Mark scored :

KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2017

Level : B. Sc. (AP)
Year : IV
Course : PHYS 431
Semester : II
Exam Roll No. :
Time : 30 mins.
F.M. : 20
Registration No.:
Date : AUG 24 2017

SECTION "A"
[10 Q. × 1 = 10 marks]

Choose and tick the most appropriate answer.

1. Solar azimuth angle is defined as
   [a] the angular displacement from south of the projection of beam radiation on a horizontal surface, east of south negative and west of south positive.
   [b] the angular displacement from south of the projection of beam radiation on a horizontal surface, east of south positive and west of south negative.
   [c] the deviation of the projection on the horizontal surface of the normal to the surface from the local meridian with zero due south, east negative and west positive.
   [d] the deviation of the projection on the horizontal surface of the normal to the surface from the local meridian with zero due south, east positive and west negative.

2. The terms which describe the position of the sun in the sky are
   [a] hour angle, zenith angle and solar altitude angle
   [b] slope, solar altitude angle and solar azimuth angle
   [c] zenith angle, solar altitude angle and solar azimuth angle
   [d] zenith angle, solar altitude angle and surface azimuth angle

3. In a typical horizontal axis wind turbine (HAWT), the machine bedplate or main frame
   [a] is required to keep the rotor shaft properly aligned with the wind
   [b] consists of the tower structure and supporting foundation of the turbine
   [c] protects the drive train components, generator and controls from the weather
   [d] provides for the mounting and proper alignment of the drive train components

4. If ρ is the water density, g is the acceleration due to gravity, 'a' is the amplitude, λ 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 length of the wave is given by
   [a] $\frac{1}{2}\rho g a^2 f$ [b] $\frac{1}{2}\rho g a^2 L f$ [c] $\frac{1}{2}\rho g a^2 \lambda f$ [d] $\frac{1}{2}\rho g a^2 \lambda L f$

5. The flow rate required to yield P watts from an ideal heat engine operating between the temperatures T_h and T_c is given by
   [a] $\frac{P T_h}{\rho C (T_h - T_c)}$ [b] $\frac{P T_c}{\rho C (T_h - T_c)}$ [c] $\frac{P T_h}{\rho C (T_h - T_c)^2}$ [d] $\frac{P T_c}{\rho C (T_h - T_c)^2}$

6. H: C ratio in the petroleum product is
   [a] more than 1
   [b] between 0.8 – 1
   [c] less than 0.5
   [d] between 1 – 1.75

7. If Q_1 is the actual flow through turbine and Q_2 is the flow supplied by the nozzle, then volumetric efficiency of the turbine is defined as

[a] $\frac{Q_1}{Q_2}$ [b] $\frac{Q_2}{Q_1}$ [c] $Q_1 \times Q_2$ [d] $\frac{Q_2 - Q_1}{Q_2}$

8. The product component missing in the nuclear fusion reaction ${}_1^2D + {}_1^3T \rightarrow ..... + {}_0^1n$ is

[a] ${}_1^1H$ [b] ${}_1^2H$ [c] ${}_2^4He$ [d] ${}_1^3H$

9. Which one of the following statements is true?
[a] rotor of impulse turbine usually rotates under water
[b] reaction turbines are more efficient than impulse turbines
[c] impulse turbines are more efficient than reaction turbines
[d] rotor of reaction turbine operates in atmospheric pressure

10. In a MHD power generator, the power produced per unit volume of the system depends on
[a] square of the gas velocity
[d] inverse square of the gas velocity
[b] square of the conductivity of working gas
[c] inverse square of the conductivity of working gas

SECTION "B"
[10 Q. × 1 = 10 marks]

Fill in the blanks.

11. The day length N_d at Kathmandu (latitude 27° 42' N) at the winter solstice is about _____ (hours).

12. Wind has a velocity of 10 m/s and the wind turbine has a diameter of 120 m. If air density is about 1.225 kg/m^3, then the maximum obtainable power density is about _____W/m^2.

