B. Sc. in EEE, 4th Sem / DTE, 2nd Sem Date: 22 February, 2023 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course Number: EEE 4401 / EEE 4495
Course Title: Power System II

Summer Semester : 2021 - 2022
Full Marks: 75
Time : 1.5 Hours

There are **03 (three)** questions. Answer **all** the questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable value for any missing data, if required.

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1. a) Briefly explain the advantages of the per unit system on the analysis of power system. **(5+20) (CO1) (PO1)**

b) A power system network is shown in Figure 1. The generators at buses 1 and 2 are represented by their equivalent current sources with their reactances in per unit on a 100 MVA base. The lines are represented which consists series reactances and shunt reactances are also expressed in per unit on a 100 MVA base.
The loads at buses 3 and 4 are expressed in MW and MVAR. Assuming a voltage magnitude of 1.0 per unit at buses 3 and 4, convert the loads to per unit impedances. Convert impedance diagram to equivalent admittance diagram and obtain the bus admittance matrix by inspection.

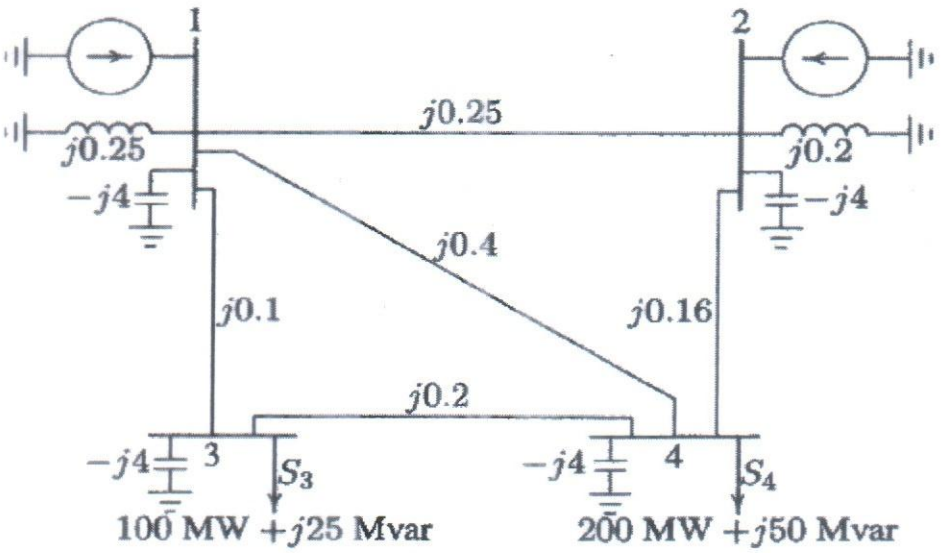

Figure 1

2. a) The single line diagram of a three phase power system is as shown in Figure 2. Impedances are marked in per unit on a 100 MVA, 400 kV base. The load at bus 2 is $S_2 = 15.93$ MW – j 33.4 Mvar, and at bus 3 is $S_3 = 77$ MW + j14 Mvar. It is required to hold the voltage at bus 3 at $400\angle 0°$ kV. Working in per unit, determine the voltage at buses 2 and 1. **(15+10) (CO2) (PO2)**

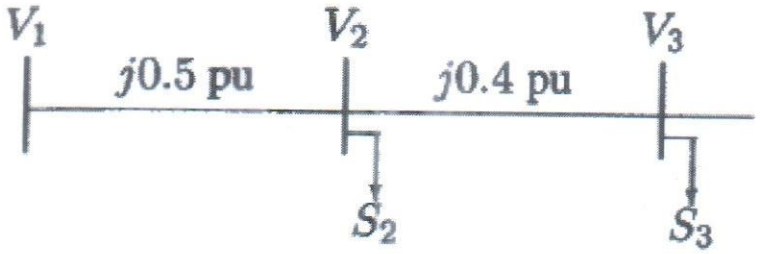

Figure 2

b) Use Gauss-Seidel method to find the solution of the following equations:

$$x_1 + x_1x_2 = 10$$
$$x_1 + x_2 = 6$$

with the following initial estimates

$x_1^{(0)} = 1$ and $x_2^{(0)} = 2$

Continue the iterations until $\Delta x_1^{(k)}$ and $\Delta x_2^{(k)}$ are less than 0.001.

3. Figure 3 shows the single line diagram (SLD) of a simple three-bus power system with generation at bus 1. The voltage at bus 1 is $V_1 = 1\angle 0°$ per unit. The scheduled loads on buses 2 and 3 are marked on the diagram. Line impedances are marked in per unit on a 100 MVA base. **(10+15) (CO2) (PO2)**

a) Using Gauss-Seidel method and initial estimates of $V_2^{(0)} = 1.0 + j0$ and $V_3^{(0)} = 1.0 + j0$, determine V_2 and V_3. Perform **two** iterations.

b) If after several iterations the bus voltages converge, determine the line flows and line losses and the slack bus real and reactive power. Construct a power flow diagram and show the direction of the line flows.

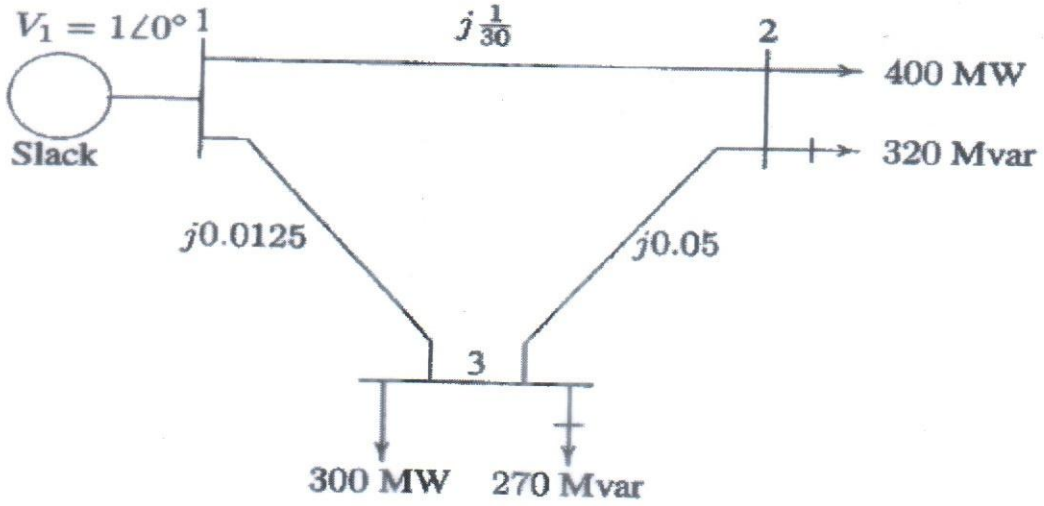

Figure 3