Hall Ticket No | | | | | | | | | | | Question Paper Code: AEEC22

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech VI SEMESTER END EXAMINATIONS (REGULAR) - JULY 2023
Regulation: UG-20
POWER SYSTEM ANALYSIS

Time: 3 Hours **ELECTRICAL AND ELECTRONICS ENGINEERING** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Illustrate the procedure for forming the bus admittance matrix using the singular transformation method. [BL: Understand| CO: 1|Marks: 7]

   (b) Obtain the per unit impedance and reactance diagram of the power system shown in Figure 1.
   Generator No. 1: 30 MVA, 10.5 kV, X” = 1.6 Ω
   Generator No. 2: 15 MVA, 6.6 kV, X” = 1.2 Ω
   Generator No. 3: 25 MVA, 6.6 kV, X” = 0.56 Ω
   Transformer T1 (3phase): 15 MVA, 33/11 kV, X = 15.2 Ω per phase on high tension side.
   Transformer T2 (3phase): 15 MVA, 33/6.2 kV, X = 16 Ω per phase on high tension side.
   Transmission line: 20.5 Ω/phase
   Load A: 15MW, 11 kV, 0.9 pf lagging
   Load B: 6.2kV, 34 MW + j20.07 MVAR.

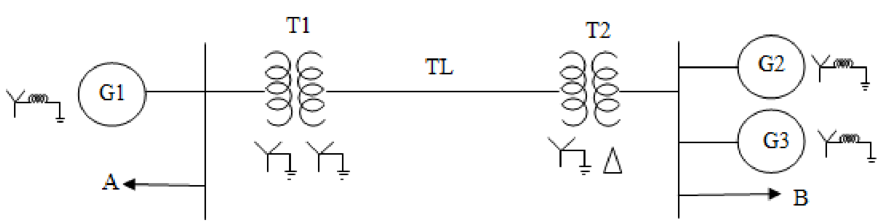

Figure 1

[BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Explain the step-by-step computational procedure for the Gauss-Seidel method of load flow studies. [BL: Understand| CO: 2|Marks: 7]

   (b) The Figure 2 shows a five bus power system. Each line has an impedance of 0.05 + j0.15 pu. The line shunt admittances may be neglected. The bus power and voltage specifications are given below in Table 1. Find the line voltage after first iteration using Gauss-Seidal method. [BL: Apply| CO: 2|Marks: 7]

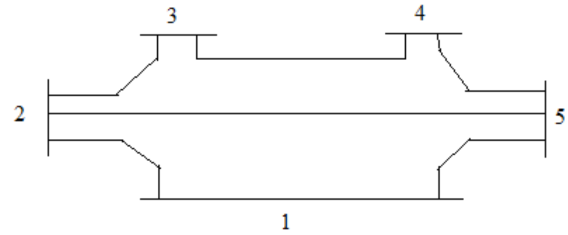

Figure 2

Table 1

Bus	PL	QL	PG	QG	V	Bus Specification
1	1.0	0.5	not specified	not specified	1.02∠	Slack bus
2	0	0	2	not specified	1.02	PV bus
3	0.5	0.2	0	0	not specified	PQ bus
4	0.5	0.2	0	0	not specified	PQ bus
5	0.5	0.2	0	0	not specified	PQ bus

MODULE – III

3. (a) Summarize the step-by-step procedure to be followed for short circuit analysis using Thevenin's theorem. [BL: Understand| CO: 3|Marks: 7]

   (b) The Figure 3 shows a generating station feeding a 132 kV system. Determine the total fault current and the fault current supplied by each alternator for a 3 phase fault at the receiving end of the bus. The line is 300 km long. [BL: Apply| CO: 3|Marks: 7]

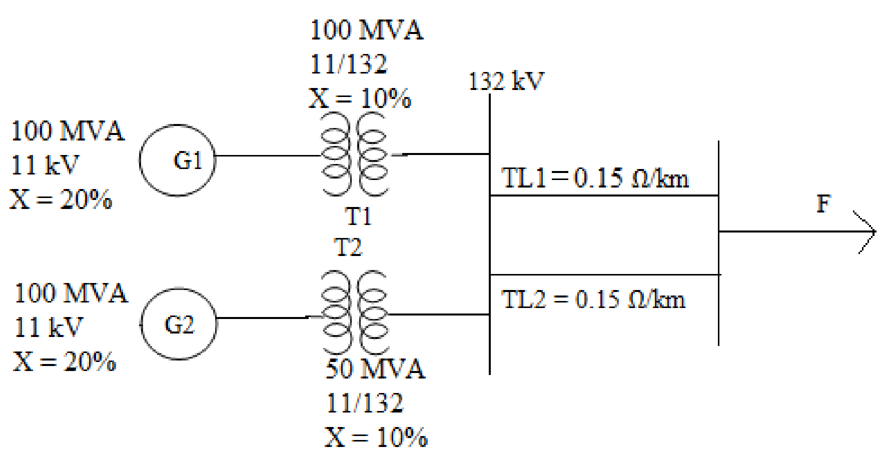

Figure 3

4. (a) Obtain the necessary equation to determine the fault current for a single line to ground fault. Draw a diagram showing the interconnection of sequence networks.

