



**Strathmore**  
UNIVERSITY

**STRATHMORE UNIVERSITY**  
**SCHOOL OF COMPUTING AND ENGINEERING SCIENCES**  
**MASTER OF SUSTAINABLE ENERGY TRANSITION**  
**MSSET 8103: POWER SYSTEMS FUNDAMENTALS**

**DATE: 13<sup>th</sup> DECEMBER 2024**

**TIME: 18:00-18:30 HOURS**

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**INSTRUCTIONS**

1. This examination contains **FOUR** questions.
  2. Attempt **Question ONE (COMPULSORY)** and any other **TWO** questions
  3. All workings should be shown clearly.
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**QUESTION ONE**

**[20 MARKS]**

- a) Explain how the following shifts have played a critical role in the modern power systems.
  - i. Distributed Generations
  - ii. Plummeting Prices of Renewables
  - iii. Electric Mobility
  - iv. Flexible Tariff **[8 marks]**
- b)
  - i) Give the main components of an overhead transmission line.
  - ii) Briefly explain the effect of increasing the electrical loading of a transmission line on the clearance between the line conductors and the earth surface. **[5 marks]**
- c) Discuss the ways in which the negative Impacts of variable renewable energy systems (VRES) can be mitigated as they are integrated in conventional power systems **[7 marks]**

**QUESTION TWO****[15 MARKS]**

a) The daily demands of three consumers are given below:

Time	Consumer 1	Consumer 2	Consumer 3
12 midnight to 8 A.M.	No load	200 W	No load
8 A.M. to 2 P.M.	600 W	No load	200 W
2 P.M. to 4 P.M.	200 W	1000 W	1200 W
4 P.M. to 10 P.M.	800 W	No load	No load
10 P.M. to midnight	No load	200 W	200 W

Plot the load curve and find

- (i) Maximum demand of individual consumer
- (ii) Load factor of individual consumer
- (iii) Diversity factor and
- (iv) Load factor of the station.

**[10 marks]**

b) A 3-phase, 4-wire, 400 V, 50 Hz system has a balanced 3-phase motor load of 20 kW at 0.8 power factor (*pf*) lagging and three single-phase loads connected in phases A, B, and C drawing 25 A at unity *pf*, 45 A at 0.9 *pf* leading, and 25 A at 0.8 *pf* lagging, respectively. Determine;

- i) The current in each line
- ii) The current in the neutral.

**[5 marks]****QUESTION THREE****[15 MARKS]**

- a) Discuss any two ways in which energy storage can be utilised in grid scale. Give example on where such applications can be best suitable **[8 marks]**
- b) One of the emerging trends in modern power systems is the growth of renewable energy systems.
  - i. What are the benefits of having renewable energy as part of the generation mix?
  - ii. Distinguish between Dry and Flash-steam Geothermal Power Plants **[7 marks]**

**QUESTION FOUR****[15 MARKS]**

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- a) Distinguish between variability and uncertainty as used in power systems in reference to renewable energy systems **[3 marks]**
- b) Investment in mini-grids is one of the trends in modern power system which have assisted in reaching the underserved communities especially in developing countries. There exist different ownership models for such solutions that have been used. Discuss the following ownership models giving applications examples, merits and demerits of each of them.
- (i) Community based ownership model
  - (ii) Privately owned mini-grid model
  - (iii) Anchor load-based model
  - (iv) Utility ownership model **[12 marks]**