

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2025

Marks Scored:

Level : B.E.

Course : MEEG 141

Year : I

Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 15 APR 2025

SECTION "A"

[20Q. × 1 = 20 marks]

Choose the most appropriate answer and **Mark [X]**.

1. Energy is defined as _____.
 the capacity to perform work a form of matter
 a measure of mass the potential to generate heat
2. In a steam power plant, the process that increases coal's calorific value by enhancing its carbon content is known as _____.
 Combustion Oxidation Coalification Condensation
3. In power plant terminology, the abbreviation FLH stands for _____.
 fuel level heating frequency limiting hours
 fast load handling full load hours
4. The Brayton cycle, also known as the Joule cycle, is primarily associated with which type of power plant?
 Steam Hydro Nuclear Gas turbine
5. A notable advantage of gas turbine power plants over steam power plants is that they _____.
 require extensive cooling system can be constructed more rapidly
 operate solely on fossil fuels produce higher baseline efficiencies
6. Ancillary services in grid operations are implemented to _____.
 facilitate new power plant construction ensure grid stability and reliability
 increase consumer billing rates manage renewable energy installations
7. Which of the following is a primary environmental impact associated with fossil fuel-based energy systems?
 reduced greenhouse gas emissions increased renewable resource utilization
 air pollution (SO₂ & NO_x included) minimal water contamination
8. Which international agreement is central to global efforts to limit global warming and has significantly influenced energy policy?
 Paris Agreement Montreal Protocol
 Kyoto Protocol Basel Convention
9. In the sequential transformation of organic matter during coalification, which of the following correctly orders the stages?
 Peat → lignite → bituminous → anthracite
 Lignite → bituminous → anthracite → peat
 Anthracite → bituminous → lignite → peat
 Bituminous → anthracite → lignite → peat

10. During the coalification process, the original volume of the organic material typically reduces to approximately _____ percent of its initial volume.
 100 50 10 5
11. A detailed energy audit is characterized by _____.
 exclusive rapid inspections
 comprehensive data collection, measurement and financial analysis
 a focus exclusively on utility bills
 minimalist site inspection
12. When a gas turbine power plant incorporates a preheater and operates at approximately 1250°C, the efficiency increases from 22% to approximately _____ percent.
 30 35 40 45
13. Frequency regulation, as an ancillary service in grid operations, primarily ensures that the grid maintains a stable operating frequency by _____.
 adjusting voltage levels only increasing power plant outputs
 reducing overall energy consumption balancing supply and demand
14. In an energy audit, _____ is most appropriate device to detect insulation deficiencies and heat losses.
 Pressure gauge Ultrasonic leak detector
 Thermal camera Flow meter
15. In a solar farm, the stage during which the direct current produced by photovoltaic panels is converted to alternating current for grid integration is known as the _____ stage.
 combustion inversion compression filtration
16. Determine the approximate power output when the grid frequency is 50 Hz and the motor torque is 40 Nm, with a constant factor of approximately 6.28.
 6,280 W 12,560 W 3,140 W 25,120 W
17. In an energy audit scenario, if a facility's winter heating cost is \$5,000 and the summer cooling cost is 40% higher, what is the summer cooling cost?
 \$5,000 \$6,000 \$7,000 \$7,500
18. A gas turbine power plant's efficiency improves from 22% to 40% after implementing a preheater. The absolute increase in efficiency is _____ percentage points.
 18 22 40 62
19. What factor primarily increases the efficiency of a steam power plant?
 temperature speed volume density
20. Which factor decreases when grid frequency drops?
 power voltage resistance current

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2025

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

Course : MEEG 141
Semester : I
F. M. : 55

15 APR 2025

SECTION "B"

[2Q. × 10 = 20 marks]

1. You are assigned to conduct an energy audit for a manufacturing facility experiencing high energy consumption. In your answer, describe the following:
 - a. The key steps in planning and executing the energy audit.
 - b. How you would identify inefficiencies and propose energy conservation measures.
 - c. A numerical analysis: if the facility's monthly energy bill is \$20,000 and energy efficiency improvements can reduce consumption by 15%, determine the expected monthly cost savings.

2. Three power generation systems have the following specifications:

System	Rated Capacity (MW)	Annual Energy Output (MW.hr)
A (Baseload)	500	3,250,000
B (Medium Load)	300	1,200,000
C (Peak Load)	100	100,000

The demand ranges from a minimum of 50 MW at night to a maximum of 100 MW during peak hours (e.g., morning and evening).

- Calculate the Full Load Hours (FLH) for each system and state whether the resulting values qualify as baseload, medium-load, or peak-load.
- Based on the calculated FLH and draw a demand profile (50–100 MW), indicate how Systems A, B, and C would be dispatched throughout a typical 24-hour period. Draw a typical 24-hour load curve, assigning:
 - Base-load (Accordingly)
 - Medium-load required from 8:00 AM to 12:00 PM.
 - Peak-load required from 9:00 AM to 10:00 AM

SECTION "C"

[3Q. × 5 = 15 marks]

3. Explain the working principle of a wind turbine. Describe how wind energy is converted into electrical energy, highlighting key components.
4. What are ancillary services in electricity grids? List and briefly explain any two types of ancillary services that help maintain grid stability and reliability.
5. Describe the Brayton (Joule) Cycle in a gas turbine power plant. Outline its four main processes and explain why gas turbines operate at high temperatures and pressures.

P.T.O.

SECTION "D"

[5Q. × 4 = 20 marks]

6. Differentiate between impulse turbines and reaction turbines.
7. A wind turbine has a blade radius of 5 meters and operates in wind with a speed of 8 m/s. Given that the air density is 1.225 kg/m^3 and the efficiency factor is 40%, calculate the power output of the wind turbine
8. Differentiate centralized and decentralized grids.
9. Describe an Investment-Grade Audit (IGA)
10. List any four types of renewable energy and briefly describe one benefit of using renewable energy over fossil fuels.