UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination – December, 2017

Program/course: B. Tech ET+IPR	**Semester – V**
Subject: Alternate Energy Technologies	**Max. Marks : 100**
Code : ETEG 305	**Duration : 3 Hrs.**
No. of page/s: 2	

Section A

All questions are mandatory: (Each question: 4 marks)

1) What are the major advantages and limitations of an MHD generating system?
2) What are the potential applications of a fuel cell?
3) Derive the classification of fuel cells.
4) What is the source of tidal energy? What is the minimum tidal range required for a practical tidal plant?
5) What are the environmental impacts of OTEC?

Section B

All questions are mandatory: (Each question: 10 marks)

6) A hydrogen oxygen fuel cell, operating at 25^0C has the following reactions occurring:

   At Anode: $H_2 \relbar\joinrel\relbar\joinrel\rightarrow 2H^+ + 2e^-$; At Cathode: $2e^- + \frac{1}{2} O_2 + H_2O \relbar\joinrel\rightarrow 2OH^-$

   Calculate the following:
   (i)   Voltage output of the cell
   (ii) Maximum efficiency
   (iii) Electrical o/p per mole of H_2 consumed and per mole of H_2O produced.
   (iv) Heat transfer to the surroundings.

Given are the values of change in Enthalpy and change in Gibbs free energy respectively at the operating temp.

   $\Delta H^o_{298 K}$ = -68,317 kcal/kg mole; $\Delta G^o_{298 K}$ = -56,690 kcal/kg mole

7) Explain with the help of polarization curve about various losses that determine the electrochemical efficiency of a fuel cell.

8) Derive the equation for wave power density. Final equation must include the parameters frequency(f) & density (ρ).

9) a. Explain the present status of development of ocean energy resources.

   b. Explain the operation of an oscillating water type of wave device.

Section C

Answer all questions: (Each question: 20 marks)

10) Discuss VI characteristics of a fuel cell and define various types of polarization. What is the present state of development in fuel cell technology?

OR

A deep ocean waves of 2m peak to peak appears at a period of 8s. Find the wavelength, phase velocity and power associated with the wave. At the power rate, what is the avg. annual wave energy in MWh/m^2.

11) a) Derive an expression for avg. annual wave energy at a particular site.
    b) Consider water trapped at high tide in basin area A and allowed to run through a turbine at low tide. Develop an expression for avg. theoretical power generated in one filling or emptying of the basin.

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Section A

All questions are mandatory: (Each question: 4 marks)

1) With the help of a schematic diagram, explain the operation of closed cycle MHD generating system.
2) Explain the principle of operation of an alkaline fuel cell.
3) Comment on environmental effects of fuel cell.
4) What do you understand by spring and neap tides? How are they caused?
5) What are the potential sites for tidal energy in India?

Section B

All questions are mandatory: (Each question: 10 marks)

6) A single basin type tidal power plant has a basin area of $2km^2$. The tidal has an average range of 13 m. Power is generated only during the ebb cycle. The turbine stops operating when the head on it fails below 3m. Calculate the average power generated by the plant in single emptying process of the basin if the turbine generator efficiency is 0.7. Estimate the average annual energy generation of the plant.
7) Explain various methods of production of H_2 for use as energy carrier. Comment on the safety issues related to the use of H_2.
8) Compare the performance of segmented electrode and continuous electrode faraday generator. Discuss the merits and demerits of MHD generator.
9) Explain the operation of an oscillating water type of wave device.

Section C

Answer all questions: (Each question: 20 marks)

10) Derive an expression for average annual wave energy at a particular site. What are the main advantages and disadvantages of OTEC system?

11) a. Explain the different methods used for hydrogen transportation.

   b. Explain the overview of research and development in the field of hydrogen storage in India.

   OR

   Discuss the extra-vehicular activities regarding fuel cell and explain the kind of fuel cell used in it with a neat diagram.