Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

II SEMESTER M.TECH.

END SEMESTER EXAMINATIONS, April 2017

SUBJECT: FUEL CELL & HYDROGEN ENERGY [CHE5283]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	Define activation over potential and derive Tafel equation from butler volmer equation.	**6**
1B.	Briefly describe about Electrochemical Impedance Spectroscopy? How do we represent EIS?	**6**
1C.	Clearly explain the 1D fuel cell model on the basis of flux balance with the help of a neat diagram.	**8**
2A.	Define Fuel Cell. Draw a neat diagram of a SOFC and Explain the half-cell reactions that take place in a fuel cell when transport ions are O^{2-} and CO_3^{-2}.	**7**
2B.	Describe clearly about methods of H2 storage.	**8**
2C.	**Calculate the metal dispersion and active metal area for 0.5 wt % Platinum on Alumina catalysts by CO pulse chemisorption. The areas of the pulses are given in the table. Additional given data are :** Sample amount: 1gm ; Analysis gas: 10%CO/He; Carrier gas: He ; Temperature: 25^{o}C ; Pulse volume: 0.5cm^3 ; stoichiometry factor of CO on Pt = 1. **Peak No.** 1 2 3 4 5 6 7 **Peak area** 0.0 0.0 0.0003 0.001 0.005 0.007 0.007	**5**
3A.	What is Bragg's law? Determine the working principle and the instrumentation of XRD with the help of a neat diagram.	**6**
3B.	Explain any two Ex situ characterization techniques of a fuel cell with the help of neat diagrams.	**8**
3C.	Briefly explain the S-I cycle. Give advantages and disadvantages of this method.	**6**
4A.	Write about direct and indirect reforming of fuel cells. What is the role of anode in this reforming technique? What are the advantages of direct internal reforming technique?	**8**
4B.	How does Ohmic polarization arise in a fuel cell? Explain. Describe the three ways of transport in the electrolyte.	**7**

<table>
<tr><td>4C.</td><td>What is Steam Reforming? Determine both the reactions for SR. write any 3 advantages and disadvantages of reforming reactions.</td><td>5</td></tr>
<tr><td>5A.</td><td>Explain the working of FT-IR technique with the help of a diagram.</td><td>5</td></tr>
<tr><td>5B.</td><td>Give any two advantages and disadvantages of fuel cell. At 25°C, determine how does the electrical energy (ΔG) and heat produced differ if the water (the product) is in liquid and gaseous states???

<table><tr><th></th><th>hf (kJ/mol)</th><th>sf (kJ/mol.K)</th></tr><tr><td>H_2
O_2
H_2O (l)
H_2O (g)</td><td>0
0
-286.02
-241.98</td><td>0.13066
0.20517
0.06996
0.18884</td></tr></table></td><td>7</td></tr>
<tr><td>5C.</td><td>Why do we use Chemisorption technique in characterizing a catalyst for fuel cell? Briefly explain working of pulse chemisorption technique with the help of a neat diagram.</td><td>8</td></tr>
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