

KATHMANDU UNIVERSITY  
End Semester Examination  
August/September, 2017

Mark Scored:

Level : B. Sc.

Year : II

Exam Roll No. :

Time: 30 min

Course : PHYS 207

Semester : II

F. M. : 20

Registration No.:

Date

SEP 07 2017

SECTION "A"

[10 Q × 1 = 10 marks]

Choose and tick the most appropriate answer.

- Irradiation (insolation) is defined as
  - the incident radiant energy on a surface
  - the rate at which radiant energy is incident on a surface
  - the incident radiant energy per unit area on a surface over a specified time
  - the rate at which radiant energy is incident on a surface per unit area of the surface
- At the hill and mountain sides,
  - the air above the slopes heats up during the day and cools down at night more rapidly than the air above the low lands which causes the air to rise along the slopes during the day and flow down at night.
  - the air above the slopes heats up during the day and cools down at night more rapidly than the air above the low lands which causes the air to flow down during the day and rise along the slopes at night.
  - the air above the low lands heats up during the day and cools down at night more rapidly than the air above the slopes which causes the air to rise along the slopes during the day and flow down at night.
  - the air above the low lands heats up during the day and cools down at night more rapidly than the air above the slopes which causes the air to flow down during the day and rise along the slopes at night.
- If the average wind power density  $\bar{P}/A$  is greater than  $700 \text{ W/m}^2$ , then the wind resource is considered as
  - poor
  - average
  - good
  - great
- A tidal power plant with a basin area of  $10^6 \text{ m}^2$  starts operating in a tide of range 12 m. Assume that the average sea water density is about  $1025 \text{ kg/m}^3$  and the acceleration due to gravity is about  $9.81 \text{ m/s}^2$ . If the power plant stops operating when the head on it falls below 3 m, the average power generated in one emptying process is about
  - 12.3 MW
  - 20.3 MW
  - 30.2 MW
  - 41.8 MW
- If  $\rho$  is the water density,  $g$  is the acceleration due to gravity, 'a' is the amplitude,  $\lambda$  is the wavelength,  $L$  is the width of the wave perpendicular to the direction of propagation of the wave and  $f$  is the frequency, then the power per unit width of the wave is given by
  - $\frac{1}{2} \rho g a^2 f$
  - $\frac{1}{2} \rho g a^2 L f$
  - $\frac{1}{2} \rho g a^2 \lambda f$
  - $\frac{1}{2} \rho g a^2 \lambda L f$
- The hardest form of coal is
  - peat
  - lignite
  - bitumin
  - anthracite
- H:C ratio in natural gas is
  - less than 0.5
  - between 0.8 – 1
  - between 1 – 1.75
  - more than 2

8. Hydroelectric power plants having generation capacity less than 10 MW and more than 100 kW are called  
 [a] picohydro plant [b] minihydro plant  
 [c] microhydro plant [d] large hydro plant
9. In a nuclear reaction  ${}_{92}\text{U}^{235} + {}_0n^1 \rightarrow {}_{56}\text{Ba}^{141} + {}_{36}\text{Kr}^x + 2{}_0n^1 + Q$ , the value of x should be  
 [a] 72 [b] 89 [c] 90 [d] 92
10. Thermal neutrons are  
 [a] fast neutrons [b] moderately fast neutrons  
 [c] slow neutrons [d] exceptionally fast neutrons

SECTION "B"  
 [10 Q. × 1 = 10 marks]

Fill in the blanks.

1. The zenith angle of the sun at Kathmandu (latitude  $27^\circ 42' \text{ N}$ ) at the winter solstice at 12:00 solar time is about \_\_\_\_\_ (degrees).
2. The day length at Kathmandu at the summer solstice is about \_\_\_\_\_ (hours).
3. The rock occurring at moderate depths but to which water does not have access, either because of the absence of ground water or the low permeability of the rock, is called the \_\_\_\_\_.
4. For temperature difference  $\Delta T = 18 \text{ K}$  and warm ocean surface water temperature  $T_h = 27^\circ\text{C}$  (300K) with  $\rho = 1 \times 10^3 \text{ kg/m}^3$  and  $C = 4.2 \times 10^3 \text{ J/kg/K}$ , the flow rate required to yield 1 MW of electricity output from an ideal heat engine is about \_\_\_\_\_  $\text{m}^3/\text{s}$ .
5. Biochemical conversion (wet processes) takes two forms which are fermentation and \_\_\_\_\_.
6. A fuel cell converts \_\_\_\_\_.
7. The nature of the current developed in MHD generator is \_\_\_\_\_.
8. The neutral temperature of a thermocouple is defined as the temperature at which the thermo EMF \_\_\_\_\_.
9. The amount of energy released per fission of U-235 atom is 200 MeV. The energy released when 1 gm of uranium undergoes nuclear fission will be equal to \_\_\_\_\_ Joules.
10. A hydroelectric plant has a discharge of  $200 \text{ m}^3/\text{s}$  and the head of the water 100 m. If the efficiency of the turbine alternator is set to 0.85, the power generated is equal to \_\_\_\_\_ MW.

