0090

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical & Computer Engineering

Study Programme	:	Bachelor of Science Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**EEX4542 Power Systems I**
Academic Year	:	2024/2025
Date	:	05th March 2026
Time	:	0930-1230h
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Five (5)** questions in three **(3)** pages.
3. Answer **all** the questions.
4. All questions carry equal marks.
5. Answer for each question should commence from a new page.
6. This is a Closed Book Test (CBT).
7. Scientific calculators are allowed.

Question 1.

a) State the main parts of a nuclear power plant and briefly describe the function of each. [8 marks]

b) What is meant by chain reaction? How is it controlled in a nuclear reactor? [6 marks]

c) Sri Lanka has studied the feasibility of inclusion of a nuclear power plant to the Sri Lankan power system to meet the future electricity demand. Briefly describe three main factors influencing the feasibility of nuclear power plant in Sri Lanka. [6 marks]

Question 2

a) State three reasons why Sulfur Hexafluoride (SF_6) circuit breakers are considered superior to other types of breakers for high-voltage applications [4 marks]

b) Generally, isolators are used as "Off-load" devices. However, under certain circumstances, isolators are also used for connecting and disconnecting of current. With the help of an appropriate busbar arrangement, describe how this is done. [5 marks]

c) Explain why the disks of an insulator-string do have unequal voltage distribution. Briefly describe how the voltage distribution among the disks can be made equal [5 marks]

d) Explain briefly how the following changes in low voltage feeder affect the load factor. Consider the LV feeder mainly consists of domestic loads.

i. Number of rooftop Solar PV units installed by consumers. Consider that the rooftop solar PV integration does not violate voltage limits. [3 marks]

ii. Installation of Battery Storage Device at a point by the utility. [3 marks]

Question 3

a) Briefly describe what is corona-effect and how it is considered in transmission line modeling. [4 marks]

b) Consider the power system shown in Figure Q3. Voltage at bus 1 and 2 are $220 \angle 0$ kV and $228 \angle -16^0$ kV. Load at bus 2 is 90+j20 MVA. Line reactance of lines L1 and L2 are j600 Ω and j200Ω respectively.

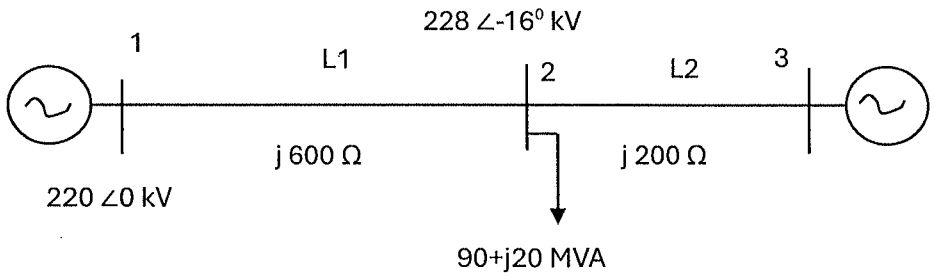


Figure Q3

i. Calculate all the parameters in p.u. on common base of 100 MVA and 220 kV. [6 marks]

ii. Calculate the load current in p.u. [3 marks]

iii. Determine the voltage at bus 3 in p.u. [7 marks]

Question 4

a) State the importance of fault current in circuit breaker selection. [3 marks]

b) Consider the power system shown in Figure Q4. Reactance of the elements of the system in p.u. on common base are given in the Table T

