



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS FOR:

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE: 4408 ELECTRICAL POWER SYSTEMS I

END-OF-SEMESTER EXAMINATION

SERIES: JULY 2025

TIME: 2 HOURS

DATE: July 2025

Instructions to Candidates

It would be best if you had the following for this examination

-Answer Booklet, examination pass, and student ID

This paper consists of FIVE questions. Attempt **Question ONE plus any other TWO Questions**

Do not write on the question paper.

Question ONE 30 -MARKS (COMPULSORY)

- a) Using a block diagram, describe the components of a steam power plant (8 marks)
- b) A diesel power station has the following data :
- Fuel consumption/day = 1000 kg
- Units generated/day = 4000 kWh
- Calorific value of fuel = 10,000 kcal/kg
- Alternator efficiency = 96%
- Engine mech. Efficiency = 95%
- Estimate;
- Specific fuel consumption,
 - Overall efficiency
 - Thermal efficiency of engine (12 marks)
- c) Explain the operations of the following water turbines
- Pelton wheel
 - Kaplan turbine (8 marks)

d) State any TWO disadvantages of gas power plants

(2 marks)

Question TWO

a) A generating station has a maximum demand of 25MW, a load factor of 60%, a plant capacity factor of 50%, and a plant use factor of 72%. Find

- i. The daily energy produced
- ii. The maximum energy that could be produced daily if the plant were fully loaded while running as per schedule.

(8 marks)

b) The annual working cost of a power station is represented by the formula Rs $(a + b \text{ kW} + c \text{ kWh})$, where the various terms have their usual meaning. Determine the values of a, b, and c for a 60 MW station operating at an annual load factor of 50% from the following data :

- i. Capital cost of building and equipment is Rs 5×10^6
- ii. The annual cost of fuel, oil, taxation, and wages of operating staff is Rs 900,000
- iii. The interest and depreciation on building and equipment are 10% per annum
- iv. Annual cost of organization and interest on cost of site, etc., is Rs 500,000:

(12 marks)

Question THREE

a) State any TWO reasons for power factor improvement

(2 marks)

b) Discuss any THREE causes of low power factors

(6 marks)

c) A station supplies 250 kVA at a lagging power factor 0.8. A synchronous motor is connected in parallel with the load. If the combined load is 250 kW with a lagging p.f. of 0.9, determine:

- i. The leading kVAR taken by the motor.
- ii. kVA rating of the motor.
- iii. P.F. at which the motor operates.

(12 marks)

Question FOUR

a) Define the term tariff

(2 marks)

b) Explain the following types of tariffs used in power systems

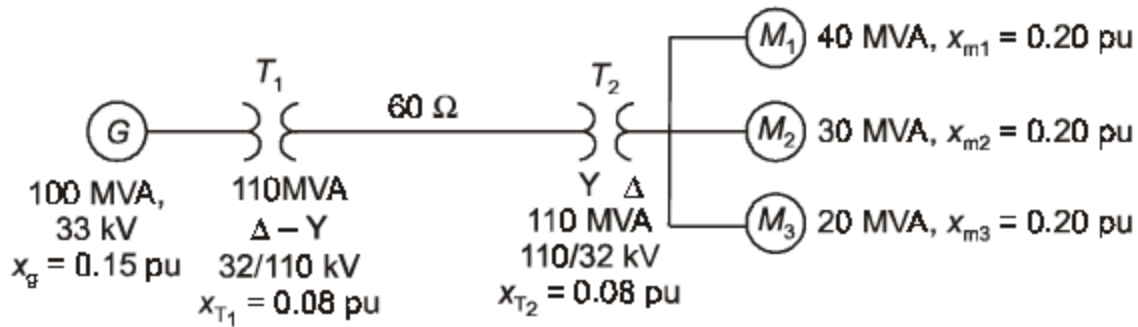
- i. kVA maximum demand tariff
- ii. Sliding scale tariff
- iii. kW and kVAR tariff

(6 marks)

- c) A consumer has an annual consumption of 2×10^5 units. The tariff is Rs 50 per kW of maximum demand plus 10 paise per kWh.
- Find the annual bill and the overall cost per kWh if the load factor is 35%.
 - What is the overall cost per kWh if the consumption were reduced by 25% with the same load factor
 - What is the overall cost per kWh if the load factor were 25% with the same consumption as in (i) above
- (12 marks)

Question FIVE

- Describe the structure of the power system, giving details of specific voltages at each stage (8 marks)
- A 100 MVA, 33 kV, three-phase generator has a reactance of 15%. The generator is connected to motors through a transmission line and transformers, as shown in the diagram below. The motors have rated inputs of 40 MVA, 30 MVA, and 20 MVA at 30 kV with 20% reactance each. Draw the per-unit circuit diagram



(12 marks)