Marks scored:

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Level : B. E.
Year : IV

Course : MEPP 428
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date FEB 25 2019

SECTION "A"
[20 Q. × 1= 20 marks]

Cross [×] mark the most appropriate answer.

1. The most appropriate Solar Radiation Measurement Instrument to measure Diffuse Radiation is
   [ ] Pyrheliometer [ ] Pyranometer
   [ ] Shading Ring Pyranometer [ ] Campbell Stokes Recorder

2. The amount of energy required to evaporate 10 cm^3 of water is .....
   [ ] 2.3 MJ [ ] 23 MJ [ ] 2.8 MJ [ ] 28 MJ

3. If there are no considerable obstructions of solar radiation the best azimuth angle for Norther Hemisphere for maximum yield is .....
   [ ] 180^o [ ] 90^o [ ] 30^o [ ] 0^o

4. As per the guidelines for commercial/ industrial solar hot water systems .....
   [ ] Limit number of balancing valves
   [ ] Number of collectors in series < 4
   [ ] ΔP (header) < 20 % of ΔP (one series run)
   [ ] Use graded piping

5. When sunlight with intensity of 1050 W/m^2 falls on solar module measuring 1250 mm by 535 mm the output of the module is 85 watts, then the efficiency of the module is .....
   [ ] 16.4 [ ] 12.1 [ ] 10.0 [ ] 8.1

6. If a battery has a capacity of 100 Ah at the C_{20} rate, then this battery will supply.....
   [ ] 20 amps. for 100 hrs. [ ] 5 amps for 100 hrs.
   [ ] 5 amps for 20 hrs. [ ] 100 amps for 5 hrs.

7. The reduction level for C_6H_{12} is .....
   [ ] 0.5 [ ] 1.0 [ ] 1.5 [ ] 2

8. For RDF pellets with HHV = 1000 kJ/kg, moisture content = 50 %, hydrogen content = 10 % and enthalpy of vaporization = 500 kJ/kg, the LHV will be approximately .....
   [ ] 300 kJ/kg [ ] 600 kJ/kg [ ] 900 kJ/kg [ ] 1200 kJ/kg

9. Hammer mills are used to produce particle sizes .....
   [ ] < 5 mm [ ] 5 – 50 mm [ ] 5 – 25 cm [ ] > 25 cm

10. In a typical reaction in the sun, 2 gm Hydrogen can go fusion to produce about ..... joules of energy.
[ ] 10^3 [ ] 10^6 [ ] 10^9 [ ] 10^{12}

11. The general efficiency rating of pump hydro storage does not exceed .....
[ ] 70 % [ ] 75 % [ ] 80% [ ] 85 %

12. A near shore wind turbine site falls within .....
[ ] in land, 1 km from the nearest shore
[ ] in land, 3 km from the nearest shore
[ ] on water, within 3 km from nearest land
[ ] on water, within 5 km from nearest land

13. A horizontal axis wind turbine is associated with .....
[ ] high speed and efficiency [ ] less starting difficulties
[ ] easy access to power train assembly [ ] less aerodynamic losses

14. Which of these methods is not a popular wind power controlling and shading mechanism for large wind power systems?
[ ] Passive pitch control [ ] slip control
[ ] rotor current control [ ] doubly fed induction generators

15. Which of this is not a common type of geothermal power plant-based energy system?
[ ] flash steam [ ] dry steam [ ] binary cycle [ ] closed loop fields

16. Which of the following is not a characteristic of Tidal Energy System?
[ ] High investment and generation cost [ ] Works throughout the day
[ ] High R & D opportunities [ ] relatively environmental friendly

17. The criteria to be classified as Improved Cooking compared to traditional ones doesn't include .....
[ ] lower investment cost [ ] higher efficiency
[ ] lower emissions [ ] better safety

18. Generally, energy rating of batteries for portable equipment like toys, power tools and T.V are .....
[ ] 20 – 630 kWh [ ] 100 – 600 Wh
[ ] 2 – 100 Wh [ ] 100 mWh – 2 Wh

19. Which dryer operates with steam above saturation temperature to ensure only using sensible heat?
[ ] super-heated [ ] flash
[ ] cascade [ ] solar

20. In pyrolysis process, biomass is heated in the absence of air to about ..... temperature.
[ ] 150^o – 250^oC [ ] 250^o - 300^oC
[ ] 300^o – 650^oC [ ] 650^o – 800^oC

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

FEB 2 5 2019

Level : B. E.
Year : IV
Time : 2 hrs. 30 mins.

Course : MEPP 428
Semester : I
F. M. : 55

SECTION "B"
[43 Marks]

Attempt *ALL* questions. Assume any missing values (if and only if needed).

1. A remote orphanage is looking at energy solution for all the electricity load related to their regular operation. They have approached you regarding the design of the system. The client requirement is a full load energy system design (Stand Alone System) using some renewable energy sources only. Use the attached tables and conditions given to design and calculate the system discussed.
   a) Calculate the average daily energy load and peak load. Also tabulate the subtotals of each category of electricity consumption units. [2+2+2]
   b) Calculate the battery bank capacity needed in voltage and ampere hours for full load and lighting loads. Select the appropriate battery configuration. [2+2+2]
   c) Calculate the separate inverter size for full load and lighting load system. [4]
   d) Design and sketch PV system with suggested configuration each for summer and winter design using respective average PSH and temperature, mentioning the number and arrangement of PV modules to compliment the battery bank. (Hint: Temperature above 15 ^{o}C is summer months) [4+4]
   e) Show the average wind speed at installation height normalized for given surface roughness. [3]
   f) Design a wind farm each for best and worst wind months, mentioning the number of wind turbine of given specification needed to sustain the energy demand if the installation height is mentioned to be 30 m above ground level. (Hint: Wind Speed above 4 m/s at 10 m is best wind months) [2+2]
   g) Prepare a list of essential maintenance and monitoring equipment with function for both PV and wind systems. [4]

2. Design appropriate superstructure (with block diagrams) including the raw material pre-processing, gasification unit (gasifier choice), syngas cooling, syngas cleaning, syngas usage and possible oxidation agent preparation for the following
   a) Client 1: Sugarcane Residue for process heating around 50 kW_R.
   b) Client 2: Raw Material X with high load fluctuations at least 20 MW_e required power and very small room for tar contents.

