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Course Code

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Eighth Semester B.E. Degree Examinations, May 2026

POWER SYSTEM OPERATION AND CONTROL

Duration: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Missing data, if any, may be suitably assumed

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO: PI)</u>
<u>Module-1</u>			
1.	a. Analyze the factors affecting the reliability of power system control.	10	(2 : 1 : 1.4.1)
	b. Illustrate the different configurations of SCADA system.	10	(2 : 1 : 1.4.1)
(OR)			
2.	a. Discuss the major components of EMC and their significance in electrical systems.	10	(2 : 1 : 1.4.1)
	b. Analyze the role of different components of a SCADA system in power system monitoring and control.	10	(2 : 1 : 1.4.1)
<u>Module-2</u>			
3.	a. Illustrate the different modes of governor operation with neat diagram.	10	(3 : 2 : 1.4.1)
	b. A control area has following data: Total generation capacity = 2000 MW, Normal load 1500 MW, $h = 4.8s$; $d = 1.2\%$; $f = 50$ Hz; $R = 2.5Hz/pu$ MW. (i) Determine the primary ALFC parameters (ii) For an increase of 0.02pu in the load, find the frequency drop without governor control (iii) Repeat (ii) with governor control (iv) Repeat (ii) with governor control but frequency dependence of the loads neglected.	10	(3 : 2 : 2.1.2)
(OR)			
4.	a. Describe the AGC controller and proportional integral controller with neat block diagram.	10	(3 : 2 : 1.4.1)
	b. A power system has a total load of 1400 MW at 50 Hz. $D = 1.2$. A load of 50 MW is tripped. Find the steady-state speed(frequency) deviation if (i) There is no speed control. (ii) The system has a spinning reserve of 250 MW with a regulation of 4 % on this capacity. Due to governor dead band only 75 % of the governors respond to the change in load.	10	(3 : 2 : 2.1.2)
<u>Module-3</u>			
5.	a. Analyze the state space model of an isolated system and explain its components with a block diagram.	10	(2 : 3 : 1.4.1)
	b. A two-area system by a tie-line has the following parameters, on a base of 1000 MVA.	10	(3 : 3 : 2.1.2)

Area	1	2
Speed regulation	$R_1=0.05$	$R_2=0.0625$
Frequency-sensitive load coefficient	$D_1=0.6$	$D_2=0.9$
Inertia constant	$H_1=5.5$	$H_2=5$
Governor time constant	$T_{G1}=0.25s$	$T_{G2}=0.3s$
Turbine time constant	$T_{TR1}=0.5s$	$T_{TR2}=0.5s$

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

The units are operating at a nominal frequency of 50 Hz, when there is a sudden change in load of area 1 by 150 MW. The synchronising power coefficient $T = 2$ pu. Obtain the time-domain response of $\Delta\omega_1$, $\Delta\omega_2$, ΔP_{m1} , ΔP_{m2} and ΔP_{12} . Repeat for a step change of 150 MW in Area 2. If the value of R_1 is reduced to 0.01 what is the effect?

(OR)

6. a. Elaborate the frequency Bias Tie-Line control with neat block diagram. 10 (2 : 3 : 1.4.1)
- b. Two control areas are connected via a tie-line with the following characteristics: 10 (3 : 3 : 2.1.2)
- Area 1: $R_1=1\%$, $D_1=0.8$, base MVA= 500
 Area 2: $R_2=1\%$, $D_1=1.0$, base MVA= 500
 A load increase of 100 MW occurs in Area 1. What is the new steady state frequency and the change in tie-line flow if the nominal frequency is 50 Hz?

Module-4

7. a. Describe the generation and absorption of reactive power in power systems. 10 (2 : 4 : 1.4.1)
- b. Three generating stations are connected to a common bus bar X, as shown in Fig. Q 7(b), for a particular system load, the line voltage at bus bar falls by 2 kV. Calculate the reactive power injection required to bring back the voltage to the original value. All per unit values are on a 500 MVA base. Justify the answer. 10 (3 : 4 : 2.1.2)

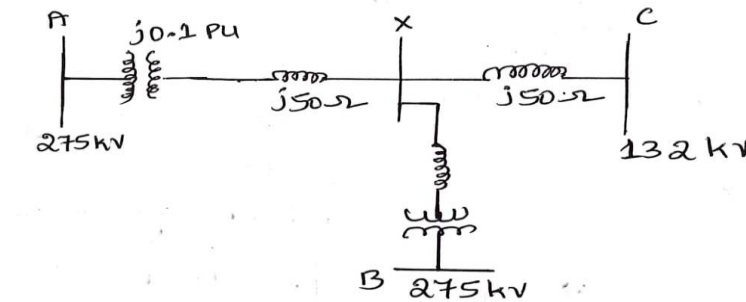


Fig. 7(b)

(OR)

8. a. Illustrate and explain the role of (i) tap changing transformers (ii) phase shifting transformers (iii) booster transformers in voltage control. 10 (2 : 4 : 1.4.1)
- b. A 415 V, 50 Hz, 3- ϕ system delivers 500 kW at 0.8 pf lag. Shunt capacitors are installed to raise the pf to 0.92. Determine the value of capacitor needed for both Star and Delta connection. Justify the answer. 10 (3 : 4 : 2.1.2)

Module-5

9. a. Analyze the different contingency analysis methods and their significance in power system security. 10 (2 : 5 : 1.4.1)
- b. Illustrate and explain the contingency selection procedure in power systems with a flowchart. 10 (2 : 5 : 1.4.1)
- (OR)
10. a. Describe the important factors affecting power system security. 10 (2 : 5 : 1.4.1)
- b. Identify the state variables and measurements involved in state estimation and explain the formulation of the problem. 10 (2 : 5 : 1.4.1)

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