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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent Institution of MAHE, Manipal)

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
MAKE-UP EXAMINATIONS, DECEMBER 2017
POWER SYSTEM ANALYSIS [ELE 3105]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 29 December 2017** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Define the following: (i) Momentary current and (ii) Interrupting current as applied to the rating of a Circuit Breaker. Mention the suitable multiplication factors to determine the above currents in terms of respective symmetrical currents. ***(03)***

1B. The single diagram of a power system is shown in Fig 1B. The ratings are given as

G : 30MVA, 11 kV, X" = 20%

T1 : Three single phase unit each rated 10 MVA, 220 kV /6.6 kV, X =10%

T2 : 30 MVA, 6.6 kV /220 kV, X = 10%

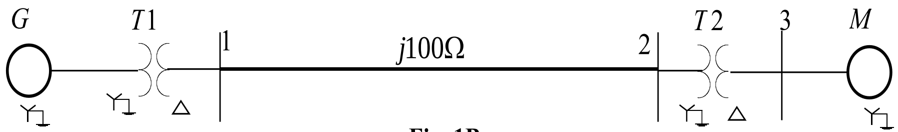

Fig. 1B

Draw the sequence reactance diagram and find the terminal voltage of the generator if the Motor is drawing 10 MW at 0.9 p.f lagging. The terminal voltage of bus 3 is maintained at 6 kV. Choose a base of 30 MVA, 220 kV on the transmission line. ***(07)***

2A. A balanced star connected load takes 30A from a balanced three-phase 4 wire supply. If the fuses in two lines are removed find

a) The negative sequence component of line current Ic

b) The positive sequence component of line current Ib ***(03)***

2B. Three 6.6kV generators A, B and C each of each of 0.1 pu reactance and MVA ratings 40, 50 and 25 respectively are interconnected electrically as shown in Fig. 2B by a tie bar through current limiting reactors, each of 0.12 pu reactance based upon the rating of the machine to which it is connected. The rupturing capacity of each circuit breaker is 200MVA. A three phase feeder with reactance of 0.12 Ω/ph is supplied from the bus bar of generator A at a line voltage of 6.6kV. Estimate the maximum MVA that can be fed into a symmetrical short circuit at the far end of the feeder. ***(07)***

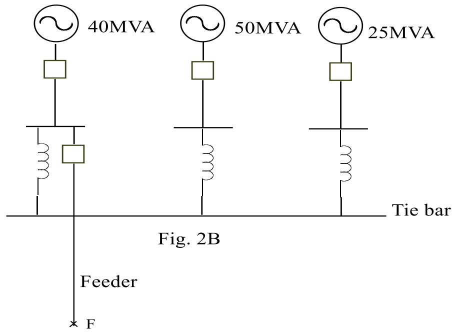

Fig. 2B

3A. A 3 phase synchronous generator has positive, negative and zero sequence impedances of (0+j0.25) pu, (0+j0.2) pu and (0.15+j0.08) pu respectively. For an unsymmetrical fault at its terminals on no-load, determine the magnitude of fault current in pu if the type of fault is (i) Single line to ground fault (ii) Line to Line fault and (iii) Double Line to ground fault. **(05)**

3B. A generator having a solidly grounded neutral and rated 50-MVA, 30-KV has positive, negative and zero-sequence reactance of 0.25 pu, 0.15pu and 0.05 pu respectively. Determine the fault current for (i) symmetrical fault (ii) Single line to ground fault at the terminals of the generator on no-load conditions. (iii) Calculate value of resistor in ohms that must be placed in the generator neutral circuit to limit the fault current for a single line to ground fault to that of a three phase fault? **(05)**

4A. A 200MVA, 11Kv 50Hz, 6 pole generator has an inertia constant of 5 MJ/MVA. The machine is operating stable at an electrical load of 120MW. The electrical load is suddenly increased to 150MW. Find the rotor retardation. If the retardation is maintained for 10 cycles, find the speed at the end of this period. **(04)**

4B. A power system network has maximum power capacities of P_{max1}, P_{max2} and P_{max3} before fault, during sustained fault and after fault isolation respectively. Under stable conditions, the network can transmit a real power of P_{e0} before fault occurs. Derive an expression for critical clearing angle.
Given P_{e0} = 1.0 pu, P_{max1} = 2.0 pu, P_{max2} = 0.5 pu and P_{max3} = 1.5 pu, determine the critical clearing angle. **(06)**

5A. Using matrix algebra, eliminate node-3 in the network shown in Fig. 5A and draw the reduced network. The reactances are given in p.u on a common base.

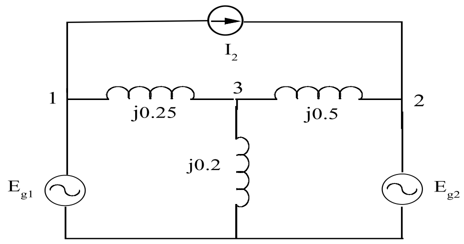

Fig. 5A ***(03)***

5B. Solve the second order equation $x^2 - 5x + 4 = 0$ using Newton Raphson method and x(0)=6. Show the calculations for two iterations. ***(02)***

5C. The one-line diagram of a power system is shown in Fig. 5C. The transmission line admittances are marked on 100 MVA base. Using Gauss-Seidal method, form Y_{BUS} and determine the voltages at the end of first iteration. Take the acceleration factor α=1.6. ***(05)***

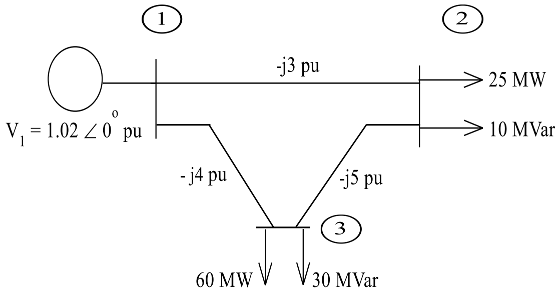

Fig. 5C