   [BL: Understand| CO: 4|Marks: 7]

(b) Determine the fault current in pu, current in phase domain form for a double line to ground fault occurs between phases 'b' and 'c' at bus 4 of Figure 4. [BL: Apply| CO: 4|Marks: 7]

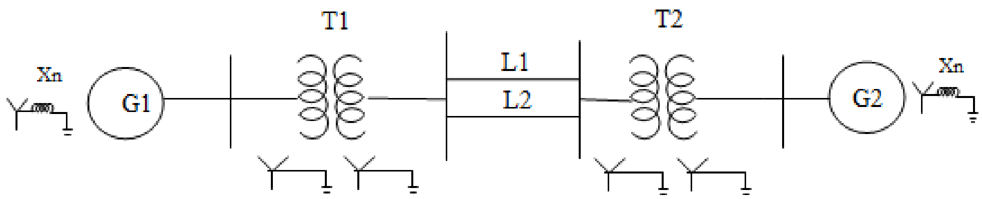

Figure 4

G_1, G_2 : 100 MVA, 11 kV, X+ = X- = 15%, X0 = 5%, Xn = 6%

T_1, T_2 : 100 MVA, 11/220 kV, Xleak = 9%

L_1, L_2 : X+ = X- = 10%, X0 = 10% on a base of 100 MVA.

MODULE – IV

5. (a) Compare steady state, transient and dynamic stability. Derive the swing equation of a synchronous machine, beginning from fundamental principles. [BL: Understand| CO: 5|Marks: 7]

   (b) A synchronous generator having a reactance of 1 p.u. is connected to an infinite bus (V = 1 $\angle 0$) through a transmission line. The line reactance is 0.5 p.u. The machine has an inertia constant of 4 MW-sec/MVA. Under no load condition, the generated emf is 1.1 p.u. The system frequency is 50 Hz. Calculate the frequency of natural oscillations, if the generator is loaded to 75% of its maximum power limit. [BL: Apply| CO: 5|Marks: 7]

6. (a) What is steady state stability? Describe it with respect to power angle curve with neat sketch. [BL: Understand| CO: 5|Marks: 7]

   (b) A synchronous generator having direct axis reactance 0.6 p.u. is supplying full load power with a power factor of 0.85 lag. The generator is connected to an infinite bus. The voltage at the bus is V = 1 $\angle$ p.u. Find the electrical power transferred to the infinite bus. If the mechanical input is raised by 25% from the previous value, find the new steady-state values of Pe and δ [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Draw a diagram to demonstrate the application of equal area criterion to study transient stability when there is a sudden increase in the input of generator. [BL: Understand| CO: 6|Marks: 7]

   (b) Find the critical clearing angle for a three phase fault at the point P as shown in Figure 5. The generator is delivering 1.0 p.u. power under prefault conditions. [BL: Apply| CO: 6|Marks: 7]

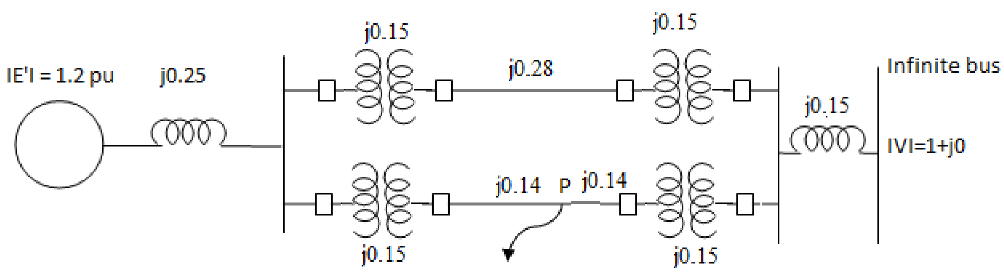

Figure 5

8. (a) Develop an expression for critical clearing angle for a system having a generator feeding a large system through a double circuit line. [BL: Understand| CO: 6|Marks: 7]

(b) A 250MW, 33kV, 60Hz, 3-phase, 2-pole synchronous generator having a rated p.f.= 0.8 has a moment of inertia of 27.5 x 10^3 kg-m^2. Determine the inertia constant (H) of the machine. [BL: Apply| CO: 6|Marks: 7]

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