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# PRESIDENCY UNIVERSITY BENGALURU

## Department of Research & Development

### Mid - Term Examinations - AUGUST 2024

**Odd Semester:** Ph.D. Course Work

**Course Code:** EEE802

**Course Name:** Power System modelling and Analysis

**Department:** EEE

**Date:** 12-08-2024

**Time:** 09.30am to 11.00am

**Max Marks:** 50

**Weightage:** 25%

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#### Instructions:

- (i) Read the all questions carefully and answer accordingly.
  - (ii) Do not write any matter on the question paper other than roll number.
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#### PART A (THOUGHT PROVOKING)

**Answer all the Questions. Each question carries 5 marks.**

**(4Qx 5M= 20M)**

1. Compare and contrast the Gauss-Seidel and Newton-Raphson methods in terms of convergence speed and computational complexity. (CO:01 BL: Comprehension)
2. Explain the relationship between reactive power (Q) and voltage magnitude ( $|V|$ ) in a power system. (CO:01 BL: Comprehension)
3. During system disturbances, such as faults or sudden changes in load, the Automatic Voltage Regulator (AVR) helps maintain transient stability by rapidly adjusting the generator's excitation. Describe the dynamic model of AVR and list its the key components (CO:02 BL: Comprehension)
4. In a single-area system, Automatic Load-Frequency control (ALFC) ensures that the system frequency remains stable by adjusting the power output of the generators in response to load changes. Explain the principle and key components of ALFC. (CO:02 BL: Comprehension)

#### PART B (PROBLEM SOLVING)

**Answer all the Questions. Each question carries 10 marks.**

**(3Qx 10M= 30M)**

1. A power system has a total load of 500 MW and operates at a nominal frequency of 50 Hz. Due to an unexpected increase in load, the total load rises to 525 MW. The system has a frequency droop characteristic of 5% (i.e., a 5% change in frequency corresponds to a 100% change in load). Calculate the new system frequency after the load increase. (CO:01 BL: Application)

2. A power system bus operates at 1.0 pu voltage and consumes 40 MVAR of reactive power. A capacitor bank of 30 MVAR is installed at the bus. Assume the system voltage before and after capacitor bank installation remains within acceptable limits and the system is linear. Calculate the new voltage magnitude at the bus if the initial reactive power consumption caused a 5% voltage drop. (CO:01 BL: Application)
  
3. A synchronous generator is equipped with an AVR. The reference voltage ( $V_{ref}$ ) is set to 1.0 pu (per unit). The terminal voltage ( $V_t$ ) is measured to be 0.95 pu. The AVR has a gain ( $K_A$ ) of 200 and a time constant ( $T_A$ ) of 0.1 seconds. Calculate the field voltage ( $V_f$ ) after a short interval (e.g., 0.05 seconds) assuming the initial field voltage was 0. (CO:02 BL: Application)