

**THE KAVERY ENGINEERING COLLEGE***(An Autonomous Institution)***UG/PG DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2026****Second Semester****ME Power System Engineering****PPST2422- POWER SYSTEM DYNAMICS****Regulations - 2024****Duration: 3 Hrs.****Maximum: 100 Marks****PART – A(ANSWER ALL QUESTIONS) (Marks 10\*2=20)**

| <b>Q.No</b> | <b>Questions</b>                                                                       | <b>BLT</b> | <b>CO</b> | <b>Marks</b> |
|-------------|----------------------------------------------------------------------------------------|------------|-----------|--------------|
| 1.          | What is the purpose of modeling a synchronous machine?                                 | 1          | 1         | 2            |
| 2.          | Write the stator voltage equation of a synchronous machine.                            | 2          | 1         | 2            |
| 3.          | State the significance of excitation system modeling in power system dynamic studies.  | 2          | 2         | 2            |
| 4.          | What parameter is controlled by the speed governing system?                            | 2          | 2         | 2            |
| 5.          | Name two types of disturbances considered in small-signal stability studies.           | 1          | 3         | 2            |
| 6.          | Why is the classical model used for stability studies?                                 | 1          | 3         | 2            |
| 7.          | What is the main function of a Power System Stabilizer (PSS)                           | 2          | 4         | 2            |
| 8.          | What is the function of an Automatic Voltage Regulator (AVR) in stability enhancement? | 2          | 4         | 2            |
| 9.          | Describe shaft speed signal?                                                           | 2          | 5         | 2            |
| 10.         | Comparison between phase lead & lag compensations                                      | 5          | 5         | 2            |

**PART – B (ANSWER ALL QUESTIONS) (Marks 5\*16 = 80)**

| <b>Q.No</b> | <b>Questions</b>                                                                                                                                    | <b>BLT</b> | <b>CO</b> | <b>Marks</b> |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|--------------|
| 11. a       | Explain the transformation of synchronous machine equations from the a-b-c frame to the d-q-0 reference frame.                                      | 2          | 1         | 16           |
|             | <b>Or</b>                                                                                                                                           |            |           |              |
| b           | Explain the relationship between stator flux linkage, terminal voltage, and stator current in a synchronous machine.                                | 2          | 1         | 16           |
| 12. a       | Explain the IEEE Type-1 excitation system model with necessary block diagrams and transfer functions                                                | 3          | 2         | 16           |
|             | <b>Or</b>                                                                                                                                           |            |           |              |
| b           | Draw and explain the block diagram of a governor system with transient droop compensation. Derive the governing equations for its dynamic response. | 3          | 2         | 16           |

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|-----------|---|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|----|
| 13.       | a | i | Explain the concept of Single-Machine Infinite Bus (SMIB) system with the help of a neat diagram. Derive the swing equation for the classical model of a synchronous machine connected to an infinite bus. Also, explain the assumptions made in the classical machine model.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2 | 3 | 16 |
| <b>Or</b> |   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |    |
|           | b | i | Two identical machines feed a common load. The impedance between each machine terminal and the load bus is $0+j0.8$ p.u. on machine rated MVA. Other relevant data is given below. The terminal voltage of each machine is 1.0 p.u. Determine the network equations in the individual machine rotor (d-q) coordinates for small signal stability analysis. Assume uniform damping and classical models for the machines; ignore governor action. Generator data: Both generators are identical, rating of each =123.5MVA; reactance parameters of each machine on its own rating are $X_d=2.225, X_q=2.11, X'_d=0.266, T'_{do}=7.0$ sec. Total kinetic energy stored at synchronous speed of both machines=379.2MJ; rated frequency =50Hz. Loading Data: Both generators are identically loaded; active power output of each machine=0.5 p.u. On total rated MVA; power factor=0.85. choose the base MVA as 247. Also, (i) Derive linearised network equations suitable for small signal stability analysis. (ii) Derive state equations for small signal stability analysis (iii) Compute Eigen values and comment on stability. Assume uniform damping and classical models for the machines; ignore governor action. | 5 | 3 | 16 |
| 14.       | a | i | Explain the Thyristor-Based Excitation System with AVR in detail. Draw and describe the block diagram showing the Exciter and AVR. Discuss the effect of AVR on the Synchronizing Torque and Damping Torque components.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3 | 4 | 16 |
| <b>Or</b> |   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |    |
|           | b | i | Explain the Small Signal Stability of Multi-Machine Systems. Discuss the factors affecting it and the methods to improve small signal stability.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2 | 4 | 16 |
| 15.       | a | i | Draw a neat block diagram of power system stabilizer and explain in detail the function of each block                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3 | 5 | 16 |
| <b>Or</b> |   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |    |
|           | b | i | Describe the design and implementation of phase lead compensators in power system stabilizer (PSS), and discuss their role in improving damping of power system oscillations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2 | 5 | 16 |

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