Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI EXAMINATION – SUMMER 2025

Subject Code: 3160920 Date:30-05-2025

Subject Name: Inter Connected Power System

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 is meant by interconnected power systems? Explain in brief, the advantages of interconnection	**03**
	(b)	What is cascade tripping? Which conditions can lead to cascade tripping? Also explain the concept of islanding	**04**
	(c)	What is bus admittance matrix? Why bus admittance matrix is generally sparse? Discuss the formulation of bus admittance matrix using singular transformation method	**07**
Q.2	**(a)**	Discuss load flow problem and hence derive static load flow questions.	**03**
	(b)	Derive the criteria for most economic dispatch neglecting transmission losses	**04**
	(c)	Explain why frequency control is important in power system? Give valid reasons and explain which component of power system would be adversely affected when frequency deviates significantly from its normal value? Discuss tie line load bias method of frequency control	**07**
		OR	
	(c)	Discuss the different methods of voltage control employed in power systems	**07**
Q.3	**(a)**	How FDLF differs from NR method? Comment	**03**
	(b)	The following data for a certain power system is available Bus code Impedance Line charging Ypq 1-2 0.02 + j0.08 j0.08 1-3 0.06 + j0.24 j0.06 Find Y_{11} and Y_{12}	**04**
	(c)	Derive transmission loss formula in terms of B-loss coefficients	**07**
		OR	
Q.3	**(a)**	What is penalty factor? Under which conditions its value is equal to 1?	**03**
	(b)	Incremental fuel costs in Rs/MWhr for two units in a plant are $dF_1/dP_1 = 0.1P_1 + 20$ and $dF_2/dP_2 = 0.12P_2 + 16$. Determine incremental fuel cost and allocation of load between units when the load is 150 MW. Neglect losses	**04**
	(c)	With the help of flowchart, explain GS method of load flow	**07**
Q.4	**(a)**	Define steady state, dynamic and transient stability	**03**
	(b)	Discuss equal area criteria of stability	**04**
	(c)	Discuss the dynamics of synchronous machine and hence derive the swing equation	**07**
		OR	
Q.4	**(a)**	In a certain power system the sending and receiving end voltages are $\|Vs\| = 1.5$ pu, $\|Vr\| = 1.0$ pu and $X = 1.2$ pu. If operating angle $\delta = 30^0$, find the electrical power transferred.	**03**

	(b)	Discuss the transient model of synchronous machine tied to an infinite bus when mechanical input is suddenly increased	**04**
	(c)	Explain in detail the factors affecting transient stability	**07**
Q.5	**(a)**	What is acceleration factor in load flow? How it affects load flow solution?	**03**
	(b)	A 100 MVA synchronous generator operates initially at no load at 3000 rpm, 50 Hz. A 25 MW load is suddenly applied to the machine. Due to time lag in the governor system, the steam valves commence to open after 0.6 seconds. Determine the frequency of the system before the steam flow commences to increase to meet the new load. Assume H = 5 MW-sec/MVA	**04**
	(c)	Discuss numerical solution of the swing equation	**07**
		OR	
Q.5	**(a)**	Explain what is meant by synchronizing coefficient or electrical stiffness of the machine	**03**
	(b)	For the purpose of load flow analysis, classify different types of buses in power system	**04**
	(c)	What is meant by LDC? Explain the functions carried out by LDC	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2024

Subject Code:3160920 Date:24-05-2024

Subject Name:Inter Connected Power System

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 is Islanding?	**03**
	(b)	Discuss the significance of Load Dispatch Centre	**04**
	(c)	Form of Y- Bus using singular transformation technique. (Consider 0 bus as a ground)	**07**

From bus	To bus	X(pu)
0	1	0.2
0	2	0.2
1	2	0.1

Q.2	**(a)**	What is the purpose of load flow study?	**03**
	(b)	Discuss Static Load Flow Equations	**04**
	(c)	Discuss flow chart of N-R method used for load flow study	**07**

OR

	(c)	Discuss the comparison between different techniques used for load flow studies	**07**

Q.3	**(a)**	What is Booster Transformer? Discuss it as a tool for voltage control.	**03**
	(b)	Discuss tie line frequency control	**04**
	(c)	Discuss the modeling of speed governing system	**07**

