TECHNICAL UNIVERSITY OF MOMBASA

FACUULTY OF ENGINEERING AND TECHNOLOGY

ELECTRICAL ENGINEERING DEPARTRMENT

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE2511: POWER SYSTEM ANALYSIS I

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.

Do not write on the question paper.

Question ONE (Compulsory 30 marks)

a)

i. Specify THREE kinds of buses in any power system network

ii. Explain the power system elements connected to each of the buses above

(6 Marks)

b) Show that for a N bus system the power flow equation is given by:

$$P_k = \sum_{j=1}^{N} |V_k||V_j|\left(G_{kj}\cos(\theta_k - \theta_j) + B_{kj}\sin(\theta_k - \theta_j)\right)$$

$$Q_k = \sum_{j=1}^{N} |V_k||V_j|\left(G_{kj}\sin(\theta_k - \theta_j) - B_{kj}\cos(\theta_k - \theta_j)\right)$$

(7 Marks)

c)

i. Highlight any FOUR factors that are considered in generation planning in a certain country

ii. Explain the THREE categories of load forecasting techniques and specify any criteria used

(7 Marks)

d) Determine the Y matrix in Figure 1 below for the Five Bus power system below:

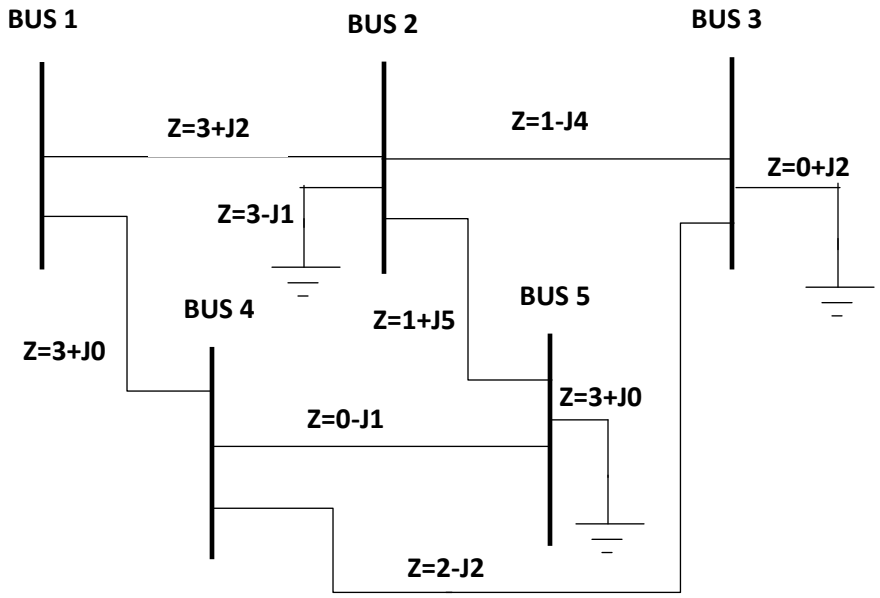

Figure 1

(10 Marks)

Question TWO

a)

i. State any FOUR limitations of computer models in load flow analyses

ii. Compare and contrast Newton Raphson methods with Fast Decoupled power flow technique.

(8 Marks)

b) Show that for FAST Decoupled Load Flow:-

$$\begin{vmatrix}\Delta P\\ \Delta Q\end{vmatrix}=\begin{vmatrix}J_1 & 0\\ 0 & J_4\end{vmatrix}\begin{vmatrix}\Delta\theta\\ \Delta V\end{vmatrix}$$

hence find the Jacobian matrix for the load flow equations below:

$$P_2(\mathbf{x})+2.0 = |V_2|(10\sin\theta_2)+2.0$$
$$Q_2(\mathbf{x})+1.0 = |V_2|(-10\cos\theta_2)+|V_2|^2(10)+1.0$$

(12 Marks)

Question THREE

a)

i. Describe any FOUR difficulties faced in Power Flow formulation

ii. state TWO advantages and TWO disadvantages of Gauss-Seidel technique in load flow analyses

(8 Marks)

b) For the system shown in the Figure 2 below, the line impedances are as indicated in per unit on 100MVA base. A Bus 1is the slack bus.

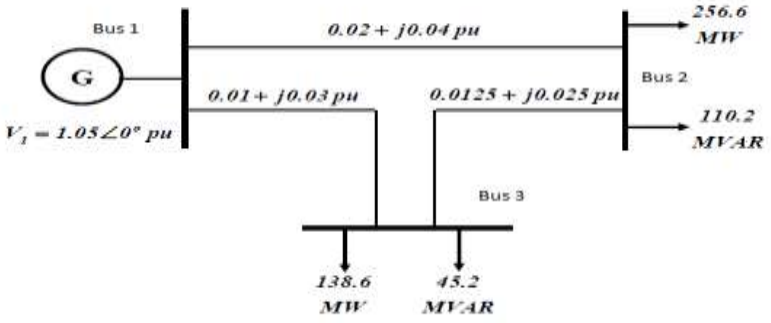

Figure 2

Using Gauss-Seidel method find the bus voltages after 2 iterations.

(12 Marks)

Question FOUR

a)

i. Define power system planning
ii. Highlight THREE kinds of power system planning
iii. Explain the FOUR broad categories of power system load
iv. Explain how weather sensitive load is treated in load forecasting

(11 Marks)

b) The admittance matrix of a power system is given as:

$$Y_{bus} = j\begin{bmatrix} -13 & 5 & 4 & 0 \\ 5 & -13.5 & 2.5 & 2 \\ 4 & 2.5 & -9 & 2.5 \\ 0 & 2 & 2.5 & -4.5 \end{bmatrix} \text{ per unit}$$

Given that existing voltages V_1, V_2 V_3 and V_4 are 4 p.u each in magnitude and corresponding angles are 0^o, 30^o, 45^o and 60^o respectively, estimate the load current forecast in t = 5 years assuming a parabolic load growth given by $I = a + bt + ct^2$ where constants a, b, c are 7.5, 2.0 and 0.5 respectively

9 Marks)

Question FIVE

a)

i. Explain the unique feature of Newton Rapson Technique over Gauss-seidel
ii. Highlight FOUR reasons why Newton Raphson algorithms is common in Power flow analyses over Gauss-seidel

(6 Marks)

b) Figure 3 below is a TWO bus power system:

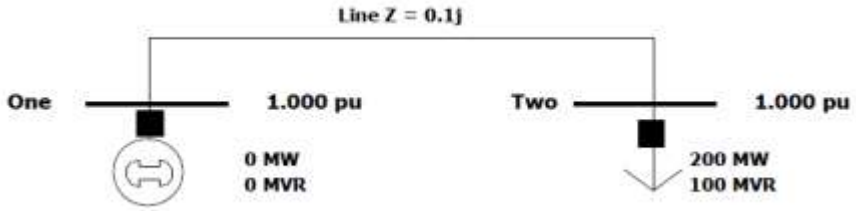

Figure 3

Use the Newton- Raphson power flow to determine the voltage magnitude and angle at bus two after 2 iterations. Assume that Bus I is the slack and S-base = 100 MVA

(14 Marks)