Power System Operation and Control VTU Question Paper Set

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10EE82

Eighth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Power System Operation and Control

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is a SCADA system? Draw and explain the functional block diagram of the dual computer configuration for control and monitoring of power system. **(10 Marks)**

b. Derive the expression for tie-line power and frequency deviation for two area system. **(06 Marks)**

c. Two areas A and B interconnected by tie-line. The generating capacity of area A is 25,000 MW and its regulating characteristic is 2.5% of capacity per 0.1 Hz. Area B has a generating capacity 5000 MW and its regulating characteristic is 1.5% of capacity per 0.1 Hz. Find each areas share of a 800 MW disturbance (load increase) occurring in area B and resulting tie-line flow. **(04 Marks)**

2 a. What is the function of AVR? Explain with suitable block diagram. the mathematical modeling of AVR. **(10 Marks)**

b. What is load frequency control? Obtain and explain the transfer function model of load frequency control for an isolated power system. **(10 Marks)**

3 a. Write notes on basic generator control loops and cross coupling between control loops. **(05 Marks)**

b. Determine the primary ALFC loop parameters for control area having the following data:
Total rated area capacity $P_r = 2000$ MW
Inertia constant 5.05, Frequency $f_0 = 60$Hz, Normal operating load $P_D = 1000$ MW **(05 Marks)**

c. A single area consists of two generators with following parameters:
Generator – 1 = 1200 MVA, R = 6% (on machine base)
Generator – 2 = 1000 MVA, R = 4% (on machine base)
The units are sharing 1800 MW at nominal frequency of 50 Hz. Unit 1 supplies 1000 MW and unit 2 supplies 800 MW. The load is now increased by 200 MW. Choose a common base of 2000 MVA.
Find (i) Steady state frequency and generation of each unit if D = 0
(ii) Repeat (i) if D = 1.5. **(10 Marks)**

4 a. Explain different sources of reactive power generation and absorption of reactive power in a power system. **(08 Marks)**

b. Derive the equations to get the relation between voltage, power and reactive power at a node. **(06 Marks)**

c. Explain voltage instability and voltage collapse. **(06 Marks)**

PART – B

5 a. Explain the problem of unit commitment. What are the constraints in solving the unit commitment problem? Explain each of it. **(10 Marks)**

b. With the help of flow chart, explain the dynamic programming method in unit commitment problem. **(10 Marks)**

6 a. What is meant by power system security? Explain major functions involved in system security. Explain the factors affecting system security. **(10 Marks)**

b. With the help of flow chart, explain the contingency selection procedure. **(10 Marks)**

7 a. Explain energy management system. **(10 Marks)**

b. Explain the least square estimation method used in power system state estimation. **(10 Marks)**

8 a. Derive the steady-state reliability expression and general reliability expression. **(10 Marks)**

b. With the help of flow chart, explain loss and load probability for planning of generating capacity. **(10 Marks)**

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Eighth Semester B.E. Degree Examination, June/July 2016
Power System Operation and Control

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain different operating states of a power system with the help of a block diagram. **(08 Marks)**

b. Derive expression for frequency deviation Δf and tie line power flow ΔT_L in a two area inter connected power system. **(08 Marks)**

c. What is an ECC? Mention its functions. **(04 Marks)**

2 a. With relevant characteristics, explain parallel operation of two generators with different capacity and regulation. **(07 Marks)**

b. Draw the schematic of load frequency control and excitation voltage regulators of a generator and explain. **(07 Marks)**

c. A synchronous generator rated 100MVA operates on full load at unity power factor with frequency 50Hz. The load is suddenly reduced to 50MV. Due to time lag in governor system, the steam valve begins to close after 0.4 seconds. Determine the change in frequency that occurs in this time. Take H = 5kW-sec/KVA of generator capacity. **(06 Marks)**

3 a. Explain with block diagram, the modeling of
i) Speed governing system ii) Turbine iii) Generator and load. **(10 Marks)**

b. With a block diagram representation, explain tie-line bias control of a two area load frequency control. **(10 Marks)**

4 a. List the components that absorb and generate reactive power in an electric system. **(06 Marks)**

b. Fig. Q4(b) shows one line diagram of a power system with three supply points A, B and C connected to a common busbar M. If at a particular system load, the line voltage of M falls below its nominal value by 5kV, Calculate the magnitude of the reactive volt-ampere injection required at M to re-establish the original value. The pu values are expressed on a 500MVA base. **(08 Marks)**

