(3 Hours)

[Total marks: 80]

N.B:- (1) **Question 1 is compulsory**
     (2) Solve any **three** questions from remaining **five** questions.
     (3) Figures to the right indicate **full** marks.
     (4) Assume suitable data if necessary.

Q1   Answer the following questions.   **20**

a) Solve the following NLPP using lagrange's multiplier method
$$Max\ Z = 5x_1 + x_2 - (x_1\text{-}x_2)^2$$
$$\text{Subjected to } x_1 + x_2 = 4$$
$$x_1, x_2 \geq 0$$

b) What are the different methods of solving OPF problem.
c) Explain the importance of state estimation in power system.
d) What do you understand by system monitoring.

Q2 a)   What are linear sensitivity factors. Derive expression for the same.   **10**
Q2 b)   What is unit commitment? Define briefly various constraint imposed while solving   **10**
     unit commitment problem.

Q3 a)   Solve the following two variable unconstrained non-linear problem using Gradient   **10**
     search method. Do 2 iterations
$$Max\ f(x) = 8x_1 - x_1^2 - 12x_2 - 2x_2^2 + 2x_1x_2$$
Q3 b)   What do you understand by network observability and pseudo measurements in state   **10**
     estimation.

Q4 a)   Explain the interior point algorithm in optimal power flow   **10**
Q4 b)   Explain maximum likelihood weighted Least square method of state estimation.   **10**

[TURN OVER]

Q5 a) Find the optimal dispatch and the total cost in $/hr for three thermal power plants   **10**
whose fuel cost functions are

$$C_1 = 500 + 5.3P_1 + 0.004P_1^2$$
$$C_2 = 400 + 5.5P_2 + 0.006P_2^2$$
$$C_1 = 200 + 5.8P_1 + 0.009P_1^2$$

Where P_1, P_2, P_3 are power in MW. The total load is 975 MW with the generator limits as given

$$200 \leq P_1 \leq 450$$
$$150 \leq P_2 \leq 350$$
$$100 \leq P_3 \leq 225$$

Assume $\lambda^{(1)} = 6$

Q5 b) Explain the strategy used in obtaining optimal power flow using linear programming   **10**

Q6 a) Differentiate between GS, NR and Fast decupled load flow study methods.   **10**
Q6 b) Explain AC power flow security analysis with contingency case selection.   **10**