OR

Q.3	**(a)**	Discuss Fixed Capacitor Thyristor Controlled Reactor as a tool for voltage control.	**03**
	(b)	Discuss Selective frequency control	**04**
	(c)	Two generating units rated for 130 MW and 220 MW has governor speed regulation of 6.0 and 4.0 percent from no-load to full-load, respectively. They are operating in parallel and sharing a load of 315 MW. Assuming free governor action, determine the load shared by each unit.	**07**

Q.4	**(a)**	Discuss Vertically Integrated Electricity Market	**03**
	(b)	What is Penalty factor considering unit commitment aspect?	**04**
	(c)	Discuss unit commitment using dynamic programing method	**07**

OR

Q.4	**(a)**	Discuss Power exchangers and spot pricing in power system in brief	**03**
	(b)	Discuss transmission loss formula	**04**
	(c)	In a power system, two units are connected in parallel. The incremental fuel cost for Gen-1 =0.02*(PG1) +10 Rs./MWh Gen-2= 0.03*(PG2) +20 Rs./MWh It has been observed that at optimal scheduling the units generated by Gen-1 and Gen-2 are 100MW (PG1=PG2=100 MW). If dPL/dPG2 =0.2, Find out the penalty factors of both the plants and dPL/dPG1	**07**
Q.5	**(a)**	What is power system stability? Classify the stability	**03**
	(b)	List out the assumptions to be considered for transient stability study.	**04**
	(c)	The two poles, 50 Hz, 11 kV turbo generator has a rating of 100 MW at 0.8 power facto. The moment of inertia of rotor is 11000 kg-m^2. Calculate Inertia constant (H) and Angular Momentum (M)	**07**

OR

Q.5	**(a)**	List out the methods to improve steady state stability	**03**
	(b)	Discuss the factors affecting transient stability limit.	**04**
	(c)	Discuss Point by point (considering swing equation) method to determine critical fault clearing time and angle.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023

Subject Code:3160920 Date:14-07-2023

Subject Name:Inter Connected Power System

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)**	In a 99 bus power system a new line is being added (with series admittance Y and shunt half line charging susceptances Y_0) between the buses 44 and 87. Give the expressions for calculating new Y bus matrix from the original Y bus matrix.	**03**
	(b)	In a 100 bus power system, there are 10 generators and rest are load bus. While solving for NRLF (polar) method, following dimensions of jacobian submatrices derived: J1= (99 x 99) J2= (99 x 90) J1= (90 x 99) J2= (89 x 89) Will problem solution converge or diverge? Explain.	**04**
	(c)	For the power system network shown in **fig. 1**, determine admittance matrix by singular transformation method	**07**

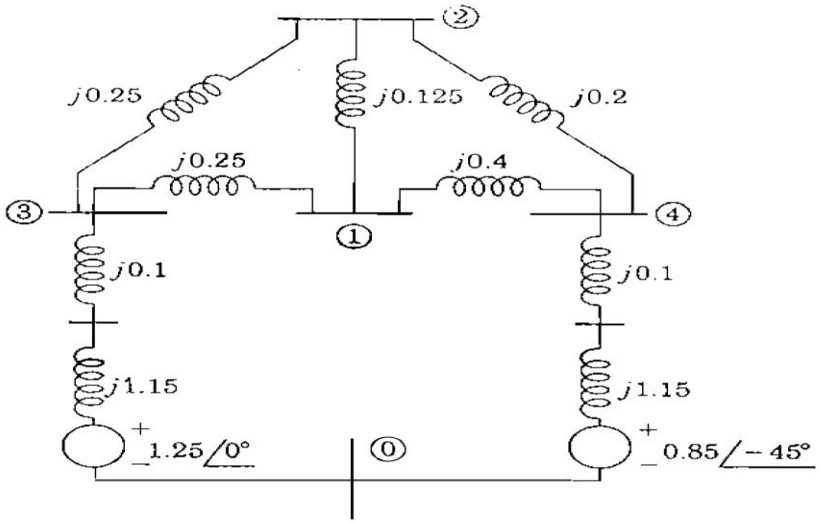

Fig. 1

Q.2	**(a)**	What is meant by interconnected power system? State its advantages.	**03**
	(b)	Breifely explain hierarchy of load dispatch centres of Indian national grid. Also discuss functions of load dispatch centres.	**04**
	(c)	For the power system shown in fig. 2, write down power flow equations in polar form.	**07**

