

Paper ID : 121602 Roll No.

B. TECH.

Theory Examination (Semester-VI) 2015-16

POWER SYSTEM ANALYSIS

Time : 3 Hours

Max. Marks : 100

Section-A

1. Attempt all parts. All parts carry equal marks. Write answer of each part in short. (2×10 = 20)

- Represent the reactance diagram of a power system with justification.
- Show that

$$Z_{pu(new)} = Z_{pu(old)} \times \left(\frac{KV_{(old)}}{KV_{(new)}} \right)^2 \times \frac{MVA_{(new)}}{MVA_{(old)}}$$

- Derive the equation $[Y_{bus}] = [A][Y][A]^T$ using singular transformation.

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2005/10/25

- (d) Discuss the significance of Slack or Swing bus in case of load flow study.
- (e) What are the assumptions made to make the load flow equations decoupled?
- (f) Name the factors which affect the transient stability.
- (g) Define steady state and Transient stability in respect of a power system. Also define their stability limit.
- (h) A 50Hz four pole turbogenerator rated 20MVA, 13.2KV has an inertia constant $(H) = 9.0 \text{ kW-sec/KVA}$. Determine the kinetic energy stored in the rotor.
- (i) Derive the expression of a transmission line for wave propagation.
- (j) Discuss the propagation of a wave travelling along a line and then enters the cable.

Section-B

2. Attempt any five questions from this following.

(5×10 = 50)

- (a) Prepare a perphase schematic of the system shown in Fig-1 and show all impedances in per unit (p.u.) on a 100MVA, 32kV base in the transmission line circuit. The necessary data for this problem are as follow :

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2005/10/1/25

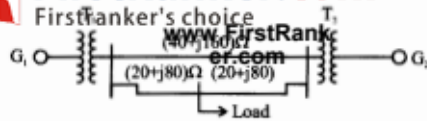


Fig. 1

G_1 : 50MVA, 12.2kV, $X = 0.15$ p.u.

G_2 : 20MVA, 13.8 kV, $X = 0.15$ p.u

T_1 : 80MVA, 12.2/161kV, $X = 0.10$ p.u

T_2 : 40MVA, 13.8/161kV, $X = 0.10$ p.u.

Load : 50MVA, 0.80 PF lag, operating at 154KV

Determine the impedance of the load for the load modelled as a series combination of resistance and inductance.

- (b) Draw the sequence network connections for L-G fault occurring in the network shown in Fig. 2 with proper justification.

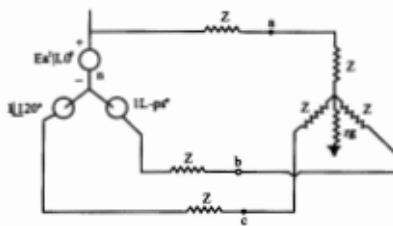


Fig. 2

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2005/10/1/25

- (ii) Explain the terms (i) subtransient reactance (x'') (ii) transient reactance (x') and synchronous reactance for a synchronous machine.
- (d) Draw the zero sequence network for the system shown in fig. (3). Assume zero sequence reactances for the generator and motors of 0.06 pu . Current limiting reactors of 2.5 ohms each are connected in the neutral of generator and motor No. 2. The zero sequence reactance of the transmission line in 300 ohm .

Data :

G : 25 MVA , 11 kV , $X'' = 20\%$; M_1 : 15 MVA , 10 kV , $x'' = 25\%$

$M_2 = 7.5 \text{ MVA}$, 10 kV , $x'' = 25\%$

$T_1 \& T_2$: 30 MVA , $10.8/121 \text{ kV}$, $X=10\%$ each

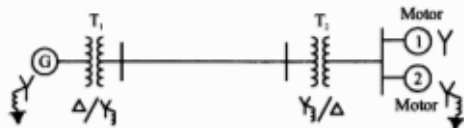


Fig.3

The series reactance of the line in 100 ohms .

Select the generator rating as base in the generator circuit.

(4)

2005/10/1/25



Classify the buses for load flow study. Formulate the load flow problem (in polar form) to be solved by newton - Raphson method. Also discuss its solution algorithm.

- (f) Derive Swing equation with the help of equal area criterion. Discuss the case of occurrence of fault and is cleared after some time with the help of equal area criterion.
- (g) What are the various method of improving transient stability? Discuss in brief.
- (h) A surge of 15kV magnitude travels along a cable towards a junction with an overhead line. The inductance and capacitance of the cable and overhead line are respectively 0.3 mH, 0.4 μ F and 1.5mH, 0.012 μ F per kilometre. Find the voltage at the junction due to this surge.

Section-C

Note: Attempt any two questions from this section.

(2 \times 15=30)

- 3. Discuss clearly the problem formulation and solution algorithm for Fast decoupled method for load flow study of a power system.

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Line admittances :

Bus Cose	Admittance
1-2	$2 - j 8.0$
1-3	$1 - j 4.0$
2-3	$0.666 - j 2.664$
2-4	$1 - j4.0$
3-4	$2 - j8.0$

The schedule of active and reactive powers :

Bus Cod	P	Q	V	Remarks
1	—	—	1.06	slack
2	0.5	0.2	$1+j0.0$	P.V; $0.2 \leq Q \leq 1.0$
3	0.4	0.3	$1+j0.0$	P-Q
4	0.3	0.1	$1+j0.0$	P-Q

Determine the bus voltages at the end of first iteration using Gauss-Seidel method. Take acceleration factor 1.6.

5. Determine the critical clearing angle for the network shown in fig. 4. When the 3-phase fault occurs at B and the breakers

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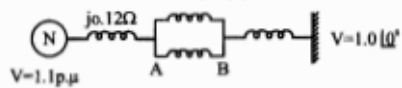


Fig. 4

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