Duration: 3 hrs **[Max Marks:80]**

N.B.: (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

Q1. Answer any Four from the following [20]

a. What is the significance of penalty factor in optimal load scheduling?

b. Explain the concept of equal area criterion for stability studies.

c. What are the various types of buses in power system and their significance load flow studies?

d. What is the necessity of load frequency control in power system?

e. Show interconnection between different operating states in power system and explain each state.

Q 2. A. A power system with two plants is connected by a tie line and load is located at plant 2. If 100 MW is transmitted from plant 1 to the load, a transmission loss of 10 MW is incurred. Find the required generation for each plant and the power received by load when the system λ is Rs 25/MWh. The incremental fuel costs of the two plants are given below: [10]

$IC_1 = 0.02P_1+16$ Rs/MWhr

$IC_2 = 0.04P_2+20$ Rs/MWhr

B. Consider a power system where a single machine tied to an infinite bus through two parallel lines. A sudden short circuit occurs at sending end of one of the parallel lines and the line is switched off. Explain equal area criteria for stability of the system. Comment on significance of critical clearing angle. [10]

Q 3. A. A 50 Hz, 4 pole, turbo generator, rated 100MVA, 11kV has an inertia constant of 8MJ/MVA. [10]

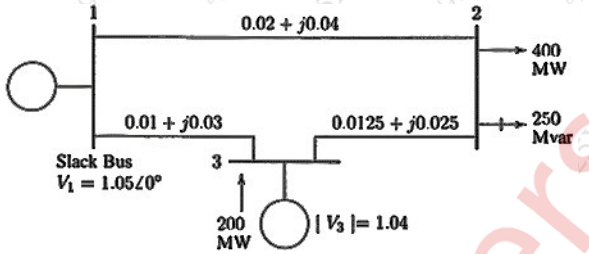
i) Find the stored Kinetic Energy in the rotor at synchronous speed.

ii) If the mechanical input is suddenly raised to 80MW for an electrical load of 50 MW find the rotor acceleration, neglecting mechanical and electrical losses.

iii) What will be change in the rotor torque angle and rotor speed in rpm at the end of acceleration period of part ii) maintained for 10 cycles.

B. Compare Newton Raphson method with decoupled and Fast decoupled method for load flow analysis in a power system. [10]

Q 4 A. Figure below shows the single-line diagram of three-bus power system with generation at bus 1 and bus 3. The voltage at bus 1 is $V_1 = 1.05\angle 0^0$ per unit. The voltage magnitude at bus 3 is fixed at 1.04 per unit with a real power generation of 200 MW. The scheduled load on bus 2 is marked on the diagram. Line impedances are marked in per unit on a 100 MVA base. By using Gauss-Seidel method, determine V_2 and V_3 with an acceleration factor α=1.3 at the end of first iteration. [10]



B. With the help of complete block diagram, explain free governor action in load frequency control. Also explain droop characteristic for the generator. [10]

Q 5 A. A generator operating at 50Hz delivers 1.0 pu power to an infinite bus through a transmission circuit in which resistance is ignored. The maximum power transferred for prefault, during fault and post fault conditions are 1.8 pu, 0.4 pu and 1.3 pu respectively. Draw $P - \delta$ curves and determine the critical clearing angle. [10]

B. Derive exact coordination equation for economic load dispatch considering transmission losses. [10]

Q 6. A. Two generators rated 1000 MW and 800 MW are operating in parallel. The droop characteristics of their governors are 6% and 4%, respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no load. When load is increased to 1000 MW, determine the system frequency at new load and load supplied by each generator. Assume free governor operation. [10]

B. Explain the different types of energy transactions and interchanges in power system. [10]

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