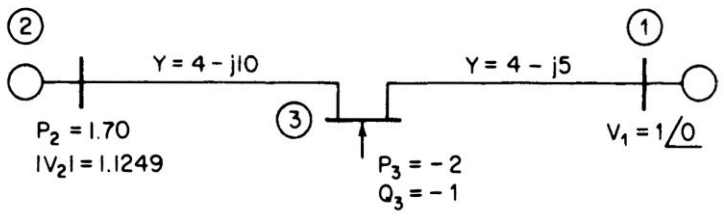

Fig.2

All values are given in p.u. [PTO]

OR

Q.2	**(c)**	Write down algorithm and draw flowchart for N-R method of load flow considering presence of PV bus in the system.	**07**
Q.3	**(a)**	Distinguish between steady state, transient and dynamic stability.	**03**
	(b)	A 100 MVA, 50 Hz alternator is operating at rated speed. The H constant of the machine is 5 kW · sec per kVA. The load suddenly increase by 50 MW. Due to delay in governor action there is a delay of 0.6 seconds in opening of steam valve. Find the frequency deviation.	**04**
	(c)	A synchronous machine is connected to an infinite bus through a transformer and transmission line. A 3-Φ fault occurs near the generator terminals which reduces the power transfer to zero. After some time the fault is cleared and original conditions are regained. Derive the expression for critical clearing angle and critical clearing time.	**07**

OR

Q.3	**(a)**	Discuss the effect of neutral grounding on the stability of power system.	**03**
	(b)	A 200 MVA 11 kV 50 Hz 4 pole generator has an intertia constant of 6 MJ/MVA. (a) Find the store energy in the rotor at synchronous speed. (b) The machine is operating at a load of 120 MW when the load is suddenly increases to 160 MV. Find the rotor retardation. Neglect losses. (c) Another generator 150 MVA, 3000 rpm, having H = 4 MJ/MVA is put in parallel with the above generator. Find the inertia constant for the equivalent generator on a base of 100 MVA.	**04**
	(c)	Discuss the dynamics of synchronous machine and hence derive the swing equation.	**07**
Q.4	**(a)**	Draw and describe significance of heat hate rate curve and incremental fuel rate curve.	**03**
	(b)	What do you understand by Unit Commitment?	**04**
	(c)	Derive the transmission loss formula explaining current distribution factors. Clearly state all assumptions made in above derivation.	**07**

OR

Q.4	**(a)**	Explain β-coefficient.	**03**
	(b)	Write basic criterion for economic division of load between units within a plant.	**04**
	(c)	What is incremental fuel cost? Give the steps for finding optimal loading of generators for system having N no. of generators in a plant.	**07**
Q.5	**(a)**	Discuss the factors affecting steady state stability.	**03**
	(b)	Discuss various methods of voltage contrel applied to the power system.	**04**
	(c)	List out the methods of Load Frequency Control and discuss (i) Selective Frequency Control and (ii) Tie Line Load Bias Control	**07**

OR

Q.5	**(a)**	Define critical clearing angle and critical clearing time	**03**
	(b)	How shunt compensation is differ from series compensation in voltage control?	**04**
	(c)	With the help of a neat diagram explain turbine speed governing system.	**07**

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2022

Subject Code:3160920 Date:10/06/2022

Subject Name:Inter Connected Power System

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 is Islanding? Elaborate the need of Islanding	**03**
	(b)	Discuss the main functions of Load Dispatch Centre and its grid arrangement.	**04**
	(c)	Form Y bus using data given in figure-1. Impedance of transmission line connected between two buses is shown in figure-1.	**07**
Q.2	**(a)**	Derive (i) Elements of Primitive Matrix and (ii) size of incidence matrix using figure-1.	**03**
	(b)	List out the methods used for formation of Ybus. Derive the equation of Ybus using singular transformation method.	**04**
	(c)	The governor speed regulation of Gen-1 and Gen-2 is of the order of 6.0 and 5.0 percent from no-load to full-load, respectively. The generation capacity of Gen-1 and Gen-2 is 250 MW and 350 MW, respectively. They are operating in parallel and share a load of 600 MW. Assuming free governor action and no-load operating frequency of generator is 50 Hz. determine the load shared by each unit.	**07**
		OR	
	(c)	List out the methods of Load Frequency Control and discuss (i) Selective Frequency Control and (ii) Tie Line Load Bias Control	**07**
Q.3	**(a)**	Discuss the need of load flow study and discuss importance of slack bus in load flow study.	**03**
	(b)	Derive the static load equations for active and reactive power	**04**
	(c)	Elaborate flow chart for load flow study using Newton-Rapson method.	**07**
		OR	
Q.3	**(a)**	List out the assumptions which are made to carry out approximate load flow study	**03**
	(b)	Discuss Bus classification for load flow study and mention specified quantities and quantities to be obtained on each of them.	**04**
	(c)	Discuss the comparison of Decoupled Load Flow method & Fast Decoupled Load Flow Method with Newton-Rapson Load Flow Method	**07**
Q.4	**(a)**	Discuss Incremental Rate curve	**03**
	(b)	Discuss Penalty factor	**04**
	(c)	A power system network consist of two plant is shown in Figure-2. The load is connected only at Bus-2. In this case, it is observed that 100 MW power flows from plant-1 to plant-2 which causes 10 MW power loss in transmission. The incremental costs of plants are given below dC1/dP1=0.2P1+22 dC2/dP2=0.15P1+19 Calculate the economic loading of plant 1 and 2 when λ (Lamda)=49. Also	**07**

