Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (Old) EXAMINATION – WINTER 2019

Subject Code: 170901 **Date: 30/11/2019**

Subject Name: Inter Connected Power System

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Assume suitable data only if necessary.**

Q.1 (a) State various functions performed by LDC and elaborate how can cascade tripping happen in interconnected power system. **07**

(b) Define inertia constant and angular momentum of synchronous generator and derive their relationship with usual notations using basic concepts of angular dynamics in context with power system stability. **07**

Q.2 (a) For a thermal power plant having 'n' generating units, using Lagrange multiplier (λ) method show that total cost of generation is minimum when all the units are operated at equal incremental cost being equal to Lagrange multiplier λ. **07**

(b) Construct speed governing mechanism for a steam turbine based single area load-frequency control. Also develop transfer function of the mechanism in terms of frequency error and speed changer command power as input and displacement of the main stream valve as output. **07**

OR

(b) Develop point-by-point procedural steps of solving swing equation numerically with necessary assumptions for transient stability analysis. **07**

Q.3 (a) A 2-pole, 50 Hz, 11 kV alternator has rating of 100 MW, power factor 0.8 lagging. The rotor of the alternator has a moment of inertial of 10000 kg-m^2. Calculate its kinetic energy in MJ stored in the rotor, inertia constant in MJ/MVA and angular momentum in MW-s^2/elect. degree of the alternator. **07**

(b) What is bus incidence matrix and primitive admittance matrix? With usual notations of graph theory and using singular transformation technique prove that bus admittance matrix is given as **07**

$$[Y_{bus}]=[A]^T[Y][A]$$

where [A] is bus incidence matrix and [Y] is primitive admittance matrix.

OR

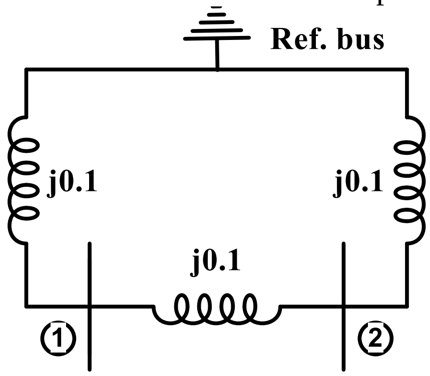
Q.3 (a) A power system bus data and Ybus are given as below in per unit on 100 MVA base. At the end of the first iteration calculate voltage at bus 2 and bus 3 using Gauss-Seidal method. **07**

$$Y_{bus} = \begin{bmatrix} 53.85\angle-68.2^\circ & 22.66\angle116.6^\circ & 31.62\angle108.4^\circ \\ 22.66\angle116.6^\circ & 58.13\angle-63.4^\circ & 35.77\angle116.6^\circ \\ 31.62\angle108.4^\circ & 35.77\angle116.6^\circ & 67.23\angle-67.2^\circ \end{bmatrix}$$

Bus code	Assumed bus voltage	P_G	Q_G	P_D	Q_D
1 (slack)	1.05+j0.0	--	--	0	0
2(PQ)	1+j0.0	0.5	0.3	3.056	1.402
3(PQ)	1+j0.0	0.0	0.0	1.386	0.452

(b) With usual notations and basic concepts derive swing equation for synchronous generator. **07**

Q.4 (a) Using step-by-step method determine bus impedance matrix for the following network. Neglect mutual coupling and consider all reactances in per unit. **07**

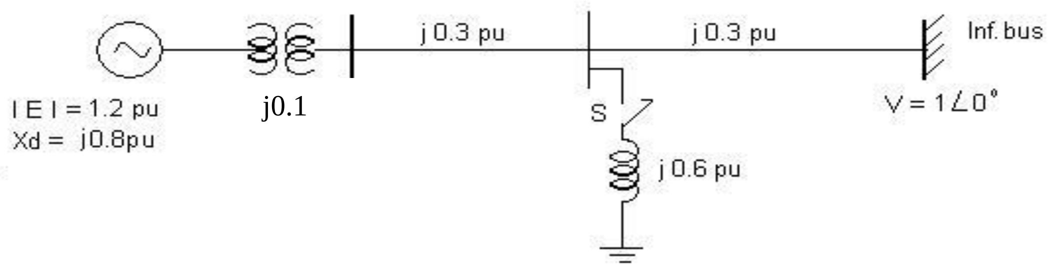


(b) Differentiate steady state, transient and dynamic stability in context with power system stability. Enlist various methods to improve transient stability with brief description. **07**

OR

Q.4 (a) Derive expressions of diagonal and off-diagonal elements of Jacobian matrix for an n-bus power system with usual notations when Newton Raphson method is used. **07**

(b) For the system shown in figure, an inductor of reactance 0.6 pu is connected at the mid-point of transmission line. Determine the steady-state power limit when switch S closed **07**



Q.5 (a) Enlist various methods of voltage control in power system and elaborate tap changing under load in details. **07**

(b) What is equal area criterion? With the help of equal area criterion dervie an expression of maximum power angle when mechanical input to the generator is suddenly increased? **07**

OR

Q.5 (a) Derive expression of modified Z_{bus} for n-bus linear passive network when (i) a branch is added between a new k^{th} bus and reference bus (ii) a new ranch is added between a new k^{th} bus and old j^{th} bus. **07**

(b) Construct flowchart for Gauss-Seidal method with PV buses. Also mention expression of voltage at any i^{th} bus at the end of iteration (k+1). **07**

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