KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.Sc.
Year : III

Course : ESEE 309
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 23 FEB 2025

SECTION "A"

[20 Q. × 1 = 20 marks]

Choose and encircle the most appropriate option from each set of choices

1. Which of the following is a disadvantage of wind energy?
   a. High initial cost
   b. High carbon footprint
   c. Requires large amounts of water
   d. Limited to specific geographic regions

2. In which type of biomass energy conversion process is organic matter directly burned to produce energy?
   a. Combustion
   b. Gasification
   c. Fermentation
   d. Pyrolysis

3. Which of the following is the most efficient type of wind turbine for residential use?
   a. Horizontal axis wind turbine
   b. Vertical axis wind turbine
   c. Offshore wind turbine
   d. High-altitude wind turbine

4. The efficiency of a photovoltaic solar panel is typically around:
   a. 5-10%
   b. 15-25%
   c. 30-40%
   d. 50-60%

5. Which of the following is a major environmental benefit of renewable energy sources?
   a. Reduced greenhouse gas emissions
   b. Reduced water usage
   c. Reduced deforestation
   d. Reduced air pollution

6. Which of the following is a primary challenge for large-scale solar energy adoption?
   a. Lack of sunlight
   b. Energy storage
   c. High maintenance costs
   d. Limited materials

7. What is the main purpose of a battery storage system in renewable energy applications?
   a. To generate additional energy
   b. To convert electrical energy into heat
   c. To store excess energy for later use
   d. To reduce system efficiency

8. Which of the following is an example of a second-generation biofuel?
   a. Ethanol from corn
   b. Biodiesel from soybeans
   c. Biomethane from landfills
   d. Ethanol from algae

9. Which renewable energy source is most suitable for providing baseload power?
   a. Biomass Energy
   b. Solar Energy
   c. Wind Energy
   d. Tidal Energy

10. What type of solar technology uses mirrors or lenses to concentrate sunlight and generate heat?
   a. Solar Photovoltaic
   b. Concentrated Solar Power
   c. Solar Thermal
   d. Passive Solar Heating

11. The capacity factor of a renewable energy plant measures:
    a. The energy efficiency of the system
    b. The total energy output over a period of time
    c. The ratio of actual energy output to maximum possible energy output
    d. The carbon emissions produced by the system

12. What is the primary reason geothermal energy is not widely used in certain areas?
    a. Geothermal sites are geographically limited
    b. High upfront capital costs
    c. High availability of resources
    d. Environmental concerns

13. Which of the following is true about biofuels?
    a. They are made from food crops
    b. They contribute to a net increase in carbon emissions
    c. They are made from organic matter and waste products
    d. They do not require land use or water

14. What is the main function of a photovoltaic inverter?
    a. To convert DC electricity to AC electricity
    b. To store energy
    c. To track sunlight
    d. To increase panel efficiency

15. What is the primary challenge in scaling up hydrogen fuel cell technology for widespread use?
    a. Limited hydrogen availability
    b. High production costs
    c. Lack of suitable storage infrastructure
    d. Low efficiency

16. Which of the following is the key environmental concern associated with large-scale hydropower?
    a. Greenhouse gas emissions
    b. Water scarcity
    c. Disruption of local ecosystems
    d. Access road construction

17. Which of the following is the primary function of an energy storage system in renewable energy applications?
    a. To reduce energy consumption
    b. To store excess energy for later use
    c. To generate electricity
    d. To convert AC electricity to DC

18. Which of the following energy storage technologies stores energy in the form of potential energy?
    a. Flywheel Energy Storage
    b. Lithium-ion Batteries
    c. Pumped Hydro Storage
    d. Supercapacitors

19. What is the main advantage of using lithium-ion batteries for energy storage?
    a. High energy density
    b. Low cost
    c. Long cycle life
    d. Ability to store large amounts of energy

20. How does climate change potentially affect HDI rankings of countries?
    a. Climate change has no effect on HDI rankings.
    b. Countries heavily impacted by climate change may see a decline in life expectancy and income, lowering their HDI.
    c. Climate change primarily affects education, not life expectancy or income.
    d. HDI rankings automatically improve with climate change due to technological advancements.

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F. M. : 55

SECTION "B"

Attempt ALL questions. Assume the necessary data wherever required.

1. Write down any two adverse and beneficial impacts of hydrogen energy.
A family with 8 members plans to install a solar water heater which is mainly used for bath. The hot-water temperature required for bath is 35 °C, while the annual average temperature of cold water is 22 °C. Assuming that each person needs 80 liters of hot water for taking bath a day and there is a certain solar panel which can offer a heat supply of 1720 Kcal/m^2 in a day, Calculate:
   a. how much heat should be provided by the solar water heater to satisfy the family's demand for bath?
   b. the minimum heat demand
   c. the required installation area of solar panel in absence of auxiliary heating device.

   [4+3]

2. Design a Solar PV system to supply a constant power for telecommunication equipment of 950 Watt for 24 hours a day. The operating voltage of equipment is 48V DC. Given peak sun hour is 4.5 hours and DOA 3 days. Assume other suitable data whenever is necessary. Also, draw the installation layout of the system. [7]

3. Select an appropriate PV pump and design PV array system (with figure) for a water supply system for a village for a decade with following data: [7]
   a. population of people = 250 (average water consumption 25 lpcd) with increment rate of 2%.
   b. population of cattle = 50 (average water consumption 40 lit/day/cattle)
   c. monthly avg. solar insolation = 4.5 Kwh/m^2/day
   d. static head = 20 m
   e. draw down level = 3 m
   f. pipe friction loss = 0.5 m

4. Discuss the current state of renewable energy in Nepal, highlighting the major sources of renewable energy being utilized, the challenges faced in their development and implementation, and the potential opportunities for scaling up renewable energy solutions in the country. In your answer, consider both technical and socio-economic factors. [7]

5. List out the major components of hydropower with their working functions.
The power produced by a HP is 55.25 MW with net head of 32.59 m and overall efficiency of the plant 0.864. Calculate the discharge through the penstock pipe. If the plant has to increase its power by 25% to meet the peak load, calculate the increment percentage in discharge. [3+4]

P.T.O.

6. Examine the environmental and health hazards associated with emissions from fossil fuel combustion, the disposal and recycling challenges of batteries, and the risks posed by nuclear energy. In your answer, discuss the potential long-term impacts of each hazard, along with possible mitigation strategies to reduce these risks in the context of sustainable energy development. [7]

7. Discuss the factors that influence the efficiency of wind energy conversion in large-scale wind farms. A wind turbine has a rotor diameter of 40 meters and is located in an area where the average wind speed is 10 m/s. The air density is 1.225 kg/m^3, and the coefficient of performance (Cp) of the turbine is 0.4. Calculate the electrical power generated by the wind turbine. [3+4]

8. Write short notes on (***ANY TWO***): [2×3 = 6]
   a. UNFCCC
   b. Biofuels
   c. Current energy status in Nepal