

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-VI EXAMINATION – WINTER 2025****Subject Code:3160920****Date:25-11-2025****Subject Name:Inter Connected Power System****Time:02:30 PM TO 05:00 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 need of interconnected power system? State its benefits. **03**
 (b) Derive the Static load flow equations. **04**
 (c) Determine the Y_{BUS} for a 3-bus system as shown in Figure 1. The line series impedances are as follows. **07**

Line (bus to bus)	Impedance (pu)
1-2	$0.06+j0.18$
1-3	$0.03+j0.09$
2-3	$0.08+j0.24$

If each line has a total shunt admittance of $-j0.5$ p.u. Determine the modified Y_{BUS} also.

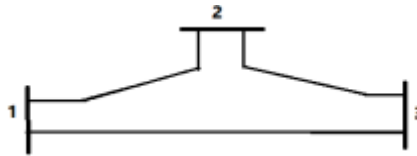


Figure 1

- Q.2** (a) Define types of Bus in detail. State the need of slack bus. **03**
 (b) Discuss the main functions of Load Dispatch Centre and its grid arrangement. **04**
 (c) The following is the system data for a load solution. **07**

Bus code	Admittance
1-2	$2-j8$
1-3	$1-j4$
2-3	$0.666-j2.664$
2-4	$1-j4$
3-4	$2-j8$

Bus	P_g	Q_g	P_d	Q_d	Bus Voltage
1	?	?	0	0	1.06
2	0	0	0.5	0.2	? (PQ)
3	0	0	0.4	0.3	? (PQ)
4	0	0	0.3	0.1	? (PQ)

Find the bus voltage V_2 and V_3 at the end of first iteration using GS method. Use acceleration factor $\alpha=1.6$.

OR

- Q.3** (c) Discuss the Z_{bus} building algorithm. **07**
 (a) What do you understand by Unit Commitment? **03**
 (b) A system having two generating units connected through a line has the following loss co-efficients, **04**

$$B_{11}=0.1 \times 10^{-2} \text{ MW}^{-1}$$

$$B_{12}= -0.01 \times 10^{-2} \text{ MW}^{-1}$$

$$B_{22}=0.13 \times 10^{-2} \text{ MW}^{-1}$$

Power is being dispatched economically with $P_1 = 120 \text{ MW}$ and $P_1 = 200 \text{ MW}$. To raise the system load by 1 MW cost an additional Rs. 40 per hour. Find the penalty factor of plant 1 and additional cost per hour to increase the output of plant 1 by 1 MW.

- (c) Derive the transmission loss formula explaining current distribution factors. Clearly state all assumptions made in above derivation. **07**

OR

- Q.3** (a) List out the assumptions which are made to carry out approximate load flow study. **03**

- (b) Input–output curve and heat rate curve of generating unit with proper label. **04**

- (c) The fuel costs of a two unit plant are given by **07**

$$C_1 = 100 + 2P_1 + 0.005P_1^2$$

$$C_2 = 200 + 2P_2 + 0.001P_2^2$$

Where P_1 and P_2 are in MW. The plant supplies load of 450 MW. Find economical load scheduling of two units and the incremental fuel cost. Neglect losses.

- Q.4** (a) Explain the Primitive Network. **03**

- (b) Define critical clearing angle and critical clearing time **04**

- (c) Discuss the procedure of solving swing equation using point by point method. **07**

OR

- Q.4** (a) What do you mean by cascade tripping? **03**

- (b) A two-pole 50 Hz 60 MVA turbo generator has a moment of inertia of $9 \times 10^3 \text{ Kg-m}^2$, Calculate (i) The kinetic energy, (ii) the inertia constant. **04**

- (c) Find the steady state power limit of a system consisting of a generator equivalent reactance 0.50 pu connected to an infinite bus through a series reactance of 1.0 pu. The terminal voltage of the generator is held at 1.20 pu and the voltage of the infinite bus is 1.0 pu. **07**

- Q.5** (a) Discuss the factors affecting steady state stability. **03**

- (b) List out the methods of Load Frequency Control and discuss (i) Selective Frequency Control and (ii) Tie Line Load Bias Control. **04**

- (c) With the help of a neat diagram explain turbine speed governing system. **07**

OR

- Q.5** (a) Compare GS and NR method of load flow study. **03**

- (b) Discuss Automatic Generation control (AGC) with block diagram **04**

- (c) Discuss the methods for improving transient stability in a power system in detail. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-VI (NEW) EXAMINATION – WINTER 2024****Subject Code: 3160920****Date:05-12-2024****Subject Name: Inter Connected Power System****Time: 02:30 PM TO 05:00 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) List the advantages and disadvantages of the interconnected power system. | 03 |
| | (b) Why the bus admittance matrix is a sparse matrix? (Answer in brief) | 04 |
| | (c) Fig. 1 shows the four-bus network with interconnected lines. The value on each line indicates the impedance of the line. The shunt admittance at each bus is assumed to be negligible. Utilizing the given data from the Y_{BUS} for the given network for two cases, | 07 |

Case -1: The dotted line between bus 2 and bus 3 is disconnected.

