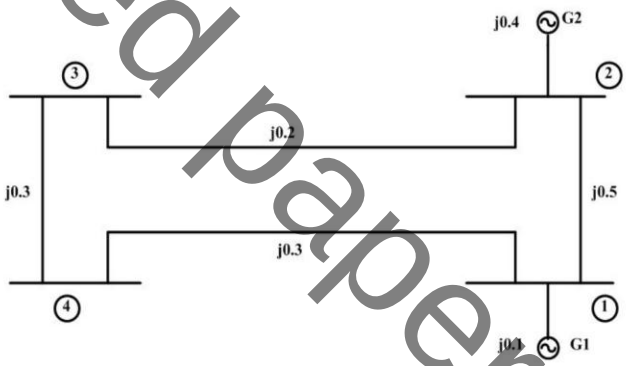
Code No: 156CK **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, August - 2022
POWER SYSTEM OPERATION AND CONTROL
(Electrical and Electronics Engineering)

Time: 3 Hours **Max.Marks:75**

Answer any five questions
All questions carry equal marks
- - -

1.a) Explain the procedure for formation of nodal admittance matrix by step by step procedure.
b) Form the Y_{BUS} for the network shown in figure, including the generator buses 1 and 2 with impedance of 0.1, 0.4 p.u. respectively. All the values are p.u. impedances for the network. [7+8]



2.a) Explain about the classification of buses with neat sketch.
b) Explain Gauss-Seidel iterative method for power flow analysis of any power system with a flow chart. [6+9]

3.a) Derive generalized expression for transmission loss in a n-bus network.
b) 150 MW, 220 MW and 220 MW are the ratings of three units located in a thermal power station. Their respective incremental costs are given by the following equations:

$$\frac{dC_1}{dP_1} = Rs(0.11P_1 + 12)$$
$$\frac{dC_2}{dP_2} = Rs(0.095P_2 + 14)$$
$$\frac{dC_3}{dP_3} = Rs(0.1P_3 + 13)$$

Where P_1, P_2 and P_3 are the loads in MW. Determine the economical load allocation between the three units, when the total load on the station is (i) 350 MW (ii) 500 MW. [6+9]

4.a) Define penalty factor and state its significance.
b) Derive relevant equations to explain economic dispatch of thermal plants coordinating the system transmission losses. [7+8]

5.a) Derive the model of speed governing system and hence draw its block diagram.
b) A 100 MVA synchronous generator operates on full load at a frequency of 50 Hz. The load is suddenly reduced to 50 MW. Due to time lag in governor system, the steam valve begins to close after 0.4 sec. Determine the change in frequency that occurs in this time. [7+8]

6.a) What are the basic requirements needed for control strategy in Load Frequency Control (LFC) system.
b) Obtain the mathematical modeling of tie line power in an inter connected system and its block diagram. [7+8]

7.a) Give the list of methods improving transient stability of the system.
b) Derive the equal area criterion of stability and explain clearly how you can determine the stability limit of a synchronous motor when there is a sudden change in the mechanical load on the motor. [7+8]

8.a) What are the steps to be followed in planning of a computer control?
b) Explain the implementation of SCADA system in the electric utility. [7+8]

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B. Tech III Year II Semester Examinations, August/September - 2021
POWER SYSTEM OPERATION AND CONTROL
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Time: 3 Hours **Max. Marks: 75**

Answer any five questions
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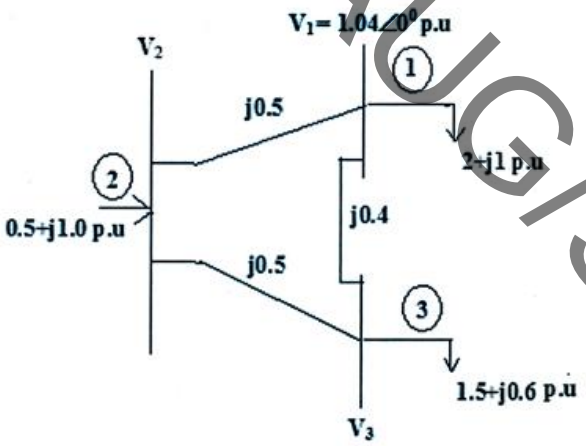
1.a) Explain the need for slack bus in load flow analysis.

b) For the three bus system whose Y_{bus} is given below, calculate the second iteration value of V3 using the Gauss-Seidel method. Assume bus 1 as the slack (with V1 = 1.0/0), and buses 2 and 3 are load buses with a per unit load of (S2 = 1 + j0.5) and (S3 = 1.5 + j0.75). Use voltage guesses of 1.0/0 at both buses 2 and 3. The bus admittance matrix for a three-bus system is

$$Y_{BUS} = \begin{bmatrix} -j10 & j5 & j5 \\ j5 & -j10 & j5 \\ j5 & j2 & -j10 \end{bmatrix}$$

[5+10]

2. A sample power system is shown in diagram. Determine V_2 and V_3 by N.R. method after one iteration. The P.U. values of line Impedances are shown in figure. [15]



3. Develop an iterative algorithm for solving the optimum dispatch equation of an 'n' bus power system by taking into account the effects of system losses. [15]

4. The fuel cost functions in Rs/hr for two thermal plants are given by:

$$C1=420+9.2P1+0.004\ P_1^2$$
$$C2=350+98.5P2+0.0029\ P_2^2P$$

Where P1, P2 are in MW? Determine the optimal scheduling of generation if the total load is 640.82 MW. Estimate value of λ=12Rs/MWh. The transmission power loss is given by the expression $PRL(pu)R=0.0346\ P_1^2 +0.00643P_2^2$. [15]

5. Draw the block diagram of a two area system and prove that the integral control reduces the static error in frequency and the line power flow to zero. [15]

