Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Renewable Energy Technologies – 1, EPEC 7011 **Semester: II**
Programme: M.Tech. Energy Studies
Time: 03 hrs. **Max. Marks: 100**
Instructions: ***"OPEN BOOK EXAM" – Textbooks and Notes are allowed during the Examination***

SECTION A

S. No.		Marks	CO
Q 1	a) Explain difference between 'Beam' radiation and 'Diffuse' radiation. b) Explain why only one of these two types of solar radiation can be used by Solar Concentrators, but both of them can be harnessed by Flat Plate Solar Collectors.	4	**CO1**
Q 2	a) Draw the "I-V curve" for a typical silicon solar photovoltaic module and indicate the Short circuit current, Open circuit voltage, Fill Factor and Maximum Power Point. b) A 250 Wp Solar PV module has Voc = 37.6 V, Isc = 8.79 A, Vmp = 31.0 V, and Imp = 8.08 A. Calculate the Fill Factor of this module.	4	**CO2**
Q 3	Compare the layout and operation of a "Single Basin Tidal Power Plant" with the "Double Basin Tidal Power Plant".	4	**CO2**
Q 4	Estimate the collector area required for a 80 MWe line focusing solar thermal power plant producing electricity for 10 hours every day. Assume: • Collector efficiency may be taken as 0.6 (since operating temperature is 400^{O}C) • .Rankine cycle efficiency = 0.36. • Electrical generator efficiency = 0.96. • Solar insolation during a typical day = 5 kWh/m^2.	4	**CO3**
Q 5	a) Explain the difference between Combustion and Gasification. b) Explain the difference between Biogas and Producer gas.	4	**CO3**

SECTION-B

Q 6	a) A hydro turbine delivers 900 kW of shaft power when it is operated at a net head of 40 metres. • What is the specific speed of this turbine if it rotates at 600 rpm? • Which type of turbine would you select for this specific speed. b) Identify two negative environmental impacts of Large Hydropower projects based on a dam with reservoir (e.g. Tehri hydropower project) that are not found in "Run-of-the-River" hydro power projects.	8	**CO2** **CO4**
Q 7	a) Explain the working of a Solid Oxide Fuel Cell (with the help of a schematic).	8	**CO3**

	b) Write the chemical equations of the reactions that occur at the Anode and Cathode.		
Q 8	a) Explain the difference between a "Flash Steam Power Plant" and a "Dry Steam Power Plant" used to generate electricity from a geothermal resource. b) Explain briefly the operation of an "Overtopping Device" such as a Wave Dragon to generate electricity from Wave power. (draw a schematic)	8	**CO2** **CO3**
Q 9	a) Explain the difference between "Cut-out" wind speed and "Survival" wind speed for a wind turbine generator. b) Explain how the "Salt Gulp" method is used for measuring the flow of a small mountain stream.	8	**CO1**
Q 10	a) Discuss the movement of the gas holder in a Floating Drum biogas plant. Why does the gas holder move up and down? (Draw a schematic). b) Explain why the "Open Cycle" OTEC power plant produces Distilled Water as a By-product, but the "Closed Cycle" OTEC power plant does not produce distilled water. **OR** Discuss the different technologies for Power generation using Solar Thermal systems: a) Low Temperature systems. b) Medium Temperature systems. c) High Temperature systems.	8	**CO2** **CO3**
Q 10			
SECTION-C			
Q 11	Analyse and compare power generation from Windpower with power generation from Hydropower based on the following: a) Reliability and the Intermittent nature of the two energy resources. b) Any physical characteristics of the two fluids (wind and water) that affect power generation. c) The equations for calculating power generation from windpower and hydropower. d) The two main types of turbines used to harness windpower and hydropower. e) Suitability for meeting Base Load or Peak Load requirements. f) Lifetime of the equipment.	20	**CO2**
Q 12	Analyse and discuss the role of Ethanol as a Biofuel to substitute fossil fuels used in the transport sector in India by examining the following:	20	**CO2** **CO3**

	a) The main feedstock for ethanol production in India, and the production process. b) The difference between Hydrous Ethanol and Anhydrous Ethanol c) The process for converting Hydrous Ethanol to Anhydrous Ethanol. d) Why only Hydrous Ethanol can be used for blending with Petrol (i.e. Gasoline). e) How Anhydrous Ethanol has been used in Brazil to substitute Petrol as a fuel in automobiles. **OR** Design a stand-alone Solar PV system which can be installed in New Delhi for supplying power to a house having following AC load: • Ten Lights, 20W each • Two Fans, 65W each • One Refrigerator, 150W Refrigerator is operated three hours every day, and all Lights and Fans for five hours a day. The system should be designed so that it runs smoothly for three consecutive foggy days in Delhi in the month of December. Use the following equipment that is already available : • 75 Wp SPV modules, Nominal Voltage = 12V, Peak current = 4A. • 60 Ah Batteries with Nominal Voltage = 6V. Use solar radiation data for New Delhi given in Appendix-3 of your textbook. Assume: • Inverter Efficiency = 95% • Depth of Discharge of batteries = 80% • Battery Efficiency = 85% Your design should provide the technical specification of the Inverter, Solar PV Array, Battery Bank and Charge Controller.		
Q 12			

