

Roll No: -----



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2018

Program Name:	M.Tech. Renewable Energy Engineering	Semester	: II
Subject (Course):	Alternate Energy Technologies	Max. Marks	: 100
Course Code :	EPEC 7020	Duration	: 3 Hrs
No. of page/s:	4		

Section A

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

- 1) Explain the formation of Tides in the seas and oceans? Explain how the positions of the sun and moon relative to the earth produce “Neap tide” and “Spring tide”.
- 2) Identify four different types of Fuel Cells and give one fuel gas that can be used with each type.
- 3) Explain the four main components of the Hydrogen Economy.
- 4) Identify the four different Types of Wave Energy Converters and give one example of each type.
- 5) Compare the Magneto Hydro Dynamic generator with the widely used Turbo Generator by explaining their advantages and disadvantages.

Section B

All questions are mandatory: (Each question: 8 marks)

- 6)
 - a) Explain briefly the operation of a Single Basin Tidal Power Plant (draw a schematic).
 - b) Discuss the advantages of a Double Basin Tidal Power Plant that we do not find in the Single Basin Tidal Power Plant.

- 7)
 - a) Explain, with the help of a schematic, the operation of an Open Cycle OTEC plant.
 - b) Explain the important additional benefit from an Open Cycle OTEC plant that is not provided by the Closed Cycle OTEC plant.

- 8)
 - a) Explain the working of a Solid Oxide Fuel Cell (with the help of a schematic).
 - b) Write the chemical equations of the reactions that occur at the Anode and Cathode.

- 9) Based on the data given in the Table below, compare and analyze the five different hydrogen storage technologies given in the Table for using hydrogen as a fuel for vehicles:

the “energy input” metric. Two more common metrics of hydrogen storage technologies are specific storage density by weight (wt%) and specific storage density by volume (vol%). It is important to clarify if these numbers are for the material or the entire storage system. The following numbers are for storage systems.

Table 2. Weight and Volume % for Storage Systems

Technology	Wt%	Vol %
Liquid Hydrogen	7.50	0.03
CHG 5000 PSI	6.67	0.02
CHG 10000 PSI	6.00	0.03
Low Temp MH	5.45	0.06
Sodium Borohydride	4.50	0.02

Table two shows the comparison of total system weight and total system volume for the different storage technologies.

- 10) Explain the difference between the Open Cycle and Closed Cycle systems for Magneto Hydro Dynamic power generation (draw schematics).

Section C

Answer both questions: (Each question: 20 marks)

- 11) Analyze the data on ‘*Energy Consumption in Different Types of Passenger Cars*’ provided in the Table below and answer the following questions:

TYPE	ENERGY CONSUMPTION, kJ/km		
	Well-to-tank	Tank-to-wheel	Well-to-wheel
Gasoline ICE	694	2777	3471
Diesel ICE	377	2314	2691
CNG ICE	423	2834	3257
H₂ ICE	1424	2136	3560
Gasoline ICE-HEV	479	1915	2394
Diesel ICE-HEV	251	1543	1794
CNG-ICE-HEV	241	1615	1856
H₂ ICE-HEV	1102	1653	2755
H₂ FC	771	1157	1928
H₂ FC-HEV	740	1111	1851

- a) Explain the terms: ‘Well-to-tank’, ‘Tank-to-wheel’ and ‘Well-to-wheel’.
- b) Expand the abbreviations: ICE, FC, HEV, CNG, H₂.
- c) Analyze and compare the Energy Consumption of the two methods for using Hydrogen as a fuel in automobiles (ICE and FC).
- d) Analyze and discuss the change in energy consumption when a ‘H₂ ICE’ car is converted into a ‘H₂ ICE-HEV’ car. Analyze and discuss why we do not see similar benefits when we convert a ‘H₂ FC’ car into a ‘H₂ FC-HEV’ car.
- e) Analyze and compare the Greenhouse Gas Emissions of the two gaseous fuels for automobiles shown in the table (H₂ and CNG)

12) Analyze and discuss the different methods for production of Hydrogen:

- a) Analyze and explain one commercially used method for the production of Hydrogen from Natural Gas.
- b) Analyze and compare the different methods for production of Hydrogen that can utilize Renewable Energy resources such as solar, wind, biomass and small

hydropower. Discuss the maturity of these technologies (i.e. whether they have been Commercialized or are they still under Research & Development ?)

- c) Analyze and discuss the benefits of producing Hydrogen from the power generated by Solar Photovoltaic power plants, Onshore Windfarms and Offshore Windfarms.
- d) Analyze and discuss two different methods of using Hydrogen as a fuel in vehicles.

(OR)

12)

- a) Analyze and discuss the Construction and Working of the Magneto Hydro Dynamic (MHD) generator.
- b) For MHD power generation, discuss the working of the '*Hall Effect Disk Generator*' (draw a schematic).
- c) Analyze and explain how the '*Hall Effect Disk Generator*' overcomes the drawbacks of the '*Faraday Generator*'.
- d) Compare the working of an '*Open Cycle*' MHD generator with a '*Closed Cycle*' MHD generator (draw schematics).
- e) Discuss the Applications of MHD power generation.

