	Explain the construction and working of a Nicad battery. (10) (i) Write a short note on batteries for pace makers.(3)	**13**	2	5
13(a)	(i) Derive the Butler Volmer relation. (10) (ii) Distinguish between energy conversion device and energy storage device. (3)	**13**	3	2 4
	OR			
13(b)	(i) Discuss the various types of voltage losses in a fuel cell. (10) (ii) Distinguish between a fuel cell and an electrolyzer. (3)	**13**	3	2 4
14 (a)	(i) With a neat diagram explain the working mechanism of SOFC. What are its advantages and limitations? (10) (ii) Write a note on interconnect. (3)	**13**	4	3
	OR			
14 (b)	(i) With a neat diagram explain the working mechanism of MCFC. What are its merits and demerits (10) (ii) Write a note on bio fuel cell. (3)	**13**	4	3
15 (a)	(i) Compare: (1) Quantum dot solar cells and normal solar cells (2) Type 1 and Type 2 hydrogen storage cylinders (5 x 2 = 10) (ii) State any two ways to beat SQ limit. (3)	**13**	5	3
	OR			
15 (b)	(i) Compare: (1) Single junction and multi junction solar cells (2) Type 3 and type 4 hydrogen storage cylinders (5 x 2 = 10) (ii) Write a note on recombination of e-h pairs. (3)	**13**	5	3

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

<table>
<tr><th>Q.No</th><th>Questions</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>16
(i)</td><td>Match the following appropriately and justify your answers.
<table><tr><td>PEMFC</td><td>Interconnect, high temperature</td></tr><tr><td>AFC</td><td>Methanol, low temperature</td></tr><tr><td>MFC</td><td>Biocatalyst, ambient temperature</td></tr><tr><td>DMFC</td><td>Alkaline, low temperature</td></tr><tr><td>SOFC</td><td>Acidic, low temperature</td></tr></table></td><td>5</td><td>4</td><td>6</td></tr>
<tr><td>(ii)</td><td>Match the following and justify your answers.
<table><tr><td>Czochralski process</td><td>Solar cell efficiency recorder</td></tr><tr><td>Shockley Quiesser limit</td><td>Toxicity</td></tr><tr><td>Thin film technology</td><td>Amorphous Si</td></tr><tr><td>CdTe</td><td>Tandem cells</td></tr><tr><td>NREL</td><td>Si wafer</td></tr></table></td><td>5</td><td>5</td><td>6</td></tr>
<tr><td>(iii)</td><td>Explain the different colours of hydrogen.</td><td>5</td><td>5</td><td>6</td></tr>
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