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Semester : II  
F. M. : 55

SECTION "C"

[5 Q. × 4 = 20 marks]

1. Discuss the geothermal resources. Draw a schematic diagram of heat extraction from a hot dry rock (HDR) system.

OR

With a labeled diagram, explain the basic principle used in energy from tides (tidal energy). Define the terms spring tide, neap tide and tidal range.

2. Derive an expression for the power per unit area of the surface from the ocean wave.

OR

What is the basic principle of ocean thermal energy conversion (OTEC)? Draw a schematic diagram of an OTEC system and determine the maximum output of mechanical power one can obtain from the system.

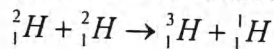
3. Explain briefly the process of formation of different coals and also mention their calorific values. Describe the basic physical process of coal cleaning with the help of a block diagram.

4. Explain the differences between an impulse turbine and a reaction turbine used in hydropower.

OR

What is Seebeck thermoelectric effect? Describe briefly a thermoelectric power generator with the help of a labeled diagram.

5. What is mean by mass defect and binding energy? Calculate the mass defect and energy released in the following nuclear fusion reaction



(Given  ${}^2_1\text{H} = 2.014102 \text{ a.u.}$ ,  ${}^1_1\text{H} = 1.007825 \text{ a.u.}$  and  ${}^3_1\text{H} = 3.0161 \text{ a.u.}$ )

SECTION "D"

[5 Q. × 7 = 35 marks]

6. Define the term irradiance. How do you convert the local standard clock time into solar time by applying two corrections? What is  $H_0$ , the day's solar radiation on a horizontal surface in the absence of the atmosphere, at latitude  $43^\circ \text{ N}$  on April 15? ( $G_{sc} = 1353 \text{ W/m}^2$ )

OR

With a labeled diagram, discuss the non-concentrating or flat plate solar energy collector with its applications and advantages. Explain the environmental impacts of solar energy systems.

7. What do you mean by biomass? Explain the different types of biomass conversion technologies. Discuss the environmental impacts of biomass.

8. Discuss the cup anemometers and propeller anemometers. Derive an expression for the thrust on turbines.

OR

Discuss the local winds and planetary winds. With a labeled diagram, explain the principal subsystems of a typical horizontal axis wind turbine (HAWT).

9. Describe area-velocity method for the measurement of discharge in a river. An environmental agency measures the average velocity of the flow in a river to be 1.5 m/s where it is 1 m deep and 5 m wide. (a) What is the flow rate? (b) Just downstream, in a narrower part of the river it is 2 m wide and 0.5 m deep. What is the flow rate and average velocity there?

OR

Draw schematic diagram of an MHD power generating system and explain its working principle. What are the major advantages of a MHD power generator? A typical MHD generator has the following specifications. Calculate the maximum power generated by the system.

Electrical conductivity of the working fluid ( $\sigma$ ) = 50 mho/m

Area (A) = 2 m<sup>2</sup>

Plate separation (d) = 0.2 m

Velocity (v) = 1000 m/s

Magnetic flux (B) = 2.5 Wb/m<sup>2</sup>

10. Describe a nuclear chain reaction with example. What is neutron multiplication number? Explain critical, sub-critical & supercritical states of chain reaction. A nuclear power plant generates 400 MW of electrical power on an average. The power plant has an efficiency 40% and uses U-235 as fuel. Calculate the amount of fuel required for one day's operation of the plant. (Assume that the energy released per fission of U-235 is 200 MeV)