UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE
Department of Electrical and Electronic Engineering

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SUPPLEMENTARY EXAMINATION

Title of the Paper:
Power Systems--EE452

Instructions:
1. The answer has to be written in the space provided in the question book. Consider only the material in the answer space be the answer. If need more space, the previous page is the best option. Use the answer book as a scratch pad. Both books must be marked with the student identity, and handed in
2. There are 5 questions in the question book, no choice.
3. Time Allowed: Three Hours.
4. This paper has 6 pages, including this page.

DO NOT OPEN THE PAPER UNTIL
PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

Q1, 20pts: Draw, on one line diagram, an electrical power service system of an overhead primary radial distribution, which must include and mark the equipments: breakers, step-down transformers, buses, transmission lines, and proper protection instruments.

Q2, 20pts: A Δ-Y connected 3-Φ transformer is loaded with an unbalanced 3-Φ resistive load, R_A=381, R_B=76.5, R_C=190.5 Ω. The transformer is ideal, 1 to 1 ratio, and the primary of it receives a balanced ideal 3-Φ power source, 220V. The circuit of the power system is shown in Fig. Q2-1. Find the primary source currents and their (the source currents) power flowing into the load side of each phase.
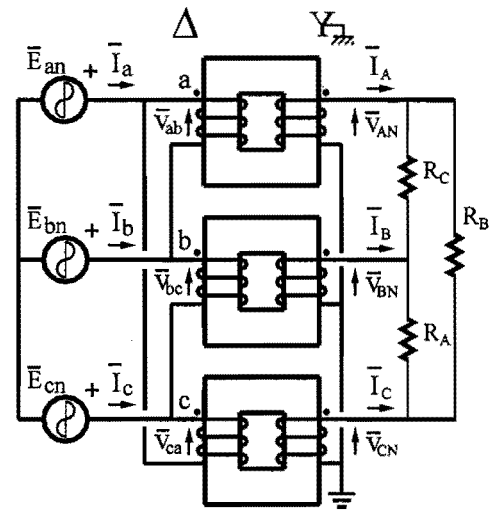
Transformers: ideal and 1:1

Fig. Q2-1

Q3, 20pts: A power service system shown in the Fig. Q3-1. The specs of its equipments are given below:

Fig. Q3-1

Generator A: 11 KV, 100 MVA, $x_A"=0.12$ pu

Generator B: Thevenin's equivalent to 69 KV, 20 MVA, $x_B"=0.08$ pu

Transformer: 11/69 KV, 75 MVA $x_T=0.1$ pu

Feeder Transmission line: 11 KV, 0.5 Ω
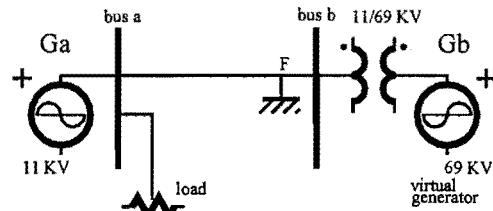
Fault at "F" spot, calculate the steady short circuit current.

Q4, 20pts: (i). Compute the inductance and the capacitance per KM of a transposed single phase line which has a bundling arrangement of 2 sub-conductors for each side as shown in Fig. Q4-1. Assume that the two sub-conductors carry equal current.
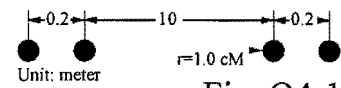

Unit: meter

Fig. Q4-1

Q5, 20pts: A simplified power protection system, 34.5 KV, 40 MVA load shown in Fig. Q5-1 consists of a recloser and fuses. These equipments are to manage short time and long time faults and to minimize power service interruption time. (i). Describe the recloser operating process, general action and delay time must be cited, (ii). With the given power fuse time characteristics in Fig. Q5-2, draw on the figure the recloser time characteristics to reach the objectives in the second sentence. Recloser action time and fuse time must be coordinated in-scale proportion for a fault current 500-1000 A.

Fig. Q5-1