Motilal Nehru National Institute of Technology, Allahabad

End- Semester Examination 2014-15

B.Tech (Power System) 5th Semester

EE-1503 Power System –II

All Question carry equal marks

Maximum Marks: 60

Time: 3Hrs.

1(a) A 100 MVA synchronous generators operate on full load at a frequency of 50Hz. The load is suddenly reduced to 50 MW. Due to time lag in governor system, the steam valve begins to close after 0.4 seconds. Determine the change in frequency that occurs in this time.
Given H = 5 kW-sec/kVA of generator capacity.

(b) Draw the complete block diagram of load frequency control of isolated power system Discuss the steady state load frequency charterstics with necessary mathematical formulation.

2. (a) Obtain the sequence component of the voltage from the transformation .Show that symmetrical component transformation is power invariant.

(b) One conductor of three phase line is open. The current flowing to the Δ-connected load through line a is 10A. With the current in line a as reference an assuming that line c is open, find the symmetrical components of line currents.

3. (a) Explain the transient, sub transient and steady state short circuit model of synchronous machine with neat sketch.

(b) A 25 MVA, 11 kV generator with $X_d'' = 20\%$ is connected through a transformer, line and a transformer to a bus that supplies three identical motors as shown in Fig.1. Each motor has $X_d'' = 25\%$ and $X_d' = 30\%$ on a base of 5 MVA, 6.6 kV. The three-phase rating of the step-up transformer is 25 MVA, 11/66 kV with a leakage reactance of 10% and that of the step-down transformer is 25 MVA, 66/6.6k V with a leakage reactance of 10%. The bus voltage at the motors is 6.6 kV when a three-phase fault occurs at the point F.
For the specified fault, calculate
(a) the sub transient current in the fault,
(b) the sub transient current in the breaker .8,
Given: Reactance of the transmission line = 15% on a base of 25 MVA, 66kV. Assume that the system is operating on no load when the fault occurs.

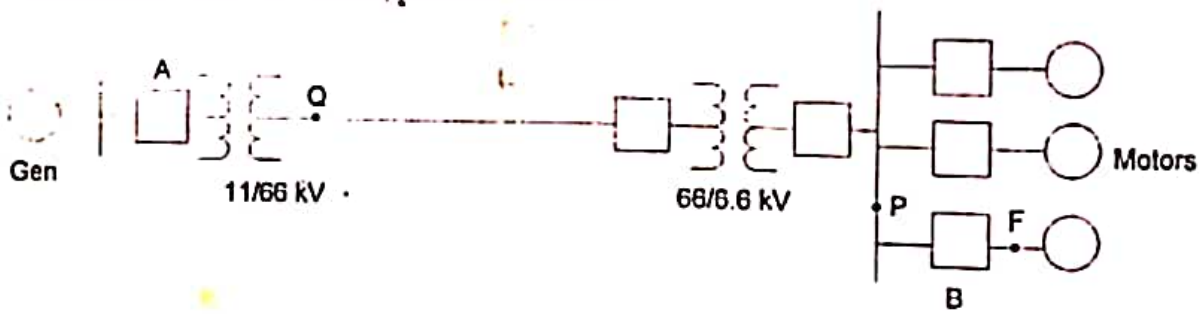

Fig. 1

4. (a) Derive the equivalent inertia constant for multi machine system with the assumption that machines swinging coherently.

(b) A 50 Hz, four pole turbo generators rated 100 MVA, 11 kV has an inertia constant of 8.0 MJ/MVA.

i) Find the stored energy in the rotor at synchronous speed.
ii) If the mechanical input is suddenly raised to 80 MW for an electrical load of 50 MW, find rotor acceleration, neglecting mechanical and electrical losses.
iii) If the acceleration calculated in part (b) is maintained for 10 cycles, find the change in torque angle and rotor speed in revolutions per minute at the end of this period.

5. (a) Using equal angle criteria derive the expression for critical clearing angle and critical clearing time.

(b) Give the system of Fig.2 where a three-phase fault is applied at the point P.

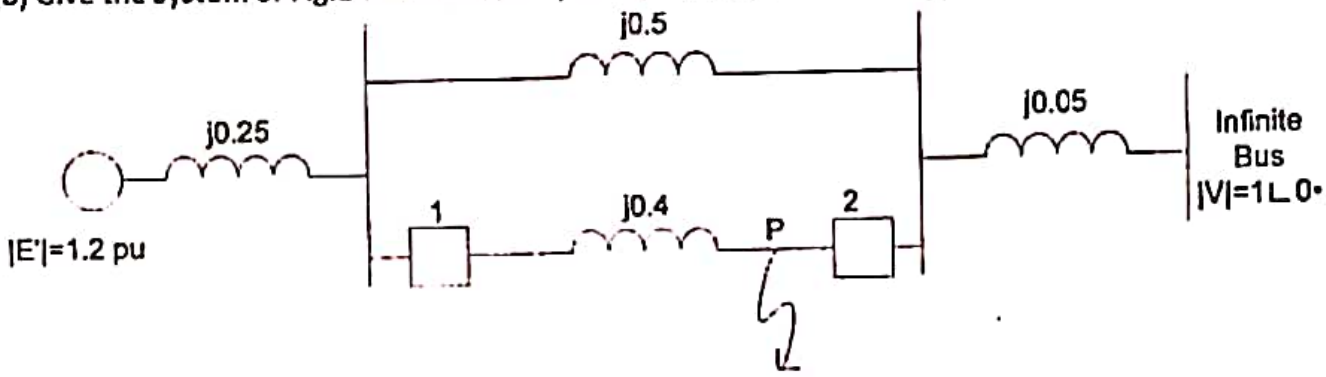

Fig. 2

Find the critical clearing angle for clearing the fault with simultaneous opening of the breakers 1 and 2. The reactance values of various components are indicated on the diagram. The generator is delivering 1.0 pu power at the instant preceding the fault.

6. Short notes
a. Z bus algorithm with type 2 modification
b. Numerical solution of swing equation