Case -2: The dotted line between bus 2 and bus 3 is connected.

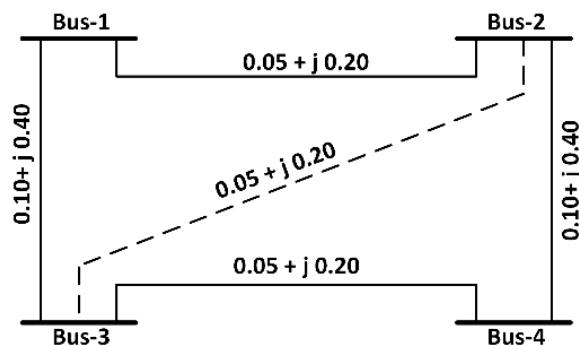


Fig. 1 Sample four bus network

- | | | |
|------------|--|-----------|
| Q.2 | (a) Explain the classification of buses. What is the significance of slack bus? | 03 |
| | (b) Compare the GS and NR methods of load flow study. | 04 |
| | (c) Discuss the Z_{bus} building algorithm. | 07 |
| | OR | |
| | (c) Explain the Fast Decoupled load flow method with necessary assumptions. | 07 |
| Q.3 | (a) List out the methods to improve steady-state stability. | 03 |
| | (b) Discuss the factors affecting the transient stability limit. | 04 |
| | (c) Discuss any method of obtaining critical fault clearing time and angle. | 07 |
| | OR | |
| Q.3 | (a) What do you mean by infinite bus with reference to the power system? | 03 |
| | (b) Explain with neat and clean waveforms (i) steady state stability and (ii) transient stability. | 04 |
| | (c) Derive the swing equation using point by point method. | 07 |
| Q.4 | (a) Explain (i) heat rate curve and (ii) incremental heat rate curve. | 03 |
| | (b) What is the penalty factor? Derive its expression in terms of incremental loss. | 04 |
| | (c) A system having two generating plants connected through a line has the loss co-efficient: $B_{11} = 0.1 \times 10^{-2} \text{ MW}^{-1}$, $B_{12} = -0.01 \times 10^{-2} \text{ MW}^{-1}$, and $B_{22} = 0.13 \times 10^{-2} \text{ MW}^{-1}$. Power is being dispatched economically with | 07 |

$P_1 = 120$ MW and $P_2 = 200$ MW. To raise the system load by 1 MW costs an additional Rs. 40 per hour. Find the penalty factor of plant 1 and the additional cost per hour to increase the output of the plant by 1 MW.

OR

- Q.4** (a) Explain generator operating cost. **03**
 (b) Briefly explain the unit commitment using the dynamic programming method. **04**
 (c) A two-bus system is shown in Fig. 3. If 100 MW is transmitted from plant 1 to the load, a transmission loss of 10 MW is incurred. Find the required generation for each plant and the power received by the load when the system λ is Rs. 25/MWh. The incremental fuel costs of the two plants are given below: **07**

$$dC_1/dPG_1 = 0.02PG_1 + 16.00 \text{ Rs/MWh}$$

$$dC_2/dPG_2 = 0.04PG_2 + 20.00 \text{ Rs/MWh}$$

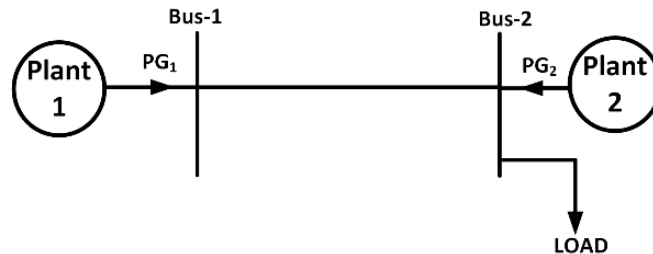


Fig. 2 A sample two-bus system.

