ADVANCED POWER SYSTEMS

Economics Operation: Economic dispatch problem of thermal units without and with losses – Gradient Method – Newton's Method – Base point and participation factor method.

Unit Commitment Solutions Methods: Introduction to unit commitment, method of unit commitment: Priority – List Methods, Dynamic Programming Solution, Forwards DP Approach, Lagrange relaxation solution.

Hydro-Thermal Co-Ordination: Hydroelectric plant models – Short Term Hydroelectric scheduling problem – gradient approach.

Optimal Power Flow: Solution of OPF, gradient method, Newton's method, linear programming method with only real power variables, linear programming with AC power flow variables, security constrained optimal power flow.

Power System Security: Contingency analysis – linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow.

The Control Problem: The two-area system, Tie-line Bias control; steady state instabilities: Torsional Oscillatory Model-Damper windings and negative damping, effect of AVR loop:AGC Design using kalman method-state variable form of the dynamic model, optimum control index, stte trajectories, the RICCATTI equations, preventive and emergency control, computer control.

TEXT BOOKS:

1. Allen J.Wood and Wollenberg B.F., 'Power Generation Operations and Control', John Willey & Sons, second edition, 1996.
2. 'Electric Energy Systems Theory-An Introduction', Olle I Elgard, TMH second edition.

REFERENCES:

1. Kirchmayer L. K., 'Economic Control of Interconnected systems', John Willey & Sons, 1959.
2. Nagrath, I.J. and Kothari D. P., 'Modern Power System Analysis', TMH, New Delhi, 2006.

ADVANCED CONTROL SYSTEMS

State Variable Representation: Introduction-Concept Of State-State Equation For Dynamic Systems-Time Invariance And Linearity-No Uniqueness Of State Model-State Diagrams-Physical System And State Assignment.

Solution Of State Equation: Existence And Uniqueness Of Solutions To Continuous Time State Equations-Solution Of Nonlinear And Linear Time Varying State Equations-Evaluation Of Matrix Exponential-System Models-Role Of Eigen Values And Eigen Vectors.

Controllability And Observability: Controllability And Observalibility-Stabilizability And Detectability-Test For Continuous Time Systems-Time Varying And Time Invariant Case-Output Controllability-Reducibility-System Realizations.

Stability: Introduction-Equilibrium Points-Stability In The Sense Of Lyapunov-BIBO Stability-Stability Of LTI Systems-Equilibrium Stability Of Nonlinear Continuous Time Autonomous Systems-The Direct Method Of Lyaunov And The Linear Continuous Time Autonomous Systems-Finding Lyapunov Functions For Nonlinear Continuous Time Autonomous Systems-Krasovskii And Variable-Gradient Method.

Modal Control: Introduction-Controllable And Observable Companion Forms-SISO And MIMO Systems-The Effect Of State Feedback On Controllability And Observability-Pole Placement By State Feedback For Both SISO And MIMO Systems-Full Order Ad Reduced Order Observers.

TEXT BOOKS:

1. M. Gopal, “Modern Control System Theory”, New Age International, 2005.
2. K. Ogatta, “Modern Control Engineering”, Phi, 2002.

REFERENCES:

1. John S. Bay, “Fundamentals Of Linear State Space Systems”, Mc Graw-Hill, 1999
2. D. Roy Choudhury, “Modern Control Systems”, New Age International, 2005.
3. John J. D’azzo, C.H.Houpis And S.N.Sheldon, “Linear Control System Analysis And Deign With Matlab”, Taylor Francis, 2003.
4. Z. Bubnicki, ”Modern Control Theory”, Springer, 2005.

Department of Electrical Engineering

Qualifying Examination for PhD Submission

ADVANCED POWER SYSTEMS

Model Question Paper

Time: 3 hrs   Max.Marks:100

Answer any Five Questions

All questions carry equal marks

1. a) Explain Newton's method of economic dispatch problem.
   b) Discuss the base point and participation factors method of economic load dispatch.

2. a) What is the unit commitment problem? Discuss the constraints in unit commitment.
   b) Explain the Lagrange relaxation technique of unit commitment solution.

3. a) Explain in detail, the long range and short range hydro scheduling.
   b) A hydroplant and a steam plant supply a constant load of 90W for 1 week. The unit characteristics are
   Hydroplant : $q=300+15P_H$ acre-ft/h; $0\leq P_H\leq 100$MW
   Steam Plant : $H_s=53.25+11.27P_s+0.0213\ P_s^2$;
   $12.25\leq P_s\leq 50$MW
   If the hydroplant is limited to 10 GWH of energy, find the runtime of the steam unit T_s^*.

4. a) Explain the gradient approaches hydrothermal scheduling.
   b) Explain the dynamic programming solution technique to hydrothermal scheduling problem.

5. a) Describe the application of OPF.
   b) Explain Newton's method of OPF solution.

6. a) Explain the flow diagram of security constrained OPF.
   b) What is the linear sensitively analysis? Explain.

7. a) Explain the four operating states power system.
   b) Explain the bounding technique of ac network analysis.

8. a) Explain the objectives of AGC
   b) Explain the preventive and emergency control problems in two area systems.

Department of Electrical Engineering

Qualifying Examination for PhD Submission

ADVANCED CONTROL SYSTEMS

Model Question Paper

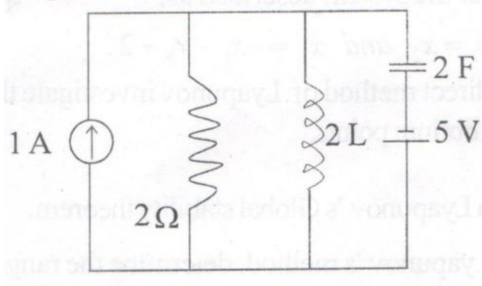
Time: 3 hrs | Max.Marks:100

Answer any Five Questions

All questions carry equal marks

1. a) Define and explain state, state variable, trajectory and portrait.

   b) Obtain the state model of the following system, state assumptions made, if any



2. a) Explain the significance of Jordan canonical approach.

   b) Obtain characteristics equation of the system matrix

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$$

3. a) Derive an expression to find the solution to state equation using the solution to differential equation.

   b) Obtain state transition matrix if $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$

4. a) Explain observable canonical form of the state space representation.

   b) Check controllability and observability if the system is given as: $d^3y(t)/dt^3 = u(t)$

5. a) Explain the classification of equilibrium points.

   b) Consider the system described as $x_1 = x_2$ *and* $x_2 = -x_1 - x_2 + 2$

   Using direct method of Lyapunov investigate the stability of the equilibrium points.

6. a) Explain Lyapunov's Global stability theorem.

   b) Using Lyapunov's method, determine the range of values of 'k' for which the system is table at the origin.

$$X_1 = kX_1[X_1^2+X_2^2]+X_2$$
$$X_2 = kX_1[X_1^2+X_2^2]-X_1$$

7. a) Explain the design of prediction observer

   b) Explain the necessary and sufficient condition for arbitrary pole-placement.

8. Write short notes on

   a) Sign definition of a function

   b) Variable gradient method for generation fo Lyapunov's function.

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