13. Hyper-thermal regions have a temperature gradient of _____

14. The duration between successive neap tides is about _____ days.

15. Fermentation is the breakdown of complex molecules into organic compound under the influence of a _____

16. H_2CO is the basic molecule forming carbohydrate, stable at low temperature and breaks at high temperature releasing an amount of heat equal to _____ kcal/mole.

17. In a nuclear fission reactor if the neutron multiplication factor K is less than 1, then the reactor is said to be in _____ state.

18. The Lawson criteria for D-D fusion reaction is expressed as _____

19. The inversion temperature of a thermocouple is defined as the temperature at which the thermoelectric EMF _____

20. A pelton turbine is more suitable in hydroelectric plant with _____ discharge and _____ head.

KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2017

AUG 2 4 2017

Level : B. Sc. (AP)
Year : IV
Time : 2 hrs. 30 mins.

Course : PHYS 431
Semester : II
F. M. : 55

SECTION "C"
[5 Q. × 4 = 20 marks]

Attempt *ALL* questions.

1. What do you mean by geothermal energy? Discuss the geothermal resources.

OR

Define the terms spring tide and neap tide. A tidal power plant has a basin area of 3×10^6 m^2. The tide has a range of 12 m. The turbine, however, stops operating when the head on it falls below 3 m. Calculate the average power generated in one emptying process.

2. With a labeled diagram, discuss the dolphin-type wave-power machine (wave-energy conversion device).Write down the advantages and disadvantages of ocean wave energy?

OR

What do you mean by biomass? Discuss the different types of biomass conversion technologies.

3. Write a short note on the environmental impact associated to mining, transport and use of fossil fuels.

4. Describe a H_2-O_2 fuel cell with a well labeled diagram. Explain the advantages of such cell compared to other sources of energy.

5. Describe nuclear fusion reaction with a suitable example. Find the energy released in the reaction ${}_1^2H + {}_1^2H \rightarrow {}_1^3H + {}_1^1H$.
(Given ${}_1^2H = 2.014102\ a.u.$, ${}_1^1H = 1.007825\ a.u.$ and ${}_1^3H = 3.0161\ a.u.$)

OR

In a hydroelectric power plant, water flows from a lake through a pipe to a turbine 90 m below the dam.
(a) What is the potential energy of 1 m^3 of water at the top of the pipe?
(b) If the overall station efficiency is 80% and water flow rate is 1000 m^3/hr, what is the power output from the station?

SECTION "D"
[5 Q. × 7 = 35 marks]

Attempt *ALL* questions.

6. How do you convert the local standard clock time into solar time by applying two corrections? Determine the average value of solar radiation on a horizontal surface for June 22, at the latitude of 10°N, if constants 'a' and 'b' are given as equal to 0·30 and 0·51 respectively, and the ratio $\bar{n}/\bar{N} = 0\cdot55$. ($G_{sc}$ = 1353 W/m^2)

OR

With a labeled diagram, discuss the non-concentrating or flat plate solar energy collector with its applications and advantages. What is the difference between a solar pond and an ordinary homogeneous pond? Explain briefly the construction and working of a solar pond.

7. Derive an expression for the thrust on turbines. Discuss the classification of wind energy collectors.

OR

What are the environmental impacts of wind energy systems? With a labeled diagram, discuss the principal subsystems of a typical horizontal axis wind turbine (HAWT).

8. 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. Also, discuss the environmental impacts of OTEC systems.

9. Draw schematic diagram of an MHD power generating system and explain its working principle. Deduce the expression for maximum power generated per unit volume of a MHD system. What are the major advantages of a MHD power generator?

OR

Write short notes on
(a) Thermoelectric power generation
(b) Area-velocity method for the measurement of flow rate

10. What is binding energy? What is its importance with reference to nuclear fission and fusion? A nuclear reactor has a heat generation rate of 200 MW. How many atoms of U-235 will be needed per second to be fissioned? If the fuel core contained 60 kg of U-235, what fraction should have been used after 50 days of operation?
(Assume that the energy released per fission of U-235 = 200 MeV)