Ministry of Higher Education
King Fahd University of Petroleum & Minerals
Electrical Engineering Department

وزارة التعليم العالي
جامعة الملك فهد للبترول و المعادن
قسم الهندسة الكهربائية

Semester 171- EE 306 Electromechanical Devices
Term Project

Design of Distribution Transformers to Meet Load Demand of Residential and Commercial Areas

1. Objective

The objective of this term project is to design and select the proper distribution transformers for residential and commercial areas.

2. Background

Transformers are used in virtually every commercial and residential building, from the service transformer reducing the distribution voltage to a more usable voltage for the building, to step-down transformers serving individual floors, to small transformers for individual apparatus or functions. Typically a transformer is a long-lived device that can be in service for decades.

Suppose you have got the job of designing the power distribution transformer for a residential and commercial areas. Both the residential and commercial areas are supplied by Saudi Electric Company (SEC) 13.8 kV substation.

Scenario I: Residential (supply voltage 230 V)

Given information

1. Load demand of residential area is provided in Table 1.
2. Assume a contingency factor of 20%. The contingency factors is for reasonable unplanned load growth and for future planned additional load.

Design Goal:

Design the suitable distribution transformers based on cost and reliability to meet the load demand including contingency factor and load shedding(i.e, during high demand, some load will be turned off to prevent total interruption of service). Usually 60% of loads in residential areas are air conditioners (AC) and will be selected as the portion of the load to be interrupted.

Table 1. Single Phase loads in the residential areas (The loads include single phase circuits and single phase AC motors)

S.N	Vload (V)	Iload (A)
1	230	4
2	230	8.6
3	230	13
4	230	26
5	230	41
6	230	47.5
7	230	56.5
8	230	62
9	230	69.5
10	230	82.5
11	230	91
12	230	95
13	230	110
14	230	126

Scenario II: Commercial (supply voltage 380 V)

Given information

1. Load demand of the commercial area is provided in Table 2.
2. Assume a contingency factor of 10%.

Design Goal:

Design two identical single phase distribution transformers (to be connected in parallel) each meeting the entire commercial load demand. Having two identical transformers helps the system to be more reliable, in case one of them fails, the other one takes the entire industrial load.

Table 2. Single phase Loads in the commercial areas

S.N	Vload (V)	Iload (A)
1	380	4.6
2	380	6.5
3	380	9.1
4	380	13
5	380	22.3
6	380	34.2
7	380	45.6
8	380	68.4
9	380	113
10	380	171
11	380	192
12	380	200
13	380	221
14	380	239

Notice: You can use the ratings and cost of distribution transformers provided in the appendix.

Appendix:

Rating and cost of distribution transformers available on the market

Manufacturer: Servostar

S.N	**Rating (KVA)**	**Cost (USD)**
1	25	1000
2	63	1200
3	100	3300
4	160	5000
5	200	5500
6	250	6000
7	315	6700
8	400	7400
9	500	10000
10	630	12000
11	1000	15400

Instructions:

- Students are encouraged to work in teams of two, where each team member would share equal grade.
- You are required to submit a written project report.
- Use formal title page of the report showing the names of team members and IDs.
- The final report should be computer generated one. Handwritten report will not be accepted in any case.
- The report should mention clear calculations, formulae used, and circuit diagrams with clear labeling.
- The report must describe the assumptions made, if any.
- Most importantly, a section "Discussions" should be added at the end of your report and a brief technical analysis of your calculations/project must be provided, e.g., you can give your recommendation to enhance the design.
- You can consult your course instructor if you have any confusion.
- You can assume some appropriate data, if you feel it's missing. However, wrong assumptions will be penalized.
- Finally, team members (group-mates) are highly encouraged to contribute equally within their own group but no team member/group is allowed to cross-communicate with other groups/members.

Grading:

- This project carries 5 marks in total. The report should clearly show the calculations used to design and select the distribution transformers. Late submission of the report will NOT be accepted.

Report Submission:

- The deadline for the submission of project report is:

  ST Classes: Tuesday, December 19, 2017

  MW Classes: Wednesday, December 20, 2017