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Code No: AEE012

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER -II

III B.Tech II Semester End Examinations (Regular), May – 2020

Regulation: IARE-R16

POWER SYSTEM ANALYSIS

ELECTRICAL AND ELECTRONICS ENGINEERING

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

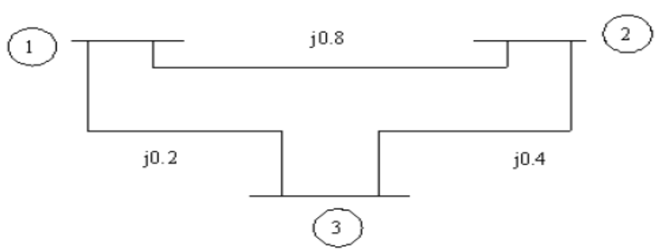
UNIT – I

1. a) With suitable power system example define tree, co-tree, basic cut set, basic tie set. Write the Bus incidence matrix by choosing arbitrary directions. [7M]

   b) Develop the expressions for diagonal and off diagonal elements of a bus impedance Matrix for the addition of element from a new bus to old bus with mutual coupling. [7M]

2. a) What is meant by primitive network in power systems? Write the expression to form YBus by using singular transformation method. [7M]

   b) Form YBus for the given power system shown in Figure 1 with reactance value in p.u. Select arbitrary directions. [7M]



UNIT – II

3. a) Classify the types of buses in a power system for load flow studies. Write the significance of each bus. [7M]

   b) Figure 2 shows the one-line diagram of a simple three-bus power system with generation at buses 1 and 3. The voltage and power at bus 1 is V1 = 1.025∠00 pu and 100 Watts respectively. Voltage magnitude at bus 3 is fixed at 1.03 pu with a real power generation of 300 MW. A load consisting of 400 MW and 200 MVar is taken from bus 2. Line impedances are marked in per unit on a 100 MVA base. Neglect line resistances and line charging susceptances. Determine the phasor values of V2 and V3 keeping the magnitude of V3= 1.03 pu for one iteration using Gauss-Seidel method and initial estimates of V20=1.0+ j 0.0 pu, V30=1.0+ j 0.0 pu [7M]

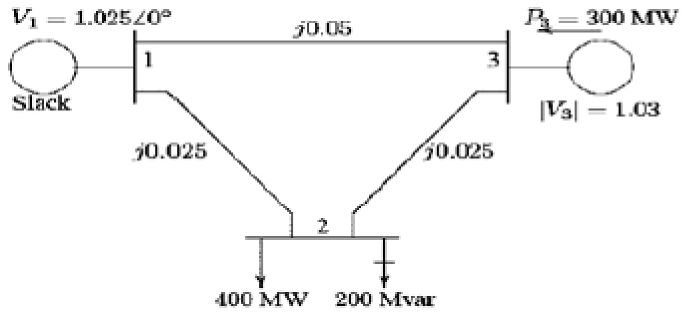


Figure 2

4. a) Explain the process of obtaining the power flow solution of a power system by using Newton Raphson technique when the system comprises of both PQ & PV buses in rectangular coordinates. [7M]

b) The data for 2-bus system is given below. S_{G1}=Unknown; S_{D1}=Unknown V_1=1.0p.u. ; S_1= To be determined. S_{G2}=0.25+jQG2 p.u.; S_{D2}=1+j0.5 p.u. The two buses are connected by a transmission line p.u. reactance of 0.5 p.u. Find Q_2 and angle of V_2. Neglect shunts susceptance of the tie line. Assume $|V_2|$=1.0, perform two iterations using GS method. [7M]

UNIT – III

5. a) Write the steps for short circuit current calculation by using Thevenin theorem and determine the expression for fault current under L-G fault. [7M]

b) Draw the reactance diagram for the power system shown in below Figure 3. The ratings as follows: [7M]
Generator: 40MVA, 33 kV, X=20%
Synchronous motor: 25MVA, 11 kV, X=30%
Transformer, T1: 40MVA, 33/220 kV, X= 15%
Transformer, T2: 30MVA, 220/11 kV, X= 15%.
Consider 100MVA base and 11kV base on motor side.

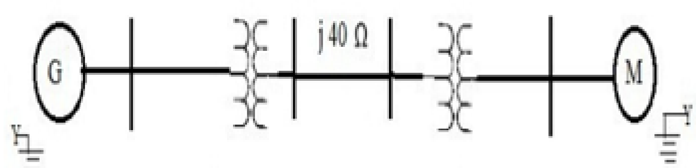


Figure 3

6. a) Develop the expressions for analyzing double line to ground fault in a large power system using Z Bus matrix. [7M]

b) A 3-phase, 50 MVA, 33kV alternator having X_1=0.18pu, X_2=0.1pu, X_0=0.05pu based on its rating, is connected to a 33kV overhead line having X_1=6.3Ω, X_2=6.3Ω and X_0=12.6Ω per phase. The alternator is solidly grounded. A single line to ground fault occurs at the remote end of the line. Calculate the fault current. [7M]

UNIT – IV

7. a) Write short notes [7M]
   i) Transfer reactance
   ii) Synchronizing power co-efficient

   b) Explain the significance of power angle equation of a two bus network and comment on the power angle curve. [7M]

8. a) Define the terms steady state stability and transient stability. Discuss the factors that affect them. [7M]

   b) Discuss the following [7M]
   i) Swing equation
   ii) Methods to improve the steady state stability of a power system.