- Q.5** (a) Explain in brief cascade tripping (blackout). **03**
 (b) Write basic criteria for economic division of load between units within a plant. **04**
 (c) With the help of a neat diagram explain the turbine speed governing system. **07**

OR

- Q.5** (a) Explain briefly the SCADA system. **03**
 (b) State the names of load dispatch centres in hierarchical order and explain their functions. **04**
 (c) Explain methods used for voltage control in a power system. **07**

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1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
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	Marks
Q.1 (a) Explain cascade tripping in power system.	03
(b) Describe network islanding phenomenon.	04
(c) Discuss advantages and disadvantages of Inter connected power system.	07
Q.2 (a) Define following terms (1) Oriented graph (2) Tree (3) Planner and non-planner graph	03
(b) Explain properties of Y-bus matrix. Why it is a sparse matrix?	04
(c) A three Bus, three line systems is shown in Figure-1, each line has as series impedance of $(0.05+j0.15)$ p.u., and the shunt admittance is neglected. Find Y_{BUS} . If a new bus (bus 4) is added with bus no.3 through transmission line of impedance $(0.1+j0.3)$ p.u., obtain New Y_{BUS} .	07

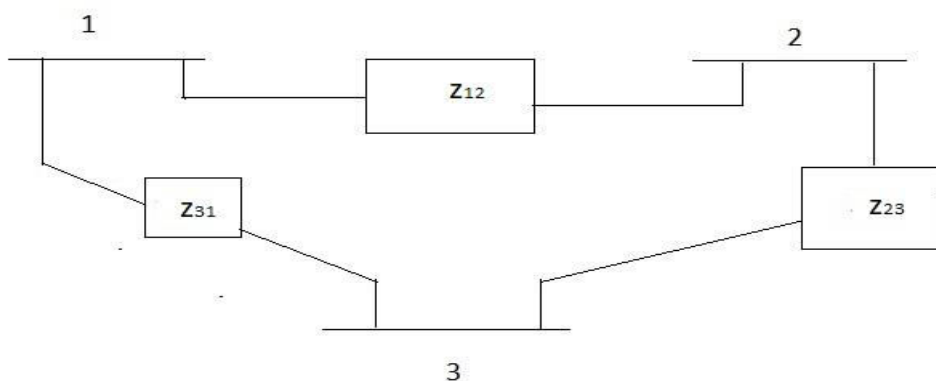


Figure-1

OR

(c) Explain following (1) Bus incidence matrix (2) Primitive network	07
Q.3 (a) Classify types of buses in power system for load flow analysis.	03
(b) By using Gauss-Seidel method determine the voltages V_1 and V_2 of following set of linear equation: $10V_1 + 2V_2 = 10$; $4V_1 + 7V_2 = 15$	04
(c) Describe Flow chart and Algorithm of load flow solution using Newton-Raphson method for all type of buses.	07
OR	
Q.3 (a) What is importance of slack bus in power system?	03
(b) Discuss Input –output curve and heat rate curve of generating unit with proper label.	04
(c) Write short notes on unit commitment and penalty factor.	07

- Q.4 (a)** What is flat frequency control method to be used for controlling frequency? **03**
- (b)** A power system has two generating plants and power is being dispatched economically with $P_1 = 200$ MW and $P_2 = 300$ MW. The loss coefficient are: **04**
 $B_{11} = 0.10 \times 10^{-2} \text{ MW}^{-1}$; $B_{12} = -0.10 \times 10^{-3} \text{ MW}^{-1}$; $B_{22} = 0.13 \times 10^{-2} \text{ MW}^{-1}$
 To raise the total load on system by 1 MW, an additional cost of 200 Rs/hour will be incurred.
 Find (1) The penalty factor of plant: 1
 (2) The additional cost per hour to increase the output of plant: 1 by 1 MW.
- (c)** Explain turbine speed governing mechanism for frequency control & derive a mathematical model of turbine speed governing system. **07**

OR

- Q.4 (a)** What is power system stability? Classify power system stability **03**
- (b)** Discuss Equal area criterion of stability. **04**
- (c)** A 100 MVA, 2 pole, 60 Hz generator has a moment of inertia $50 \times 10^3 \text{ Kg.m}^2$ **07**
 (1) What is energy stored in the rotor at rated speed?
 (2) What is corresponding angular momentum?
 (3) Determine the inertia H.
 (4) If the input to generator is suddenly increased by 25 MW, determine the rotor acceleration.

- Q.5 (a)** List out the assumptions which are made to carry out approximate load flow study. **03**
- (b)** Discuss Automatic Generation control (AGC) with block diagram. **04**
- (c)** Describe the comparison of GS method & Newton-Rapson Method with Fast Decoupled Load Flow method. **07**

OR

- Q.5 (a)** Explain the importance of voltage control in power system. **03**
- (b)** Discuss various methods to improve steady state stability. **04**
- (c)** Describe following **07**
 (1) Power angle curve.
 (2) Critical clearing angle.