Roll No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2018

Program Name:	M.Tech. Renewable Energy Engineering	Semester	: II
Subject (Course):	Alternate Energy Technologies	Max. Marks	: 100
Course Code :	EPEC 7020	Duration	: 3 Hrs
No. of page/s:	4		

Section A

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

- 1) Explain how the Oscillating Water Column device generates power from the energy of waves in the sea.
- 2) Explain the operating principle of Hydrogen Separation Membranes, with the help of a simple diagram.
- 3) Explain the differences and similarities between Electrolysis and Fuel Cell.
- 4) Identify four major applications of Fuel Cells.
- 5) Explain the operating principle of the Magneto Hydro Dynamic generator, with the help of a schematic.

Section B

All questions are mandatory: (Each question: 8 marks)

- 6) One of the most mature commercial methods for splitting water to produce hydrogen is the “Alkaline Electrolyser”.
 - a) Explain the Alkaline Electrolysis process with the help of a Process Diagram.
 - b) Write the equations for the electro-chemical reactions that take place in the Alkaline Electrolyser.
- 7)
 - a) Explain the working of a Phosphoric Acid Fuel Cell (with the help of a schematic)
 - b) Write the chemical equations of the reactions that occur at the Anode and Cathode of the Phosphoric Acid Fuel Cell.

- 8) a) Discuss briefly the technique used to generate electricity using the Temperature Gradient in the ocean.
b) Analyze the similarities and differences between Tidal Power Plant and an Ocean Current Power Plant.
- 9) a) Explain how “Neap tide” and “Spring tide” are caused by the positions of the sun and moon relative to the earth.
b) Discuss the construction and operation of a Double Basin tidal power plant.
- 10) a) Identify four different methods of producing Hydrogen by the Splitting of Water.
b) Explain the production of Hydrogen from splitting of water using ANY ONE of these four methods.

Section C

Answer both questions: (Each question: 20 marks)

11) ‘Energy Consumption in Different Types of Passenger Cars’ is given in the Table below:

TYPE	ENERGY CONSUMPTION, kJ/km		
	Well-to-tank	Tank-to-wheel	Well-to-wheel
Gasoline ICE	694	2777	3471
Diesel ICE	377	2314	2691
CNG ICE	423	2834	3257
H ₂ ICE	1424	2136	3560
Gasoline ICE-HEV	479	1915	2394
Diesel ICE-HEV	251	1543	1794
CNG-ICE-HEV	241	1615	1856
H ₂ ICE-HEV	1102	1653	2755
H ₂ FC	771	1157	1928
H ₂ FC-HEV	740	1111	1851

- a) Explain the Types of passenger cars that are compared in the Table.
 - b) Analyze and discuss the Energy Consumption for the two gaseous fuels used in passenger cars that are given in the Table.
 - c) Analyze and discuss the change in energy consumption when an Internal Combustion Engine car that runs on Hydrogen is converted into a Hybrid Electric Vehicle.
 - d) Analyze and discuss the change in energy consumption when a 'Hydrogen Fuel Cell' vehicle is converted into a 'H₂ FC Hybrid Electric Vehicle'.
 - e) Analyze and compare the Greenhouse Gas (GHG) Emissions from Hydrogen cars with the GHG Emissions from Gasoline and Diesel cars.
- 12) a) Analyze and compare the different technologies for harnessing Ocean Energy resources (waves, tides, temperature gradient, etc.). Discuss their applications, end-uses and co-products.
- b) Analyze and discuss the relevance of ocean energy technologies for India. India has a coastline that is more than 7,500 kms. Analyze the potential for the various Ocean Energy technologies in India and discuss the ocean energy technologies that can be used along the Indian coastline
 - c) Discuss the Ocean Energy projects being developed or implemented in India, including Feasibility Studies and Pilot Demonstration projects undertaken by the Govt. of India and the State Energy Development Agencies.

(OR)

- 12) a) Analyze and discuss Hydrogen purification processes that can produce Hydrogen concentration more than 99.9%.
- b) Pressure Swing Adsorption (PSA) is the most common method used today for hydrogen separation. Discuss the working principle of the PSA process for hydrogen separation and purification.
 - c) Analyze and compare the main methods for storing hydrogen in gaseous, liquid or solid forms.
 - d) Based on data given in the Figure below, analyze and compare the following pairs of fuels for use in Passenger Cars:
 - (i) Compare Liquid Hydrogen with compressed Hydrogen Gas;
 - (ii) Compare Hydrogen with Gasoline as a fuel for spark ignition IC engines.
 - (iii) Compare Hydrogen with Ethanol as a fuel for spark ignition IC engines.
 - (iv) Compare Hydrogen with Methanol as a fuel for Fuel Cell vehicles.

