QP Code: RM21BTECH457 | Reg. No | | | | | | | | | | | AY 21

# GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Sixth Semester Regular) Examinations, May – 2024

**21BELPC36002 / 21BEEPC36002 – Power System Operation and Control**

(EE & EEE)

Time: 3 hrs | Maximum: 70 Marks

**(The figures in the right-hand margin indicate marks)**

**PART – A** **(2 x 5 = 10 Marks)**

| Q.1. Answer ***ALL*** questions | CO # | Blooms Level |
|---|---|---|
| a. Write down two advantages of PU representations of the power system. | CO1 | K1 |
| b. What are the different types of buses used for the load flow studies? | CO2 | K1 |
| c. What is meant by unit commitment? | CO3 | K2 |
| d. What does 'area control error' signify? | CO4 | K2 |
| e. Mention various faults that increase the severity of the equal area criterion. | CO5 | K1 |

**PART – B** **(15 x 4 = 60 Marks)**

| Answer ***ALL*** questions | Marks | CO # | Blooms Level |
|---|---|---|---|
| 2. a. A single-phase AC voltage of 250 is supplied to a series circuit whose impedance is 5+j8. Find Resistance, Reactance, Active, Reactive and the power factor of the circuit. | 5 | CO1 | K2 |
| b. The single line diagram of a small power system is shown in the fig:1, the corresponding reactance specified in p.u. is shown in the fig:2. A generator with emf 1.25 p.u. is connected through a transformer to high voltage node (3), while a motor with internal voltage 0.85 angle $45^0$ is similarly connected to node (4). Develop the nodal admittance matrix for each of the network branches and then write the nodal admittance equation of the system. | 10 | CO1 | K3 |

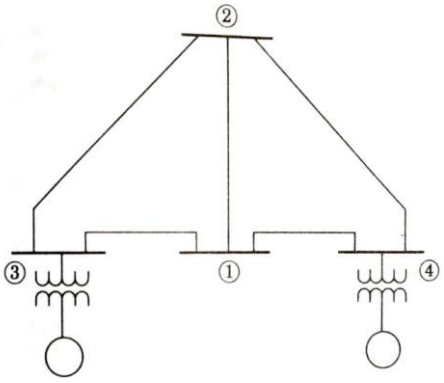


Fig.1: Single line diagram of the 4 bus system.

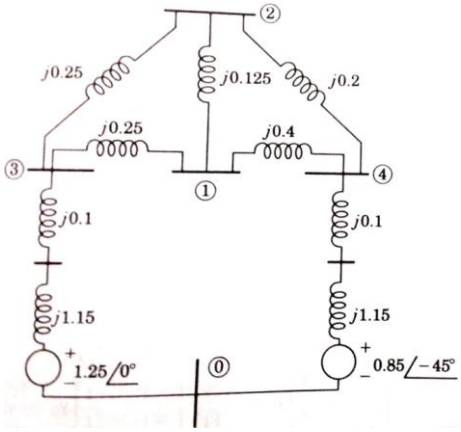


Fig.2: Reactance diagram of fig.2. Node (0) is reference, Reactance and voltages are in p.u.

(OR)

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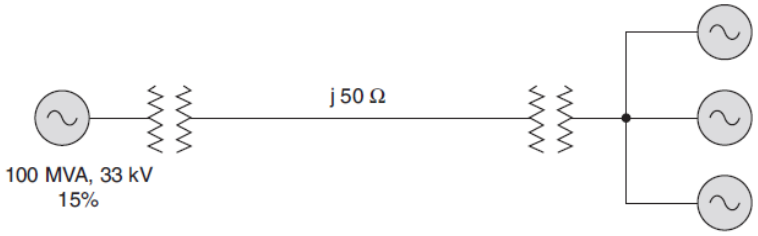
|---|---|---|---|
| c. Write short notes on the Fast Decoupled Power Flow method for load flow studies of power systems. | 5 | CO2 | K2 |
| d. A 100 MVA, 33 kV 3-phase generator has a sub-transient reactance of 15%. The generator is connected to the motors through a transmission line and transformers as shown in Fig. The motors have rated inputs of 30 MVA, 20 MVA, and 50 MVA at 30 kV with 20% sub-transient reactance. The 3-phase transformers are rated at 110 | 10 | CO1 | K2 |

MVA, 32 kV, and Δ/110 kV Y with leakage reactance 8%. The line has a reactance of 50 ohms. Selecting the generator rating as the base quantities in the generator circuit, determine the base quantities in other parts of the system and evaluate the corresponding p.u. values.