Seat No.: _____

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GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3160920

Date:17-12-2022

Subject Name:Inter Connected Power System

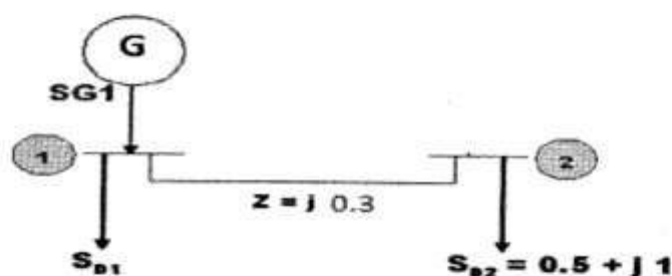
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Total Marks:70

Instructions:

1. Attempt all questions.
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		MARKS
Q.1*	(a) State objectives of Load flow Studies.	03
	(b) Define following terms regarding power system network with suitable examples. 1} Bus 2} Branch 3} Links 4} Tree and co-tree	04
	(c) State and derive swing equation for the synchronous machine connected to infinite bus as well as explain significance of swing equation.	07
Q.2	(a) List out input data requirement for load flow analysis.	03
	(b) Define voltage controlled bus, load bus and slack bus. Explain need of slack bus in power flow analysis.	04
	(c) Obtain voltage at bus 2 for the system shown in Fig given below using G-S Method.	07

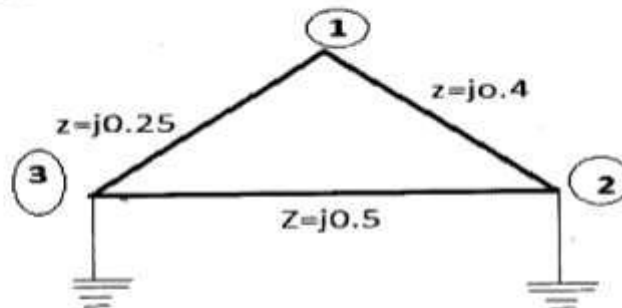


OR

	(c) Develop algorithm for solution of load flow equation in polar coordinates using Newton –Raphson method.	07
Q.3	(a) State advantages of Interconnected power system	03
	(b) Discuss function of load dispatch center.	04
	(c) Find Y-bus for the system given below.	07

From	To	Resistance	Reactance
1	2	0	0.35
2	3	0	0.45
1	3	0	0.3
GND	2	0	0.25
GND	3	0	0.1

- OR**
- Q.3** (a) Explain the Primitive network 03
 (b) Write scenario of recent Indian power system 04
 (c) Find Y – Bus of the given system using singular transformation method. 07



- Q.4** (a) Explain β - coefficient. 03
 (b) Derive the necessary condition for optimal operation of thermal power plants with the transmission losses considered. 04
 (c) A generator is supplying a load. An incremental change in load of 5 MW requires generation to be increased by 7 MW. The incremental cost at the plant bus is Rs 30 /MWh. What is the incremental cost at the receiving end? 07

- OR**
- Q.4** (a) Draw and describe significance of heat rate curve and Incremental fuel rate curve 03
 (b) Write basic criterion for economical division of load between units within a plant? 04
 (c) The fuel cost of two unit plants are given by $C_1 = 1.5 + 20P_1 + 0.1 P_1^2$; $C_2 = 2 + 30P_2 + 0.1 P_2^2$ where P_1 and P_2 in MW. The plant supplies a load of 250 MW. Find economic load scheduling of two unit and find incremental fuel cost, neglecting losses. 07

- Q.5** (a) Define critical clearing time and critical clearing angle as well as write equation of its in context of power system stability analysis. 03
 (b) List Out the assumptions that are made in order to simplify the computational task in stability studies. 04
 (c) Draw block diagram of AGC and Explain its Application 07

- OR**
- Q.5** (a) Explain significance of frequency control. Write component of power system which are more affected by frequency deviation. 03
 (b) Describe various methods for voltage control which is adopted in power system. 04
 (c) A 50Hz, 4 pole turbo alternator rated 100MVA, 11KV has an inertia constant of 6 MJ/MVA. Find 1}. The energy stored in the rotor at synchronous speed. 2}. The rotor acceleration if the mechanical input is suddenly raised to 120 MW for an electric load 90MW. 07