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SECTION A

S. No.		Marks	CO
Q 1	a) Explain difference between 'Beam' radiation and 'Diffuse' radiation. b) Explain which of these types of solar radiation is utilized by: (i) Evacuated Tube Solar Water Heater; (ii) Solar Photovoltaic module; (iii) Parabolic Trough Solar Concentrator.	4	**CO1**
Q 2	Explain the difference between the following pairs: a) P-type semiconductor and N-type semiconductor. b) Intrinsic semiconductor and Extrinsic semiconductor.	4	**CO2**
Q 3	Explain how the operation of a "Double Basin Tidal Power Plant" differs from the operation of a "Single Basin Tidal Power Plant".	4	**CO2**
Q 4	a) Explain why it is necessary to regulate the power output of wind turbine generators. b) What is difference between Stall Regulation and Pitch Regulation for wind turbine generators?	4	**CO2**
Q 5	Explain the difference between Pyrolysis, Gasification and Combustion.	4	**CO3**
Q 6	a) Explain how the Electronic Load Controller acts as a Governor for Micro-hydro power plants. b) Identify two negative environmental impacts of Solar Photovoltaic power plants.	8	**CO3** **CO4**
Q 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.	8	**CO3**
Q 8	a) Explain the operation of a "Dry Steam Power Plant" used to generate electricity from a geothermal resource. (draw a schematic) b) Explain briefly the operation of an "Oscillating Water Column" to generate electricity from Wave power. (draw a schematic)	8	**CO2** **CO3**
Q 9	a) A hydropower scheme has a net head of 40 metres, turbine RPM is 750, and the	8	**CO2** **CO4**

	generator capacity is 1,000 kW. • Calculate the specific speed of this turbine. • Which type of turbine would you select for this site. b) Identify two negative environmental impacts of large Windfarms.		
Q 10	a) Discuss the process for producing the biofuel Ethanol from Molasses. b) Draw a schematic to show the main steps in the process. c) Give Chemical Equations wherever necessary. **OR** a) Discuss the change in pressure of Biogas in a Fixed Dome biogas plant. Why does the pressure increase and decrease? (Draw a schematic). b) Identify and explain any one method for generating electricity using the temperature gradient between the surface water of the ocean and water that is 1000 meters below the surface.	8	**CO2** **CO3**
	SECTION-C		
Q 11	a) Discuss the difference between a "Lift" device and a "Drag" device used to harness wind energy. Give one example of a wind turbine that is a Lift device and one wind turbine that is a Drag device. b) Compare the two types of hydro turbines with the Lift and Drag devices used in wind energy. Give one example of each type of hydro turbine. c) Analyze why hydro turbines are much smaller than wind turbines for the same rated power output. d) Compare "Run-of-the-River" hydropower plants with "Dam-based" hydropower by giving two advantages and two negative environmental impacts of both types. e) Discuss the advantages of hydropower over wind power for "Stand-alone" (Off-grid) power generation. f) Explain why the power from the wind is proportional to the cube of the wind speed.	20	**CO2** **CO3** **CO4**
Q 12	Analyse and discuss the importance of "Pumped Hydro power projects" in the development of large scale Renewable Energy Power Plants by examining the following issues: a) What is a 'Pumped Hydro' power scheme? Explain the operation of a 'Pumped Hydro' power scheme with the help of a schematic. b) How do 'Pumped Hydro' power schemes differ from "Run-of-the-River" hydro and "Storage / Dam based" hydro? c) Explain the importance of Pumped Hydro schemes for grid-integration of large capacities of Wind farms and Solar PV power plants?	20	**CO2** **CO3** **CO4**

	d) How does hybridization with "Pumped Hydro" improve the financial viability of Solar and Wind power plants ? e) What are the constraints in the development of 'Pumped Hydro' power schemes? f) What are the likely Environmental Impacts of 'Pumped Hydro' power schemes? **OR** Design a stand-alone Solar PV system which can be installed in Mumbai for supplying power to a School having following AC load: • Twenty Lights, 15W each • Ten Fans, 60W each • Two Computers, 100W each The computers are operated four hours every day, and all Lights and Fans for eight hours a day. The system should be designed so that it runs smoothly for three consecutive cloudy days without sunshine in Mumbai in the month of August. Use the following equipment that is already available : • 100 Wp SPV modules, Nominal Voltage = 12V, Peak current = 4A • 90 Ah Batteries with Nominal Voltage = 12V. Use solar radiation data for Mumbai given in Appendix-3 of your textbook. Assume: • Inverter Efficiency = 96% • Depth of Discharge of batteries = 75% • Battery Efficiency = 85% Your design should provide the technical specification of the Inverter, Solar PV Array, Battery Bank and Charge Controller.		