



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING TECHNOLOGY

DEPARTMENT OF _____

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

**FOURTH YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR
OF TECHNOLOGY/BACHELOR OF EDUCATION TECHNOLOGY**

EET413: POWER SYSTEMS II

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer Question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a) Explain four qualities required of a circuit breaker (4marks)
- b) Define the following terms as applied to power system
- i. Insulation coordination (2marks)
 - ii. Economic dispatch (2marks)
 - iii. Transient stability (2marks)
- c) A single line diagram of a typical power system is shown in Fig.1 All the values are in per unit on a common base. The power delivered into the infinite bus (bus 2) is 1.0pu at unity power.
- i. Calculate the generated voltage (4marks)
 - ii. Obtain the swing equation for the power system (2marks)
- d) Explain the use of overhead ground wires as a protection scheme against overvoltages in a power transmission line. (4marks)
- e) i. discuss four important points to be taken into consideration while selecting the size and number of generating units in a power plant (4marks)
- ii. A transformer in a power station costs Kshs.1,560,000 and has a salvage of Kshs.60,000 at the end of 25 years. Determine the depreciated value of the transformer at the end of 20 years using straight line method (3marks)
- f) Classify Power system stability into its THREE broad categories and provide explanations for each (3marks)

SECTION TWO: ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

- a) Explain the principle of arc extinction in oil circuit breakers stating two advantages of using oil as _____ medium (9marks)
- b) A typical power system network is represented in fig.2. A three-phase fault occurs at point P with simultaneous opening of the breakers 1 and 2. The reactance values of

various components are indicated on the diagram. The generator is delivering 1.0pu power at the instant preceding the fault.

- i. Determine the expression for power angle equations before the fault, during the fault and after the fault. (8marks)
- ii. Draw the power angle curves for the power system. (3marks)

QUESTION THREE (20 MARKS)

- a) List THREE commonly used methods for determining the annual depreciation charge of a power station equipment (3marks)
- b) A proposed power plant has the following daily load cycle.

| | | | | | | | |
|---------------|-----|------|-------|-------|-------|-------|------|
| Time in Hours | 6-8 | 8-11 | 11-16 | 16-19 | 19-22 | 22-24 | 24-6 |
| Loading** | 20 | 40 | 50 | 35 | 70 | 40 | 20 |

- i. Plot the load curve and calculate the units generated per day (4marks)
 - ii. Select suitable generator units from the 10000,20000,25000 and 30000KVA (3marks)
- c) The fuel cost function for three thermal plants in \$/h are given by

$$c^1 = 561 + 7.92P_1 + 0.00156P_1^2$$

$$C_2 = 310 + 7.85P_2 + 0.00194P_2^2$$

$$C_3 = 78 + 7.97P_3 + 0.00482P_3^2$$

Where P_1, P_2 and P_3 are in Mw. The total operating load PD is 850mw. Neglecting line losses and generator limits, find the optimal economic dispatch and the total cost in \$/h by analytical method (10marks)

QUESTION FOUR (20 MARKS)

- a) Using a labelled circuit diagram, explain the construction and operating principle of a basis form of surge di_____ listing TWO types of such d_____ in general use. (6marks)
- b) With reference to ventral grounding.

- i. Illustrate the importance of system grounding particularly in the context of a distribution transformer.
- ii. Calculate the inductance and KVA rating of the Peterson coil used for earthing a 230kV, 50Hz, three-phase, 300 km transmission line having a capacitance to earth of 0.09 $\mu\text{f}/\text{km}$ per phase (5marks)
- iii. Discuss THREE commonly used methods for grounding the neutral point of a three-phase system. (6marks)