UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 7 Examination in Engineering: June 2015

Module Number: EE7240 **Module Name: Power System Analysis**

[Two Hours]

[Answer all questions, Q1 carries 5 marks and Q2 and Q3 carry 7.5 marks each]

Q1 a) Explain the importance of per unit calculations in power system analysis.

[0.5 Marks]

b) For the two bus system shown in Figure Q1, a three phase fault occurs at point F. Select S_{base} as 75 MVA and V_{base} in the primary side of the transformer T_1 as 11 kV. Determine,

i) the actual total three phase fault current at the fault point.

ii) fault level.

ii) the actual fault current supplied by each generator at the fault point.

[4.5 Marks]

Q2 a) By selecting proper matrix and vector forms, write the relationship between three unbalanced voltages to three balanced symmetrical component voltages.

[0.5 Marks]

b) Starting from the first principles, develop sequence network connections for,

i) line to line fault

ii) line to ground fault without fault impedance

[2 Marks]

c) A three phase 50 MVA, 11 kV generator is subjected to three different types of faults and the fault currents obtained in each fault type are as in Table Q2.

Table Q2: Fault currents obtained for different fault types with zero fault impedance

Fault Type	Fault current (A)
Three phase fault	2000
Line to line fault (L-L)	1800
Line to ground fault (L-G)	2200

Find the sequence impedances of the generator.

[5 Marks]

Q3 a) Classify power system stability and briefly explain the classification.

[1.5 Marks]

b) Derive the swing equation for a machine connected to an infinite bus in a power network and define the notations used.

[1 Mark]

c) A 50 Hz, 11 kV, four pole turbo generator rated at 100 MVA has an inertia constant of 8 MJ/MVA.

i) Find the stored energy in the rotor at synchronous speed.

ii) If the mechanical input is suddenly raised to 80 MW for an electrical load of 50 MW, find rotor acceleration, neglecting mechanical and electrical losses.

iii) If the acceleration calculated in ii) is maintained for 10 cycles, find the change in torque angle and rotor speed in revolutions per minute at the end of this period.

[2 Marks]

d) A synchronous generator, capable of developing 500 MW of power, initially operates at a power angle of 8^0. By how much can the input shaft power be increased suddenly without loss of stability? Assume that the generator field current and terminal voltage do not change so that the maximum power output of the generator remains constant.

[3 Marks]

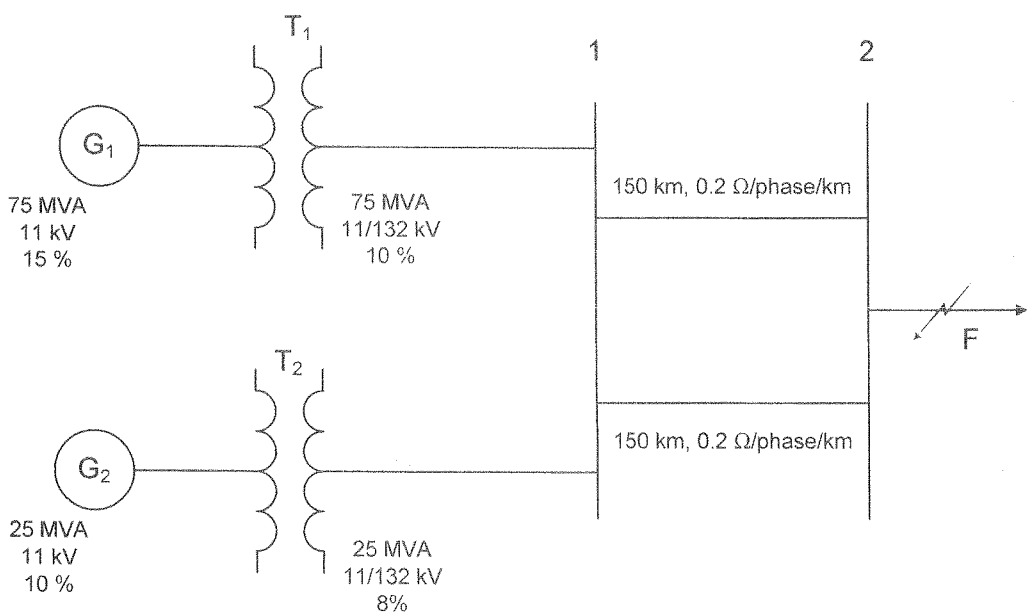

Figure Q1