   Mention the assumptions (if any) you have made related to the feedstock characteristics and explain your selection with proper reason(s). [4+4]

SECTION "C"
[4Q × 3 = 12 marks]

Attempt *ANY FOUR* questions.

3. List any three qualitative and quantitative analysis needed for characterization of biomass. Mention the need of each analysis.

4. Discuss briefly any three types of energy storage device highlighting the working principle.

5. Define angle of attack and stall with figure. List and discuss any two effect of geography in local wind pattern,

6. Describe a flash steam geothermal power plant with suitable labelled diagram.

7. Write short notes of *ANY TWO*:
   a) Tidal Barrages
   b) Difficulty in development of wave and ocean energy harnessing plants.
   c) Common methods of stove testing.

8. Describe thermosyphon technology in water heater with representative figure.

Table - MEPP-428

Table 1: Electricity Load Details for the Orphanage

S. No.	Category	Sub-category	Appliances	Quantity	Average Power Rating (W)	Average Usage per day (hr)
1	Lighting	Dormitory	CFL Bulb	3	10	2
			Tube light	2	20	2
		Staff Quarter	CFL Bulb	10	10	2
		Administrative Office	CFL Bulb	2	15	1
			Tube light	2	40	1
		Toilet / Bathroom	CFL Bulb	8	5	1
		Study Hall	CFL Bulb	2	15	4
			Tube light	2	40	4
		Audio Visual Room	CFL Bulb	2	10	2
			Tube light	2	20	2
		Recreation and Game Hall	CFL Bulb	4	10	2
			Tube light	4	20	2
		Kitchen	CFL Bulb	1	15	5
			Tube light	1	40	5
		Dining Hall	CFL Bulb	4	15	3
			Tube light	4	40	3
		Storage Room	CFL Bulb	1	10	1
			Tube light	1	20	1
		Laundry Hall	CFL Bulb	2	10	1
			Tube light	2	20	1
		Control & Utility Room	CFL Bulb	3	15	4
			Tube light	2	40	4
		Corridor	CFL Bulb	2	5	8
2	Electronics	Intercom System	Telephone	12	5	24
			Router / Modem	15	5	24
		Computer & Accessories	Desktop	5	60	4
			Scanner/ Printer	2	80	1
			Photocopy	1	300	1
3	HVAC	Cooling Units	Freezer	1	3500	8
		Heating Units	Boiler / Heater	2	1500	6
4	Kitchen Appliances	Cooking Units	Induction Cooker	2	1500	4
			Rice Cooker	2	500	3
		Exhaust	Fan	1	20	4
5	Other Essentials	Cleaning	Iron Hub	2	80	2
			Washing Machine	4	1500	2
			Vacuum Cleaner	4	1200	2
		Utility Appliances	Compressor	1	750	2
			Water Pump	2	2000	2
Load in Winter is expected to be 20 % more than in Summer						

Table 2: Meteorological Data for French Micronesia Island

Month	Average Temperature ^{O}C	Average Wind Speed (m/s) at 10 m	Average PSH
1	7.00	4.10	3.50
2	9.00	3.20	4.00
3	11.50	3.40	4.00
4	14.90	3.80	5.00
5	15.80	3.60	5.50
6	17.20	2.60	6.00
7	19.10	3.00	6.50
8	19.20	3.50	6.50
9	17.10	4.00	6.00
10	16.20	4.30	5.00
11	14.70	4.40	4.50
12	10.20	4.20	4.00

Table 3: Energy Storage System Options and Parameters

Model	Volts	Nominal Ah Capacity at 25°C to 1.85 Vpc				Cycle Life (in cycles) as function of DoD		
		C10	C20	C100	C120	20%	50%	80%
6A200	12	120	150	192	200	3500	2000	1300
2A385	2	240	276	366	385	3500	2000	1300
2A600	2	395	454	576	600	3500	2000	1300
2A920	2	600	690	876	920	3500	2000	1300
2A1040	2	700	805	990	1040	3500	2000	1300

Parameters	Battery Bank
Day of Autonomy	3
Depth of Discharge	50%
System Voltage	48
Inverter Type	Hybrid
Inverter Efficiency	90%
Storage Efficiency	85%

Table 4: Energy System Specifications

Parameters	**Solar PV**	**Wind Turbine**
Single Unit Capacity in kW	0.50	NA
Temperature Derating Factor per °C rise from 25°C	0.30	NA
Other Components Overall Efficiency (%)	98.00	NA
Power Coefficient of Wind (%)	NA	30.00
Generator Efficiency (%)	NA	98.00
Gear Box Efficiency (%)	NA	95.00
Installation Height in m	Ground Mounted	30.00
Surface Roughness	0.2	
Air Density (kg/m^3)	1.2	
Water Density (kg/m^3)	1.00	1.00
Blade Diameter in m	NA	10.00