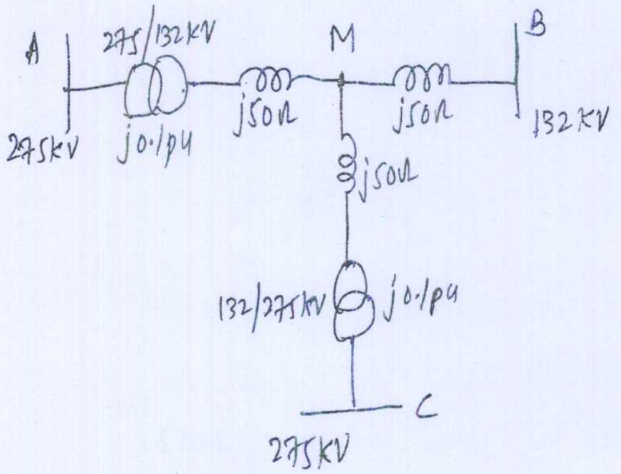

Fig. Q4(b)

c. Define:
   i) Voltage stability
   ii) Voltage collapse and
   iii) Sub synchronous resonance. **(06 Marks)**

PART – B

5 a. Obtain the exact coordination equations for optimum loading of thermal power plants considering transmission losses. **(06 Marks)**

b. With the help of a flow chart, explain the dynamic programming method in unit commitment solution. **(10 Marks)**

c. Explain priority – list method for unit commitment problem with an example. **(04 Marks)**

6 a. Explain the factors affecting power system security. **(06 Marks)**

b. Explain, with an example, the security constrained optimal power flow (SCOPF). **(06 Marks)**

c. Explain contingency analysis, using a flow chart. **(08 Marks)**

7 a. What is energy management system? **(04 Marks)**

b. Explain the weighted least squares estimation (WLSE) method of power system state estimation. **(10 Marks)**

c. Explain :
   i) Difference between load flow problem and state estimation problem
   ii) Suppression of bad data in state estimation problem. **(06 Marks)**

8 a. With a graph, explain the following :
   i) Early failure
   ii) Wear out failure and
   iii) Chance failure. **(08 Marks)**

b. A system has three generating units, each of 50MV capacity. The forced outage rate (FOR) of each unit is 0.03. Find the total number of states and their probability of occurrence. **(08 Marks)**

c. Write the possible states of a two unit system in a table form. **(04 Marks)**

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Eighth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Power System Operation and Control

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. What is a control area in an interconnected power system? Define area control error. **(04 Marks)**

b. Explain the function of a typical dual digital computer control and monitoring of a power system with the help of a block diagram. **(08 Marks)**

c. Two generators rated 200 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 4% and 5% respectively from no – load to full load. Assuming that the generators are operating at 50 Hz at no load, how would a load of 600 MW be shared between them? Also find the system frequency at this load. **(08 Marks)**

2 a. What is an interconnected power system? List out its advantages. **(05 Marks)**

b. Obtain the complete block diagram representation of load frequency control (LFC) of an isolated power system, with necessary equations [transfer functions]. **(15 Marks)**

3 a. Explain tie line bias control of a two area load frequency control, with the help of a block diagram and necessary equations. **(14 Marks)**

b. A 100 MVA alternator 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 beings to close after 0.4 seconds. Determine the change in frequency that occurs in this time. **(06 Marks)**

4 a. Show that the real power flow between two nodes is determined by the transmission angle 'δ' and the flow of real time power is determined by the scalar voltage difference between two nodes. **(10 Marks)**

b. Two generators are maintained at 66 KV and 60 KV line at ends of a interconnected system as show in Fig.Q4(b). A load of 20 MW is transferred from 66 KV unit to 60 KV unit. Calculate the necessary condition between the nodes including the power factor of the current transmitted.

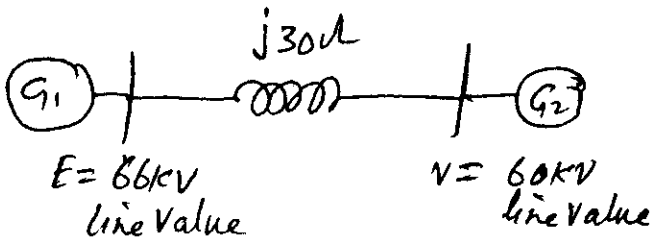

Fig.Q4(b) **(10 Marks)**

PART – B

5 a. Derive the exact co-ordination equation for optimum loading of thermal power plants considering line losses. **(08 Marks)**

b. What is a unit commitment problem? What are the different solution methods available to solve unit commitment problem. **(04 Marks)**

c. Explain the dynamic programming method to solve unit commitment problem. **(08 Marks)**

6 a. What do you understand by a secured power system? Discuss power system black out. **(06 Marks)**

b. Explain security constrained optimal power flow (SCOPF) with the help of typical power system oneline diagram. **(06 Marks)**

c. Explain the contingency analysis for detection of network problems using a suitable flow chart. **(08 Marks)**

7 a. Explain the weighted least square estimation (WLSE) used in power system state estimation (PSSE). **(10 Marks)**

b. Discuss : i) treatment of bad data ii) identification of bad data in PSSE. **(10 Marks)**

