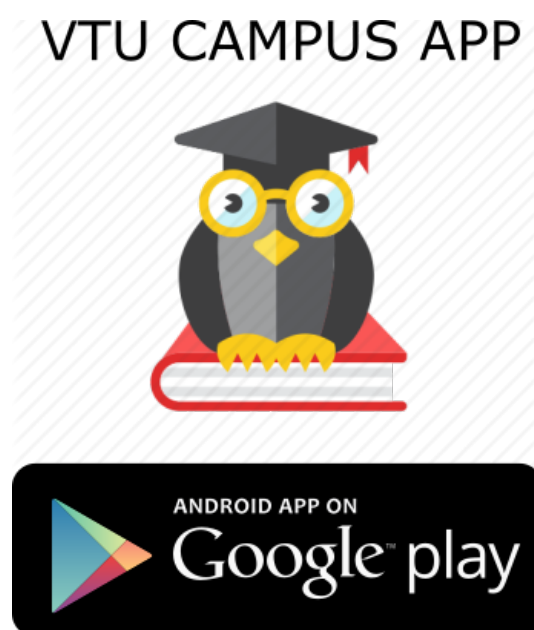


Power System Operation and Control VTU CBCS Question Paper Set 2018



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10EE82

Eighth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Power System Operation & Control

Time: 3 hrs.

Max. Marks:100

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

PART – A

- 1 a. Discuss different states of power system with neat sketch. (05 Marks)
b. Derive an expression for Tie-Line power and frequency deviation for two area system. (05 Marks)
c. Two synchronous Generators are initially supplying a common load at 1.0 p.u and frequency of 50 Hz. The rating of unit 1 is 337 MW and has 0.03 p.u droop built into its governor unit 2 is rated at 420 MW and has 0.05 p.u. droop. Find each unit share of 10% increase in load demand. Also find new-value of Line frequency. Assume free governor action. (10 Marks)
- 2 a. For two generators operating in parallel deduce,

$$R_{\text{system}} = \frac{1}{\frac{P_{1\text{rate}}}{R_1} + \frac{P_{2\text{rate}}}{R_2}} \text{ 1 /MW}$$
 Where R_1 and R_2 are droop characteristics of Generator 1 and Generator 2. (08 Marks)
 b. With a neat block diagram, explain (i) Load model (ii) Generator model. (06 Marks)
 c. Explain (i) Automatic generator control (ii) Area control error. (06 Marks)
- 3 a. With a block diagram, list the functions of, (i) AVR (ii) ALFC loops. (05 Marks)
 b. Determine the primary ALFC loop parameters for control area having the following data:
 (i) Rated capacity of area = 2000 MW (ii) Frequency = 50 Hz
 (iii) Inertia constant = 5.0 (iv) Operating load (P_D) = 1000 MW (05 Marks)
 c. A single area consist 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 system load is increased by 200 MW. Find (i) Steady state frequency and generation of each unit if $D = 0$. (ii) Repeat (i) if $D = 1.5$
 Assume a base of 2000 MVA. (10 Marks)
- 4 a. Explain different sources of reactive power generation and absorption of reactive power in a power system. (05 Marks)
 b. Deduce a equation relating voltage, power and reactive power at node. (05 Marks)
 c. A 220 KV, line has tap changing transformer at both ends. The transformer at sending end has a nominal ratio of 11/220 KV and that at receiving end 220/11 KV. The line impedance is $20 + j60\Omega$ and the load at the receiving end is 100 MVA , 0.8 γ .f (lag). If the product of two off-nominal tap setting is 1, find the tap-setting to give 11 KV at load Bus. (10 Marks)

PART – B

- 5 a. Explain in detail constraints in unit commitment problems. (10 Marks)
 b. With a neat flow-chart, explain forward dynamic programming method of solving u.c. problem. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages

- 6 a. What is meant by power system security? Explain major functions involved in system security. What are the factors affecting system security? (10 Marks)
b. With the help of flow-chart, explain contingency analysis. (10 Marks)
- 7 a. Explain 'Energy Management System'. (10 Marks)
b. Derive the steady-state reliability expression and general reliability expression. (10 Marks)
- 8 Write short notes on : (any four)
a. u.c. problem.
b. Least square estimation.
c. Spinning reserve.
d. B-coefficients.
e. Network sensitivity factors. (20 Marks)

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10EE82

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)

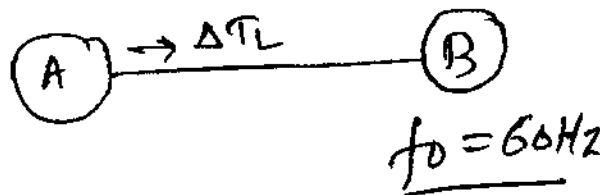


Fig.Q.1(b)

- 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 $H = 5 \text{ kW-sec/kVA}$ of generator capacity. (08 Marks)
- 4 a. Show that the real power flow between two nodes is 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)

