Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2023

Subject Code:3170919 Date:19-12-2023

Subject Name: Power System Operation and Control

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. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What are GRC Constraints? What is its effect on Load Frequency control?	**03**
	(b)	Distinguish between two major functions (security assessment and security control) of power system security analysis.	**04**
	(c)	Explain Turbine speed governing mechanism/system with help of suitable diagram.	**07**
Q.2	**(a)**	Draw the flow chart of Contingency Analysis.	**03**
	(b)	Determine the primary load frequency control parameters K_{ps}, T_{ps} and B of control area having following data. Total rated capacity of a system = 1000 MW Inertia Constant H= 5 kWs/kVA Normal operating load = 500MW at 50Hz frequency. Assume change in load 1% for 1% change in frequency. (K_{ps}= gain of power system) and (T_{ps}= Time constant of power system), and (B = per unit rate of change of power with respect to frequency)	**04**
	(c)	Give classification of different operating state of power system as per security level and explain transition between various states due to contingencies and control actions with the help of suitable of diagram.	**07**
		OR	
	(c)	Derive the expression of transfer function of generator load model and draw its equivalent block diagram. (Hint: $\Delta F(s) = [\Delta P_G(s) - \Delta P_D(s)] \times \left[\frac{K_{ps}}{1+T_{ps}}\right]$	**07**
Q.3	**(a)**	Briefly discuss an implication of surge impedance loading on reactive power requirement of transmission line.	**03**
	(b)	Explain the operation of uncompensated radial transmission line under no load condition with help of vector diagram and the graph of voltage and current profile of transmission line	**04**
	(c)	A 220 kV, 3-Phase, 50Hz and 100 km long lossless transmission line has inductive reactance of 0.6 Ω/km while capacitive admittance of 50 μS/km operating under no load condition. Calculate 1) The Surge Impedance of transmission line 2) Surge Impedance Loading of transmission line 3) Receiving end voltage under no load condition with sending end voltage as reference. 4) Sending end current 5) Sending end reactive power at sending end under no load condition	**07**
		OR	
Q.3	**(a)**	What are pseudo measurements? What is its effect on state estimation?	**03**

	(b)	Derive equation Least square estimate $\hat{x} = (H^T H)^{-1} H^T z$, where z = measurement vector, z= State variable vector, $\hat{x}$ = estimated value of state variable and H= system matrix. The system is related as $z = Hx + r$, where is r is zero mean random variable	**04**
	(c)	What are bad data with respect to State Estimation? Explain the method of bad data detection?	**07**
Q.4	**(a)**	What is voltage collapse? Enlist the main factors that contribute the phenomena of voltage collapse.	**03**
	(b)	List various method of reactive power compensation and explain briefly series compensation.	**04**
	(c)	For a transmission line connected between two buses, derive the expression of voltage regulation and also prove from the phasor diagram that the Q and V have a strong coupling.	**07**
		OR	
Q.4	**(a)**	What is Network observability analysis? How it is ensured in state estimation?	**03**
	(b)	Derive equation of Weighted Least square estimate $\hat{x} = (H^T W H)^{-1} H^T W z$, where z = measurement vector, z= State variable vector, $\hat{x}$ = estimated value of state variable, H = system matrix and W = symmetric Weighting matrix. The system is related as $z = Hx + r$, where is r is zero mean random variable of same dimension as z.	**04**
	(c)	Explain the application of power system state estimation with suitable diagram.	**07**
Q.5	**(a)**	List various factors which motivated the deregulation of power industry.	**03**
	(b)	Explain Retail competition model with help of block diagram	**04**
	(c)	Explain function of different entities of deregulated power system.	**07**
		OR	
Q.5	**(a)**	List various methods for the prediction of deterministic part and stochastic part of load.	**03**
	(b)	List various methods of load forecasting and explain what is constant or deterministic part and variable or stochastic part of load curve.	**04**
	(c)	Explain long term load forecasting using econometric model.	**07**

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