8 a. Explain the modes of failures of a system with reference to system reliability. **(10 Marks)**

b. Obtain an expression for i) steady state reliability R, and Q, and ii) general reliability index R(t). **(10 Marks)**

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Eighth Semester B.E. Degree Examination, June/July 2015
Power System Operation and Control

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Explain the function of a typical digital computer control and monitoring of a power system with the help of a block diagram. **(10 Marks)**

b. Two areas are interconnected as shown in Fig.Q.1(b). The generating capacity of area A is 36000 MW and its regulating characteristic is 1.5% of capacity per 0.1 Hz. Area B has a generating capacity of 4000 MW and its regulating characteristics is 1% of capacity per 0.1 Hz. Find each area share of a 400MW disturbance (load increase) occurring in area B and the resulting tie-line flow. **(10 Marks)**

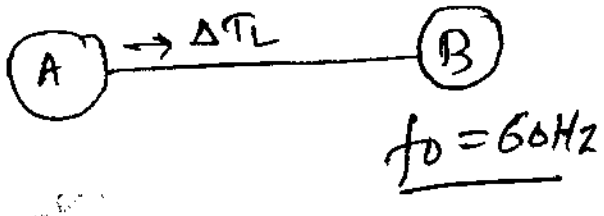

Fig.Q.1(b)

2 a. With a schematic diagram, explain the LFC loop and AVR loop of a generator:
LFC = load frequency control
AVR = automatic voltage regulator. **(08 Marks)**

b. Obtain the complete block diagram representation of load frequency control of an isolated power system. **(12 Marks)**

3 a. Obtain an expression for steady state change in system frequency Δf_{ss} for a step change in the load demand; assume free governor operation. **(12 Marks)**

b. A 100MVA alternator operating on rated load, uPF, at a frequency of 50Hz. The load is suddenly reduced to 50 MW. Due to time lag in the governor system, the steam valve begins to close after 0.4 seconds. Determine the change in frequency that occurs in this time. Take H = 5 kW-sec/kVA of generator capacity. **(08 Marks)**

4 a. Show that the real power flow between two nodes in determined by the transmission angle 'δ' and the reactive power flow is determined by the scalar voltage difference between two nodes. **(08 Marks)**

b. Define voltage stability and voltage collapse. **(04 Marks)**

c. Three supply points A, B and C are connected to a common bus bar M. Supply point A is maintained at a nominal 275 kV and is connected to M through a 275/132 kV transformer (0.1 pu reactance) and a 132 kV line of 50Ω reactance. Supply point C is nominally at 275 kV and is connected to M by a 275/132 kV transformer (0.1 pu reactance) and a 132 kV line of 50Ω reactance. If at a particular system load, the line voltage at M falls below its nominal value by 5kV. Calculate the magnitude of the reactive volt-ampere injection required at M to re-establish the original voltage. The per unit values are expressed on 500MVA base and resistance may be neglected throughout. Refer Fig.Q.4(c). **(08 Marks)**

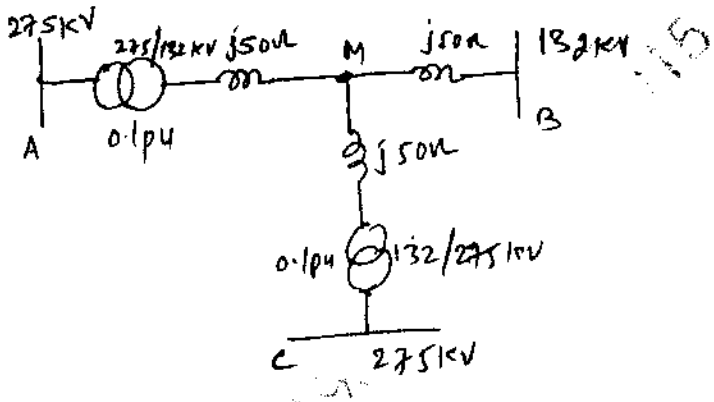

Fig.Q.4(c)

PART – B

5 a. Define unit commitment problem. **(04 Marks)**

b. Explain the dynamic programming (DP) method to solve unit commitment problem in a power system. **(10 Marks)**

c. Discuss the constraints in unit commitment for thermal plants. **(06 Marks)**

6 a. What do you understand by the term 'secured power system' and 'power system blackout'. **(06 Marks)**

b. Explain the security-constrained optimal power flow (SCOPF) function of power system security with an example. **(06 Marks)**

c. Explain contingency analysis using a suitable flow chart. **(08 Marks)**

7 a. Explain the weighted LSE (least squares estimation) method of power system state estimation. **(10 Marks)**

b. Explain: i) Suppression of bad data and ii) Identification of bad data in state estimation problem. **(10 Marks)**

8 a. Define reliability of a system. **(02 Marks)**

b. Explain the three modes of failure of a system. **(08 Marks)**

c. Obtain the expressions for steady-state reliability and general reliability function. **(10 Marks)**

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