UNIVERSITY OF RUHUNA

Faculty of Engineering

Take Home Assessment 1: Symmetrical Components & Unbalanced Faults

Module Number: EE6207 **Module Name: Power System Analysis**

This is a take home assignment which carries 5% marks. Please submit the scanned document to the provided link in LMS on or before 21st of September 2022, 11.55 pm.
Use both sides of your sheets to answer.

The handwritten answer script will be collected on 22nd of September 2022.

Q1. The single-line diagram of a three-phase power system is shown in Figure A. Equipment ratings are given as follows:

Synchronous generators:

G1	1000 MVA	15 kV	$X''_d = X_2 = 0.18, X_0 = 0.07$ per unit
G2	1000 MVA	15 kV	$X''_d = X_2 = 0.20, X_0 = 0.10$ per unit
G3	500 MVA	13.8 kV	$X''_d = X_2 = 0.15, X_0 = 0.05$ per unit
G4	750 MVA	13.8 kV	$X''_d = 0.30, X_2 = 0.40, X_0 = 0.10$ per unit

Transformers:

T1	1000 MVA	15 kV Δ/765 kV Y	X = 0.10 per unit
T2	1000 MVA	15 kV Δ/765 kV Y	X = 0.10 per unit
T3	500 MVA	15 kV Y/765 kV Y	X = 0.12 per unit
T4	750 MVA	15 kV Y/765 kV Y	X = 0.11 per unit

Transmission lines:

1–2	765 kV	$X_1 = 50\ \Omega,\ X_0 = 150\ \Omega$
1–3	765 kV	$X_1 = 40\ \Omega,\ X_0 = 100\ \Omega$
2–3	765 kV	$X_1 = 40\ \Omega,\ X_0 = 100\ \Omega$

The inductor connected to Generator 3 neutral has a reactance of 0.05 per unit using generator 3 ratings as a base.

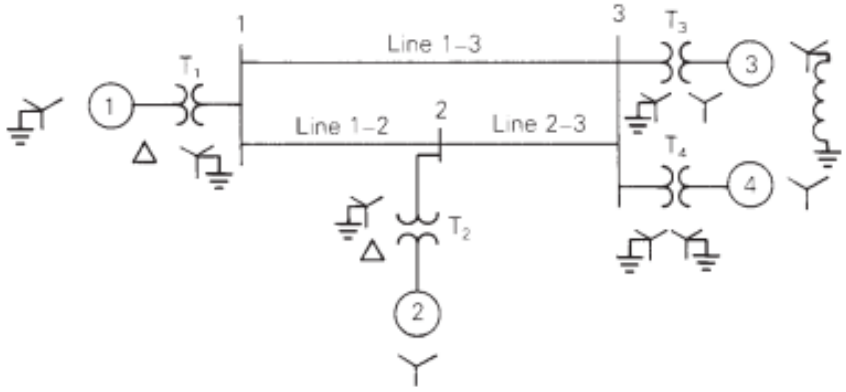

Figure A

(a) Draw the zero-, positive-, and negative-sequence reactance diagrams using a 1000 MVA, 765-kV base in the zone of line 1–2. Neglect the Δ–Y transformer phase shifts.

(b) Faults at bus 1 in above system are of interest. Determine the The´venin equivalent of each sequence network as viewed from bus 1. Pre-fault voltage is 1.0 per unit. Pre-fault load currents and Δ –Y transformer phase shifts are neglected.

(c) Hence, determine the sub-transient fault current in per-unit and in kA, as well as the per-unit line-to-ground voltages at the fault bus for a bolted single line-to-ground fault at bus 1 in above power system.

(d) Repeat above part (c) for a single line-to-ground arcing fault with arc impedance of $Z_F = 30 + j0\ \Omega$.