KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E.
Year : III

Course : CHEG 321
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 17 JUL 2023

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Encircle the most appropriate answer:

1. A 1 GWe nuclear power plant produces 7.884×10^9 kWh of energy per year. The energy produced in British Thermal Unit is … BTUs.
   a. 3412 b. 6.77×10^{15} c. 2.668×10^{13} d. 8.59×10^5

2. Cut in wind speed is the minimum speed to …
   a. generate net power c. generate designed power
   c. shut down the machine d. wing stall

3. Bulb turbine has a specific speed more than …..
   a. 100 b. 200 c. 300 d. 1000

4. The approximate power available from a proposed hydropower scheme at a site having a small stream with 100 liters per second flow at a head of 30 m and efficiency of the 55% is ...
   a. 0.018kW b. 16.5 kW c. 54.5 kW d. 1650 kW

5. For a 75Ah @ C10 battery, the term @C10 specifies that the……
   a. power from the battery is 10W b. discharging current is 10A
   c. battery voltage is 10V d. time to discharge is 10 hours

6. Super-capacitors are preferred over battery for higher ……
   a. discharge time b. operating temperature
   c. energy density d. power density

7. Betz's law states the maximum efficiency of the wind turbine rotor to be ….
   a. 1/3 b. 1/2 c. 16/27 d. 26/33

8. STC for a solar photovoltaic module is ……
   a. 1368kW/m^2, AM 1, 25°C b. 1368kW/m^2, AM 1.5, 25°C
   c. 1000kW/m^2, AM 1, 25°C d. 1000kW/m^2, AM 1.5, 25°C

9. The C/N ratio of human excreta is about 8 and that of rice straw is 73. For optimum biogas production the amount of rice straw to be mixed with 1kg of human excreta will be ……..kg
   a. 0.109 b. 0.5 c. 0.35 d. 1

10. Resins from pine tree can be used as a substitute for ……..
a. petrol b. diesel c. kerosene d. lubricating oil

11. …….. incorporates an electricity generating system based on pendulum connected to generator.
a. Salter duck b. Binary Cycle geothermal plant
c. Oscillating water column d. TAPCHAN

12. The peak sun of a site is 4, the energy required by the load is 2000Wh, the derating factor is 0.9 and columbic efficiency is 0.95. The system voltage is assumed to be 24V. The size of solar module required for the load is …….A.
a. 584.7 b. 24.3 c. 87.9 d. 78.9

13. Long wall method is generally employed for …
a. Copper ore mining b. Iron ore mining.
c. Coal mining d. Thorium mining

14. The coal with highest ash content is ….
a. Lignite b. Steam coal c. Coking coal d. Bituminous coal

15. In a nuclear power reactor, the function of the moderator is to …
a. absorb neutrons b. reduce the speed of neutrons
c. stop the chain reactions d. provide additional fuel if required

16. The following is not an unconventional source of Natural gas….
a. Indirect Liquefaction b. Coalbed methane
c. Geopressurized zones d. Methane hydrates

17. In …. exploration a magnetometer is used to determine the strength of the earth's magnetic field at a specific point on the earth's surface.
a. magnetic b. gravitational c. seismic d. sonic

18. …… is the most commonly used molten metal for cooling nuclear reactors.
a. Sodium b. Calcium c. Mercury d. Zinc

19. ……. has become the de facto international oil benchmark.
a. Dubai Crude b. West Texas Intermediate
c. Brent Blend d. Arab Light

20. For use as a gasoline or motor fuel, the octane number of the finished product should be …
a. >57 b. <40 c. >87 d. < 67

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Year : III
Time : 2 hrs. 30 mins.

Course : CHEG 321
Semester : II
F. M. : 40

SECTION "B"
[5Q. × 8 = 40 marks]

Attempt *ANY FIVE* questions. Assume necessary data if required.

1. a. Draw the power curve for a wind turbine and explain the terms cut in speed, rated speed, cutout speed and stall. [4]

   b. At a particular hydropower site, the mean monthly discharge is given in table 1, draw the hydrograph and flow duration curve for the system. [4]

Table 1: Monthly discharge of a site

Month	Discharge (m^3/s)	Month	Discharge (m^3/s)
January	100	July	1000
February	225	August	1200
March	300	September	900
April	600	October	600
May	750	November	400
June	800	December	200

2. a. What does turbine governing mean? Explain any one governing mechanisms adopted for Pelton turbine. [2]

   b. A village health post requires a photovoltaic system for the operation of the dc appliance being used. Determine the size of PV array and battery for the system. Assume your own load for the two rooms of the health post. [4]

   c. What is a concentrating solar power (CSP) system? Describe any one type of CSP systems in practice. [2]

3. a. Describe the different mining techniques adopted for extraction of Coal. [4]

   b. What is logging of Natural gas? Explain five types of loggings adopted for Natural Gas. [4]

4. a. Differentiate between a battery and a super-capacitor. Draw their characteristic curves and provide details of one practical application for each. [4]

   b. Explain different techniques adopted for harnessing geothermal energy. [4]

5. a. With a suitable diagram of a Nuclear power reactor describe the different components of the reactor. [4]

b. What is bioethanol? Describe any one approach for converting corn to bioethanol. [2]

c. Energy from sea waves can be harnessed to produce electricity. Describe any two methods for electricity production from sea waves. [2]

6. a. Explain the four basic operations for crude oil refining. [4]

b. A community of ten families is to be electrified by a biogas power plant. The expected electrical load of one family is as presented in table 2 below. Determine the size of a biogas generator to meet the expected load. Also determine the cattle requirement for the plant and the volume of the biogas digester to be used. Refer the table 3 for design parameters of the bio-gas plant. [4]

Table 2: Electrical load of a family of the community

Load	Power (W)	Quantity	Operating hours
Lamp	10	3	6
Mobile charger	5	2	4
TV (color)	160	1	4

Table 3: Bio-gas plant design considerations

S.N.	Parameters	Value
1	1kWh electrical energy	0.56m^3 of biogas
2	1kg of fresh cow dung	40 liters of biogas
3	Digestion temperature	20-35
4	Retention time (HRT)	30 days
5	Biogas energy content	6kWh/m^3
6	One cow yield	10 kg dung/day
7	One ox yield	12 kg dung/day
8	One buffalo yield	15 kg dung/day
9	One pig yield	2 kg dung/day
10	Gas production per kg dung for all	0.04 m^3
11	Gas requirement for cooking	0.25 m^3/person
12	Gas requirement for lighting one lamp	0.125 m^3/hour