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|---|---|---|---|---|
| 3.a. | Explain the Static response of a Primary ALFC loop. | 8 | CO4 | K2 |
| b. | A power plant has three units with the following cost characteristics:<br>$C_1 = 0.5{P_1}^2 + 215P_1 + 5000 \ \frac{Rs}{h}$<br>$C_2 = 1.0{P_2}^2 + 270P_2 + 5000 \ \frac{Rs}{h}$<br>$C_3 = 0.7{P_3}^2 + 160P_3 + 9000 \ \frac{Rs}{h}$<br>Where $P_1$, $P_2$ and $P_3$ are generating powers in MW. The maximum and minimum loads allowable on each unit are 150 and 39 MW. Find the economic scheduling for a total load of (i) 320 MW (ii) 200 MW. | 7 | CO3 | K3 |
| | (OR) | | | |
| c. | Explain different constraints of the Unit Commitment problem. | 7 | CO3 | K2 |
| d. | Two generators rated with 221MW and 429MW are operating in Parallel. The drop characteristics of their governors are 4.15% and 5.35% respectively from no-load to full load. The speed changers are so set that the generators operate at 50 Hz sharing the full load of 650MW in the ratio of their ratings. If the load reduces to 550 MW, what will be the load shared by each generator? Also, find out the system frequency under this condition. | 8 | CO4 | K3 |
| 4.a. | Explain the Dynamic response of two area system. | 8 | CO4 | K2 |
| b. | Two interconnected areas A and B have capacities of 2000 and 750 MW, respectively. The speed regulation coefficients are 0.1 p.u. for both the areas on their area ratings. The damping torque coefficients are 1.0 p.u. also on their own base. Find the steady-state change in system frequency when a load increment of 50MW occurs in area A. Find also the tie line power deviation. The system frequency is 50Hz. | 7 | CO4 | K3 |
| | (OR) | | | |
| c. | What do you understand by Tie line in a power system? Model the tie-line of a two-area system. | 7 | CO4 | K2 |
| d. | The parameters of two equal areas are given below.<br>R = 3.0 Hz/pu MW<br>H = 5 sec<br>(i) Determine the synchronizing coefficient $T_0$ of the line assuming the tie line capacity of 0.1 pu and operating at a power angle of $45^0$.<br>(ii) Determine the damped angular frequency of oscillation after a disturbance occurs. | 8 | CO4 | K2 |
| 5.a. | Write short notes on the "Role of Automatic voltage regulator in improving stability". | 7 | CO5 | K2 |
| b. | A power station A consists of two synchronous consists of two synchronous generators. The generator-1 has a rating of 50 MVA, 50 Hz, 1500 rpm, and has an inertia constant of 8MJ/MVA. The generator-2 has a rating of 100MVA, 50 Hz, 3000 rpm, and has an inertia constant of 4 MJ/MVA. | 8 | CO5 | K2 |

i. Find the inertia constant for the equivalent generator on a base of 100MVA
ii. Another power station B has 4 generators two of each of the above types. Find the inertia constant for the equivalent generator on a base of 100MVA
iii. If the two power systems are connected through an interconnector, find the inertia constant for the equivalent generator connected to the infinite bus bar.

(OR)

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|---|---|---|---|---|
| c. | Derive the swing equation of a single generator system. | 8 | CO5 | K2 |
| d. | Write short notes on Equal area criteria for power system stability analysis. | 7 | CO5 | K2 |

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