UNIT – V

9. a) Define critical clearing angle and find the expressions for critical clearing angle and critical clearing time in the case of single machine connected to infinite bus. [7M]

   b) A 50 Hz, 4 pole turbo alternator rated 150 MVA, 11 KV has an inertia constant of 9MJ/MVA. Find the i) stored energy at synchronous speed ii) the rotor acceleration if the input mechanical power is raised to 100 MW when the electrical load is 75 MW. iii) The speed at the end of 10 cycles if acceleration is assumed constant at the initial value. [7M]

10. a) Explain point by point method for the solution of swing equation. [7M]

    b) A 200 MVA, 2 pole, 50 Hz alternator has a moment of inertia of 50,000 Kg-m^2. What is the energy stored in the rotor at the rated speed? Find the value of H and determine the corresponding angular momentum. [7M]

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COURSE OBJECTIVES:

The course should enable the students to:

I	Determine the bus impedance and admittance matrices for power system network..
II	Calculate various parameters at different buses using load flow studies and numerical methods.
III	Discuss the symmetrical Component theory, sequence networks, short circuit calculations and per unit representation power system.
IV	Understand the steady state stability of power system and suggest improvements
V	Analyze the transient stability of power system and check methods to improve the stability.

COURSE OOUTCOMES:

I	Formulate the bus impedance and admittance matrices for complex power system networks.
II	Identify unknown electrical quantity at various buses of power system and estimate.
III	Determine effect of symmetrical and unsymmetrical faults on power system in per unit system.
IV	Check the effect of slow and gradual change in load on power system and check the methods of improvement.
V	Discuss the characteristics of power system under large disturbances and methods to improve transient stability.

COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

AEE012.1	Define the basic terminology of graph theory to form bus impedance and admittance matrices.
AEE012.2	Determine the bus impedance and admittance matrices for power system.
AEE012.3	Draw the algorithms to form the bus impedance and admittance matrices for various configuration of primitive network.
AEE012.4	Understand necessity of load flow studies and derive static load flow equations.
AEE012.5	Use different numerical methods to determine unknown parameters at various buses and to draw relevant algorithms.
AEE012.6	Compare various numerical methods of load flow studies and analyze DC load flow studies.
AEE012.7	Draw the equivalent reactance network of three phase power system using per unit system.
AEE012.8	Calculate the electrical parameters under symmetrical fault Conditions and understand symmetrical Component theory.
AEE012.9	Compute the electrical parameters under unsymmetrical faults with and without fault impedance.
AEE012.10	Discuss the steady state stability, dynamic stability and transient stability of power system.
AEE012.11	Describe steady state stability power limit, transfer reactance, synchronizing power Coefficient, power angle curve.
AEE012.12	Determination of steady state stability and methods to improve steady state stability of power system.
AEE012.13	Derive the swing equation to study steady state stability of power system.
AEE012.14	Predict the transient state stability of power system using equal area criteria and solution of swing equation.
AEE012.15	Suggest the methods to improve transient stability, discuss application of auto reclosing and fast operating circuit breakers.

MAPPING OF MODEL QUESTION PAPER QUESTIONS TO THE ACHIEVEMENT OF CLOURSE OUTCLOMES

SEE QUESTION No			OUTCOMES	COURSE OUTCOMES	BLOOM TAXONOMY LEVELS
1	a	AEE012.1	Define the basic terminology of graph theory to form bus impedance and admittance matrices.	CO 1	Remember
	b	AEE012.3	Draw the algorithms to form the bus impedance and admittance matrices for various configuration of primitive network.	CO 1	Understand
2	a	AEE012.2	Determine the bus impedance and admittance matrices for power system.	CO 1	Remember
	b	AEE012.2	Determine the bus impedance and admittance matrices for power system.	CO 1	Understand
3	a	AEE012.4	Understand necessity of load flow studies and derive static load flow equations.	CO 2	Understand
	b	AEE012.5	Use different numerical methods to determine unknown parameters at various buses and to draw relevant algorithms.	CO 2	Understand
4	a	AEE012.5	Use different numerical methods to determine unknown parameters at various buses and to draw relevant algorithms..	CO 2	Understand
	b	AEE012.5	Use different numerical methods to determine unknown parameters at various buses and to draw relevant algorithms.	CO 2	Understand
5	a	AEE012.9	Compute the electrical parameters under unsymmetrical faults with and without fault impedance.	CO 3	Understand
	b	AEE012.9	Compute the electrical parameters under unsymmetrical faults with and without fault impedance.	CO 3	Understand
6	a	AEE012.9	Compute the electrical parameters under unsymmetrical faults with and without fault impedance.	CO 3	Understand
	b	AEE012.9	Compute the electrical parameters under unsymmetrical faults with and without fault impedance.	CO 3	Understand
7	a	AEE012.11	Describe steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve.	CO 4	Understand
	b	AEE012.11	Describe steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve.	CO 4	Understand
8	a	AEE012.10	Discuss the steady state stability, dynamic stability and transient stability of power system.	CO 4	Remember
	b	AEE012.11	Describe steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve.	CO 4	Understand
9	a	AEE012.14	Predict the transient state stability of power system using equal area criteria and solution of swing equation.	CO 5	Remember
	b	AEE012.14	Predict the transient state stability of power system using equal area criteria and solution of swing equation.	CO 5	Understand
10	a	AEE012.14	Predict the transient state stability of power system using equal area criteria and solution of swing equation.	CO 5	Understand
	b	AEE012.14	Predict the transient state stability of power system using equal area criteria and solution of swing equation.	CO 5	Understand

Signature of Course Coordinator **HOD, EEE**