# GUJARAT TECHNOLOGICAL UNIVERSITY
## BE- SEMESTER–VII EXAMINATION – WINTER 2025

**Subject Code:3170915**                                          **Date:28-11-2025**

**Subject Name:Power System Dynamics 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)** | Enlist the major assumptions behind the classical model of the generator. | **03** |
|  | **(b)** | Discuss the significance of power system stability. | **04** |
|  | **(c)** | Explain the equal area criterion method used for analyzing transient stability of a single machine infinite bus (SMIB) system. | **07** |
| **Q.2** | **(a)** | State the advantages of an appropriate per unit system. | **03** |
|  | **(b)** | Draw the functional block diagram of the excitation control system and list the distinct types of excitation systems used in a three-phase synchronous generator. | **04** |
|  | **(c)** | Derive the Mutual Inductance matrix for the three-phase synchronous machine. | **07** |
|  |  | **OR** |  |
|  | **(c)** | Analyze the transient performance of the three-phase synchronous machine connected to a voltage source. | **07** |
| **Q.3** | **(a)** | Differentiate between the roles of the power system stabilizer (PSS) and the excitation system stabilizer (ESS). | **03** |
|  | **(b)** | Describe the significance of Park's transformation. | **04** |
|  | **(c)** | Derive the transfer function for a separately excited DC generator with necessary diagrams. | **07** |
|  |  | **OR** |  |
| **Q.3** | **(a)** | Compare windup limiter with non-windup limiter. | **03** |
|  | **(b)** | Express the voltage equations for the three-phase synchronous machine. | **04** |
|  | **(c)** | Elaborate on the speed governing system utilized in hydroturbines, including relevant diagrams. | **07** |
| **Q.4** | **(a)** | List the major assumptions employed in the derivation of the basic equations of the synchronous machine. | **03** |
|  | **(b)** | Explain the general load model briefly. | **04** |
|  | **(c)** | Describe the modeling of transmission lines through D-Q transformation utilizing α-β variables. | **07** |
|  |  | **OR** |  |
| **Q.4** | **(a)** | Draw the schematic diagram for a 3-phase synchronous machine along with its winding notations. | **03** |
|  | **(b)** | Discuss the various factors related to load modelling. | **04** |
|  | **(c)** | Explain the Static Var Compensators (SVC) along with their application. | **07** |

**Q.5** **(a)** Classify the models of the three-phase synchronous machine defined by IEEE. **03**

**(b)** Explain the system model using an external two-port network. **04**

**(c)** Outline the procedure for calculating the initial conditions of a synchronous generator using a phasor diagram. Consider synchronous machine model 1.1. **07**

**OR**

**Q.5** **(a)** Express the rotor mechanical equations of the three-phase synchronous machine for Model 1.1. **03**

**(b)** Outline Heun's method for obtaining system responses to various disturbances. Consider synchronous machine model 1.1. **04**

**(c)** Derive the stator equivalent circuit of a three-phase synchronous machine with a field circuit and two equivalent damper windings on the q-axis (Model 2.2) along with its stator equations. **07**

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