calculate transmission line total load demand.

OR

Q.4	**(a)**	Discuss Incremental Rate Curve	**03**
	(b)	Discuss Optimal operation by co-ordination equation.	**04**
	(c)	Derive equation for transmission loss formula	**07**
Q.5	**(a)**	List out methods used to improve transient stability and elaborate (i) Single pole Switching (ii) Breaking resistors.	**03**
	(b)	The value of inertia constant for 500 MVA and 900 MVA synchronous machine is of the order of (H1) 5.0 MJ/MVA and (H2) 3.0 MJ/MVA, respectively. Both of these units are operated in parallel with each other. Determine the equivalent inertia constant (H) for two considering 100 MVA base.	**04**
	(c)	Discuss the application of Equal Area Criteria in brief and elaborate critical clearing angle and critical clearing time	**07**

OR

Q.5	**(a)**	Discuss the factors affecting steady state stability.	**03**
	(b)	Compare steady state stability with transient stability	**04**
	(c)	Discuss numerical solution of swing equation	**07**

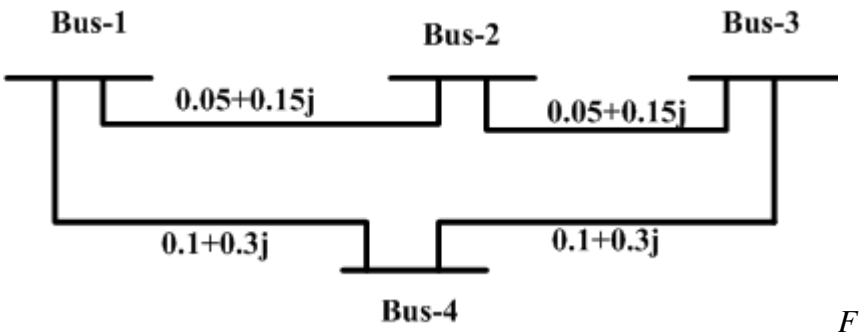

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Figure-1

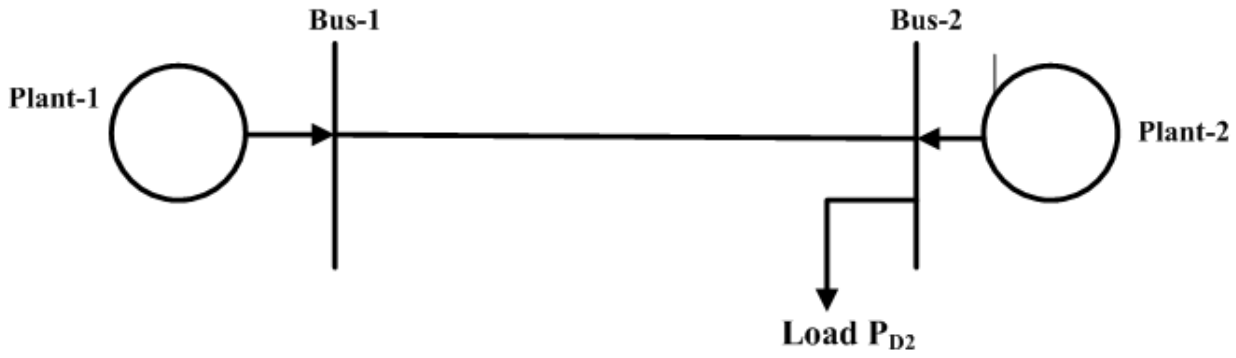

Figure-2