

Centre for Energy Studies

ESL 791 Minor I

18-03-2021 (11 AM -12PM)

Maximum Marks: 20

Instructions:

- All questions are compulsory
- Please number all the pages of your answer sheets (e.g. 1/5, 2/5, 3/5, 4/5 and 5/5 in case 5 pages are used).
- After writing is over, scan all the pages sequentially in good quality and send it through email as single PDF (averma@ces.iitd.ac.in)
- Assume Any Data if Required but write that clearly in your answer sheet

Q1 a) Write a short note on the various stakeholders and their role in power supply chain. Discuss the procedure for scheduling of the generating units and loads at various buses in power system.

b) Why it is important to consider the loss reduction or energy saving at power distribution level?

(2x2=4)

Q.2 a) Define various security states of power system. Why it is important to understand in which security condition the power system is existing?

b) A bus at which solar PV plant is connected can be considered as PV or PQ depending upon certain operational conditions. Explain.

(2x2=4)

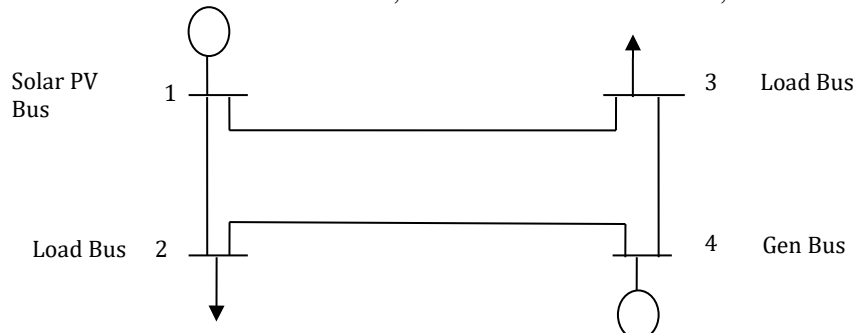
Q.3 For a three bus, three-line system with the data given below find the real power flows in line number 2 (1-3) using DC power flow method.

Line Number	Line	Reactance (p.u.)
1	1-2	0.2
2	1-3	0.5
3	2-3	0.3

(2)

4) a) Why we need to prepare data for the state estimation. What is its impact on the state estimation quality ?

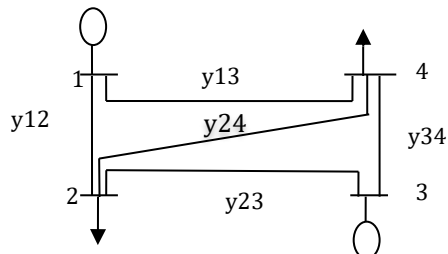
b) For a four-bus network shown below, write State estimation X, Z and H matrices



Measurements available are: $V_1, P_1, P_2, Q_2, V_3, P_3, V_4, P_{13}, Q_{13}, P_{34}, Q_{34}, P_{24}$

Also, drive the relationship of the partial derivate of P_{34} and Q_{43} with change in voltage magnitude and angle at bus 3.

Q.5 Assume the following 4-bus transmission network



Bus No	Type of the bus
1	Wind Generator
2	PQ
3	Synchronous Generator
4	PQ

a) Write the structure of Newton Raphson power flow Jacobian. Clearly mention which equations would be considered and which will not be.

The wind generator does not have the voltage control capability and is connected to the grid at a fixed power factor.

b) If the loads at bus number 2 are voltage dependent with the following equation.

$$P_{L2} = \left(\frac{v_2}{v_{2n}} \right)^{1.8} P_{L2}^0$$

$$Q_{L2} = \left(\frac{v_2}{v_{2n}} \right)^{1.8} Q_{L2}^0$$

Where, P_{L2} , Q_{L2} are the real and reactive power loads, P_{L2}^0 and Q_{L2}^0 are the base real and reactive power loads. V_2 , V_{2n} is the actual voltage and nominal voltages at bus number 2.

Model their impact in power flow Jacobian.

(3+2=5)