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Question Paper Code : 80503

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Sixth Semester

Electrical and Electronics Engineering

EE 2351/EE 61/10133EE601 — POWER SYSTEM ANALYSIS

(Regulations 2008/2010)

(Common to PTEE 2351 for BE (Part – Time)
Fourth Semester – EEE – Regulations 2009)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What are the components of power system?

2. If the reactance in ohms is 15 ohms, find the p.u. value for a base of 15 KVA and 10 KV.

3. Distinguish between the Newton-Raphson and Gauss-seidel methods of load flow analysis.

4. Why is bus impedance matrix preferred for fault analysis?

5. What is a bolted fault?

6. Define short circuit capacity

7. Define negative sequence impedance.

8. Draw the sequence network connections corresponding to L-L fault at bus.

9. Differentiate between voltage stability and rotor angle stability.

10. Define swing curve. What is the use of this curve?

PART B — (5 × 16 = 80 marks)

11. (a) (i) What are the advantages of per-unit computations? (4)

(ii) Draw the reactance diagram for the power system shown in figure 11 (a) (ii). Neglect resistance and use a base of 100 MVA, 220 KV in 50 Ω line. The ratings of the generator, motor and transformer are given below .

Generator : 40 MVA, 25 KV, X" = 20%

Synchronous motor : 50 MVA, 11 KV, X" = 30%

Y – Y Transformer : 40 MVA, 33/220 KV, X = 15%

Y – Δ Transformer : 30 MVA, 11/220 KV (Δ / Y), X = 15% (12)

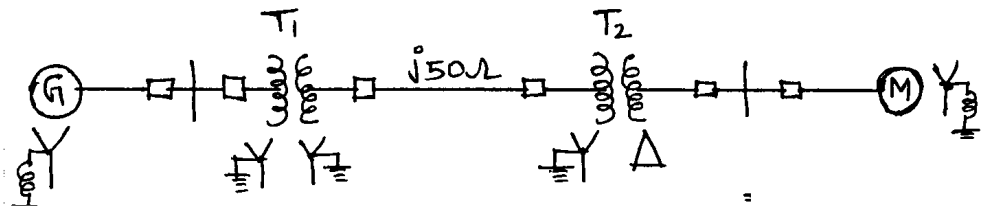

Figure 11 (a) (ii)

Or

(b) Find the bus impedance matrix for the 4-bus system shown in figure 11 (b). Consider bus-4 as the reference bus. (16)

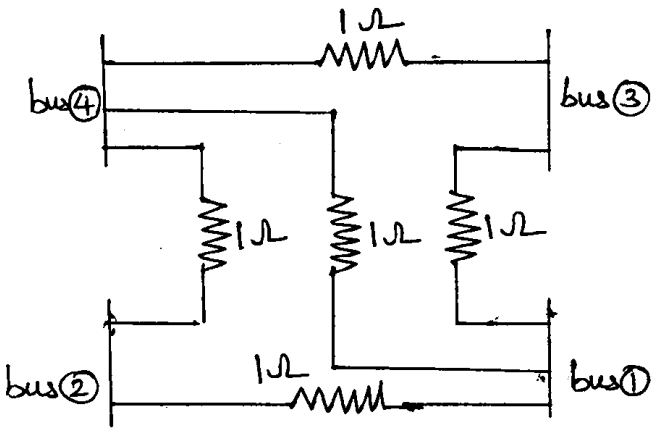

Figure 11 (b)

12. (a) Consider the power system with the following data :

$$Y_{bus}=\begin{bmatrix} -j_{12} & j_8 & j_4 \\ j_8 & -j_{12} & j_4 \\ j_4 & j_4 & -j_8 \end{bmatrix}.$$

Bus No.	Type	Generation P	Generation Q	Load P	Load Q	Voltage Magnitude	Voltage Angle
1	Slack	–	–	–	–	1.0	0°
2	P-V	5.0	–	0	–	1.05	–
3	P-Q	0	0	3.0	0.5	–	–

Assume that the bus 2 can supply any amount of reactive power. With a flat start, perform the first iteration of power flow analysis using Newton-Raphson method. (16)

Or

(b) Discuss in detail about Gauss-Seidal load flow analysis algorithm and give steps for its implementation when Pv busses also present in the system. (16)