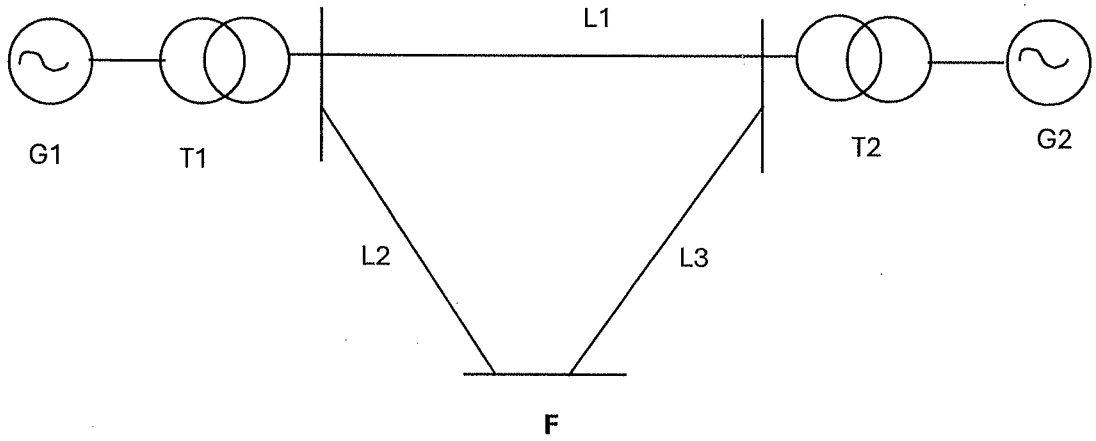


Figure Q4

Table T

Element	Reactance (p.u)
G1	0.15
G2	0.15
T1	0.08
T2	0.08
L1	0.05
L2	0.025
L3	0.025

Consider a three-phase fault occurs at point F.

i. Calculate the fault current. [10 marks]

ii. Calculate the voltage of generator G1 during the fault. [4 marks]

iii. When there is a fault reactance at point F, the fault current calculated in (i) is reduced by 25%. calculate the fault reactance. [3 marks]

Question 5

a) Three-phase currents of a Y-connected source are given below.

$$I_A = 0.5\ A; \qquad I_B = 0.5\angle -30^0\ A; \qquad I_C = 0.5\angle 30^0\ A$$

i. Calculate the positive, negative and zero sequence currents. [4 marks]

ii. Justify whether the neutral point is grounded or not. [2 marks]

Transformation matrix is given below.

$$A^{-1} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}$$

b) Consider the power system shown in Figure Q5. The generator (G) delivers power to the load (L) through transmission lines L1, L2 and transformer (T). Both the load and the generator are Y-connected with the neutral point grounded. Transformer is Y to Delta connected where the Y connection is grounded.

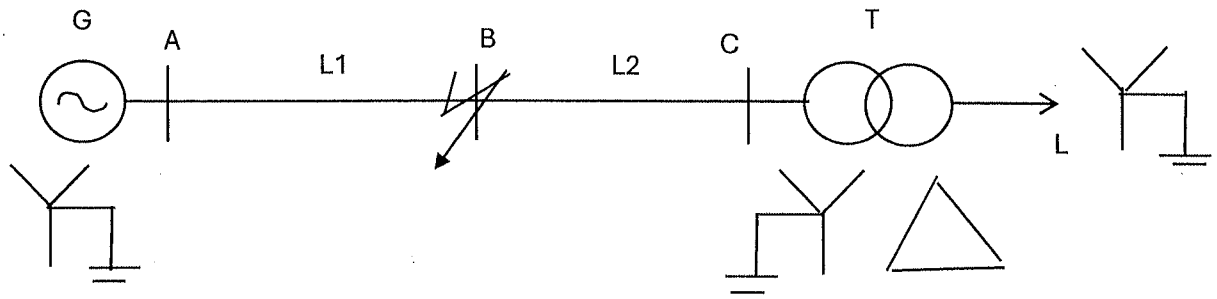


Figure Q5

Positive, negative and zero sequence reactance of the elements are given below.

$X_G^{(1)} = X_G^{(2)} = j0.1\,p.u.;\quad X_G^{(0)} = j0.05\,p.u.$

$X_{AB}^{(1)} = X_{AB}^{(2)} = j0.2\,p.u;\ X_{AB}^{(0)} = j0.4\,p.u.$

$X_{BC}^{(1)} = X_{BC}^{(2)} = j0.2\,p.u.;\ X_{BC}^{(0)} = j0.4\,p.u.$

$X_T^{(1)} = X_T^{(2)} = X_T^{(0)} = j0.05\,p.u$

$V_{L=}0.9\angle -4^0\,p.u.;\ S_L = 1 + j0.5\,p.u.$

i. Calculate load impedance [4 marks]

ii. A single line to ground fault occurs at point B.
Sketch positive, negative and zero sequence networks (considering the load as an impedance) [6 marks]

iii. Calculate the single line to ground fault current [4 marks]