6.a) Explain the effects of regulation and dead band on speed governor and automatic generation control.

b) Two alternators rated for 110 MW and 210 MW have a governor droop characteristic of 5% from no load to full load. They are connected in parallel to share a load of 250MW. Determine the load shared by them. Assume free governor operation. [8+7]

7.a) Differentiate between steady state and transient stability of a power system. Discuss the factors that affect them.

b) Explain the step by step method of solving the swing equation. Compare it with equal area criterion method. [7+8]

8. Explain the hardware components and functional aspects of SCADA system using a fundamental block diagram. [15]

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B. Tech III Year II Semester Examinations, February - 2023
POWER SYSTEM OPERATION AND CONTROL
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Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

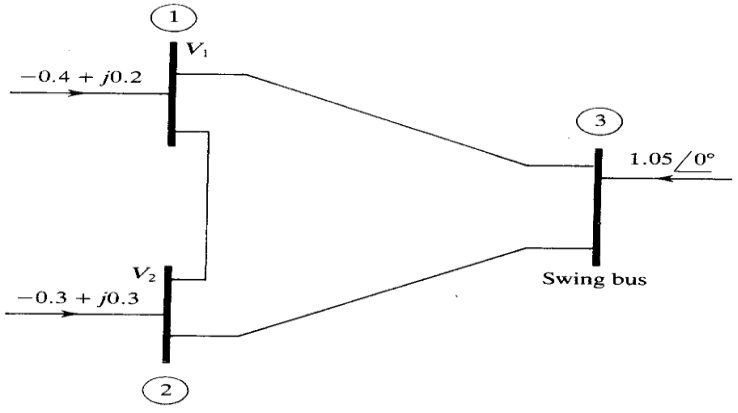
1.a)	What is the need for load flow studies?	[2]
b)	Explain the merits of N-R (Newton-Raphson) method.	[3]
c)	Define current distribution factor.	[2]
d)	Explain (i) Incremental fuel rate curve (ii) Incremental cost curve.	[3]
e)	What is Q-V control channel?	[2]
f)	What are the basic requirements of a load frequency control?	[3]
g)	What is voltage stability?	[2]
h)	Explain the terms: (i) critical clearing angle (ii) critical clearing time.	[3]
i)	What is power system monitoring?	[2]
j)	Explain the concept of load dispatch centre.	[3]

PART – B

(50 Marks)

2. For the system shown in figure below, with bus 3 as reference bus, the bus impedance matrix is given by Start with $V_1^{(0)} = V_2^{(0)} = 1.05 \angle 0^0$, and solve for V_1 and V_2 by the Gauss-Seidel method. [10]

$$\mathbf{Z}_{bus} = \begin{bmatrix} 1.33 + j1.33 & 1 + j1 \\ 1 + j1 & 1.5 + j1.5 \end{bmatrix} \times 10^{-2} \text{ pu}$$



OR

3. With a neat flow chart, explain the load flow solution by Newton-Raphson method.[10]

4. Derive the transmission line loss formula for a system consisting of n- generating plants supplying several loads interconnected through a transmission network. [10]

OR

5.a) What is penalty factor in economic scheduling? Explain its significance?

b) In a two plant system, the entire load is located at plant 2, which is connected to plant 1 by a transmission line. Plant 1 supplies 100 MW of power with a corresponding transmission loss of 5MW. Calculate the penalty factors for the two plants. [5+5]

6. Discuss the dynamic interaction between P-f and Q-V loops. [10]

OR

7. Derive the model of a speed governing system and represent it by a block diagram. [10]

8.a) State and explain equal area criterion.

b) Discuss the step by step solution of a swing equation. [4+6]

OR

9.a) The power angle characteristic for a generator supplying infinite bus is given by $P_e = 1.25 \sin\delta$. The H constant is 5 sec and initially it is delivering a load of 0.5 p.u. Find the critical clearing angle.

b) What are the various methods of improving steady state stability? Explain. [5+5]

10. Briefly explain the major components of a SCADA system. [10]

OR

11. What is the importance of load forecasting? Explain various techniques of load forecasting. [10]

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POWER SYSTEM OPERATION AND CONTROL
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Time: 3 hours **Max. Marks: 75**

Answer any five questions
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- - -

1.a) Explain the necessity of a load flow solution. Derive the necessary equations for the load flow problem.
b) Explain the Newton Raphson Load flow method in polar form, and derive the equations to compute the Jacobian matrix elements. [8+7]

2.a) What is meant by optimal generation allocation? Derive the conditions for optimal allocation of generation among the generators in a thermal plant including transmission losses.
b) A power system consists of two 200MW units whose input cost data are represented by the equations: $C_1 = 0.03P_1^2 + 21P_1 + 750$ Rs/hour, $C_2 = 0.5P_2^2 + 18P_2 + 980$ Rs/hour. If the total received power $P_R = 350$ MW, determine the load division between the units for the most economic operation. [7+8]

3. For a single area system, show that the static error in frequency can be reduced to zero for single area load frequency control with integral control. [15]

4.a) Why transient state stability limit is less than the steady-state stability limit? Explain.
b) Derive an expression for critical clearing angle for a power system consisting of a single machine supplying an infinite bus for sudden load decrement. [8+7]

5.a) What are the functions of SCADA? With a detailed diagram, describe the hardware components of SCADA as well as their functionalities.
b) What is EMS? What are its major functions in power system operation and control? [7+8]

6. Explain the fast decoupled load flow algorithm. List out all the assumptions made in arriving at it from decoupled load flow. [15]

7. Explain the significance of equality and inequality constraints in the economic allocation of generation among different plants in a system. [15]

8. How is the speed governor mechanism modeled? And explain its operations with the speed load characteristics. [15]

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