13. (a) A 11 KV, 100 MVA alternator having a sub-transient reactance of 0.25 pu is supplying a 50 MVA motor having a sub–transient reactance of 0.2 Pu through a transmission line. The line reactance is 0.05 pu on a base of 100 MVA. The motor is drawing 40 MW at 0.8 power factor leading with a terminal voltage of 10.95 KV when a 3-phase fault occurs at the generator terminals. Calculate the total current in the generator and motor under fault conditions. (16)

Or

(b) Figure 13.(b) Shows a generating station feeding a 132 KV system. Determine the total fault current, fault level and fault current supplied by each alternator for a 3 — phase fault at the receiving end bus. The line is 200 km long. Take a base of 100 MVA, 11 KY for LV side and 132 KV for HT side. (16)

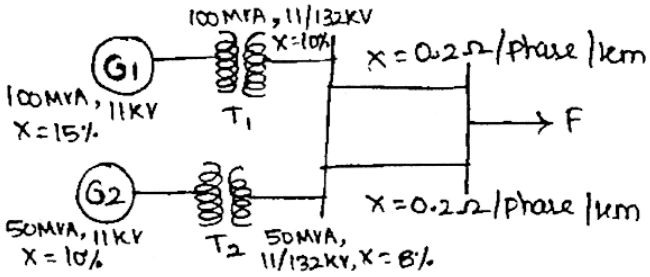

Figure. 13(b)

14. (a) Derive an expression for fault current for a double line to ground fault on an unloaded synchronous machine. Also draw the interconnection of sequence networks.

Or

(b) The sequence components of currents in a system are $I_{a1}=8.334\angle 90°$ $I_{a2}=1.6668\angle 90°$ $I_{a0}=6.6672\angle 90°$. Find I_a, I_b and I_c.

15. (a) The single line diagram of a system is shown in figure 7. There are four identical generators of rating 555 MVA, 24 kV, 60 Hz supplying power infinite bus bar through two transmission circuits. The reactances shown in figure are in per unit on 2220 MVA, 24 kV base (refer to the low voltage side of the transformer). Resistances are assumed to be negligible. The initial operating conditions, with quantities expressed in per unit on 2220 MVA, 24 kV base, is as follows

$P = 0.9, Q = 0.436$ (over excited), $\vec{E}_t = 1.0 < 28.34$, $\vec{E}_B = 0.90081 < 0$.

The generators are modeled as a single equivalent generator represented by the classical model with the following parameters expressed in per unit on 2220 MVA, 24 kV base,

$X'_d = 0.3, H = 3.5 MW.s / MVA \quad K_D = 0$

Circuit 2 experiences a solid three phase fault at point F, and the fault is cleared by isolating the fault circuit. Determine the critical clearing time and critical clearing angle by computing the time response of the rotor angle, using numerical integration.

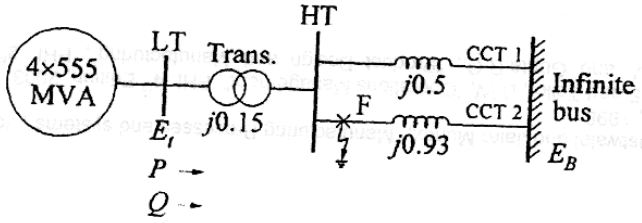

Fig.7

Or

(b) (i) Define steady state stability and stability limit with the help of curve. Power-Power angle curve. What are the techniques available to improve steady state stability? (6)

(ii) A 60-Hz synchronous generator has a transient reactance of 0.2 per unit and an inertia constant of 5.66 MJ/MVA. The generator is connected to an infinite bus through a transformer and a double circuit transmission line, as shown in Figure 8. Resistances are neglected and reactances are expressed on a common MVA base and are marked on the diagram. The generator is delivering a real power of 0.77 per unit to bus bar 1. Voltage magnitude at bus 1 is 1.1 p.u. The infinite bus voltage V = $1.06\angle 0$ per unit. Determine the generator excitation voltage and obtain the swing equation.

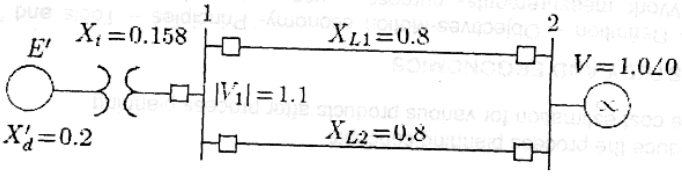

Fig.8