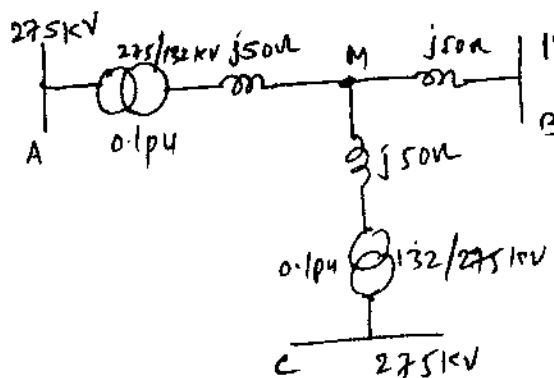


Fig.Q.4(c)

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)
- 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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10EE82

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 50MW. 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 $H = 5 \text{ kW-sec/KVA}$ 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)

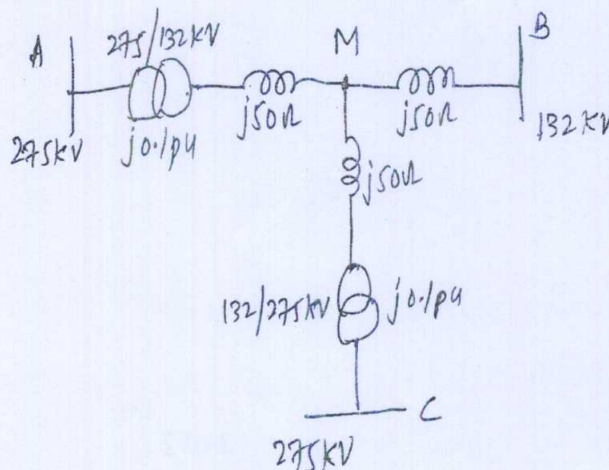


Fig. Q4(b)

- 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 50MW 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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10EE82

Eighth Semester B.E. Degree Examination, June/July 2017
Power System Operation & 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 control centre of a power system? Explain the function of control centre. (06 Marks)
b. With the help of a block diagram, explain the function of typical digital computer control and monitoring system in a power system. (08 Marks)
c. Explain the objectives and functions of AGC in a power system. (06 Marks)
2. a. Draw the schematic of load frequency control and excitation voltage regulators of a generator and explain. (08 Marks)
b. Explain with block diagram, the modeling of, (i) Speed governing system (ii) Turbine (iii) Generator and load. (12 Marks)
3. a. With a block diagram representation, explain tie-line bias control of a two area load frequency control. (12 Marks)
b. Two machines operate in parallel to supply a load of 400 MW, the capacities of the machines are 200 MW and 500 MW. Each has a droop characteristic of 4%. Their governors are adjusted so that the frequency is 100% on full load. Calculate the load supplied by each unit and the frequency at this load. The system frequency is 50 Hz. (08 Marks)
4. a. Explain briefly the components/equipments of power system that can generate and / or absorb reactive power. (06 Marks)
b. Derive the equation to get the relation between voltage, power and reactive power at a node. (08 Marks)
c. In the radial transmission system shown in Fig. Q4 (c), all p.u. values are referred to the voltages bases shown and 100 MVA. Determine the power factor at which the generator must operate. (06 Marks)

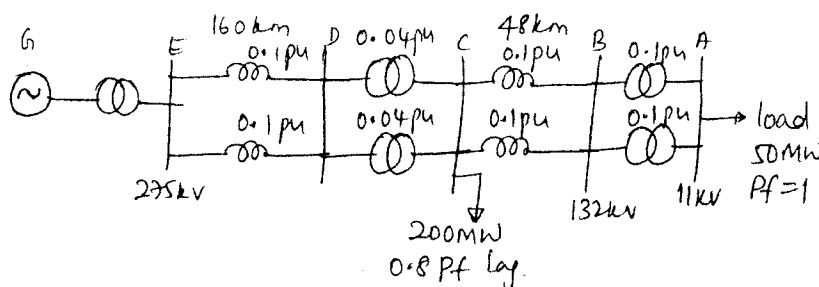


Fig. Q4 (c)

PART – B

5. a. Explain with flow chart unit commitment solution method. (10 Marks)
b. Define unit commitment problem. (04 Marks)
c. Discuss the constraints in unit commitment for thermal plants. (06 Marks)

- 6** a. Explain the Security-Constrained Optimal Power Flow (SCOPF) function of power system security with an example. (06 Marks)
b. Explain with the help of flow chart contingency analysis using sensitivity factors. (08 Marks)
c. Explain the factors affecting power system security. (06 Marks)
- 7** a. Explain the weighted least square 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. What are the requirements for power system adequacy assessment and also explain the adequacy indices. (10 Marks)
b. Define reliability and explain the three modes of failure of a system. (10 Marks)

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10EE82

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 begins 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.

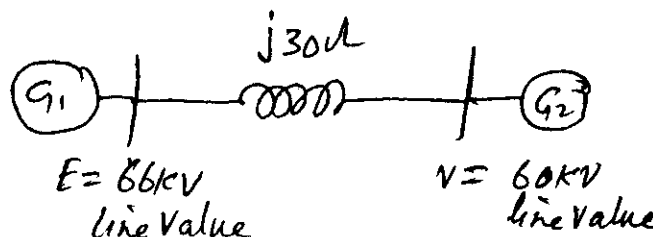


Fig.Q4(b)

(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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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)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing or identification, appear to evaluator and not equations written eg. 42+8=50, will be treated as malpractice.

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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