(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2498 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. VI) THEORY EXAMINATION 2011-12

POWER SYSTEM ANALYSIS

Time : 3 Hours *Total Marks : 100*

Note :— (1) Attempt **all** questions.

(2) Be precise in your answers.

(3) If any data is missing, assume appropriate value.

1. Attempt any **four** :— **(5×4=20)**

(a) Define Per Unit System. Show that the per unit impedance of a transformer computed from primary or secondary side is same if voltage bases on two sides are in the ratio or transformations.

(b) What do you understand by instantaneous maximum momentary current for line ? Explain it with the help of suitable diagram.

(c) Prove sum of power of three symmetrical components equals the three phase power.

(d) For the radial network shown in Fig. 1 a three phase fault occurs at F. Determine the fault current and line voltage at 11 KV bus under fault conditions.

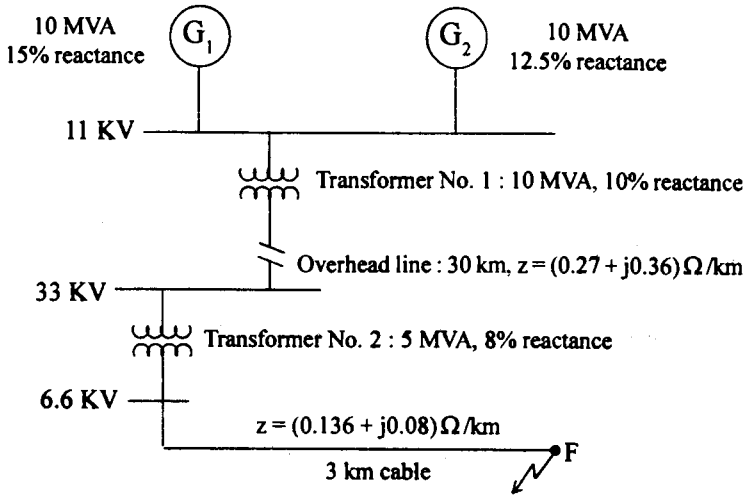

Fig. 1

(e) What is Single-line diagram ? What role does it have in power system ?

(f) Determine the symmetrical component of three voltages

$V_a = 100 \angle 0°$, $V_b = 200 \angle 245°$, $V_c = 100 \angle 105°$

If the star connected load of 100 ohms each leg is connected, find power consumed by 3 phase load.

2. Attempt any **two** :— **(10×2=20)**

(a) Develop the Expression for fault current for single line to ground fault by symmetrical component method.

(b) A 30 MVA, 13.8 kV, 3-phase alternators has sub transient reactance of 15% and negative and zero sequence reactances of 15% and 5% respectively. The alternator supplies two motors over a transmission line having transformer at both end as shown on one line diagram. The motors have rated inputs of 20 MVA and 10 MVA both 12.5 kV with 20% sub transient reactance and negative and zero sequence reactances are 20% sub transient reactance and negative and zero sequence reactances are 20% and 5% resp. Current limiting reactors of 2 ohms each are in the neutral of alternator and the larger motor. The 3 phase transformers are both rated 35 MVA, 13.2 Δ-115 Y kV with leakage reactance of 10%. Series reactance of line is 80 ohms. The zero sequences reactance of line is 200 ohm. Determine fault current when (i) L-L (ii) L-L-G fault takes place at point P. Assume V_f = 120 kV.

(c) Describe the Computational method for short circuit calculations.

3. Attempt any **two** :— **(10×2=20)**

(a) Classify various types of buses in power system for load flow studies. Explain the development of static load flow equation.

(b) Compare various methods of load flow study in power system.

(c) The following is the system data for load flow solution :

(i) The line admittances :

Bus Code	Admittance
1-2	2-j0.8
1-3	1-j4.0
2-3	0.666-j2.664
2-4	1-j4.0
3-4	2-j8.0

(ii) The schedule of active and reactive powers :

Bud code	P	Q	V	Remarks
1	-	-	1.06	Slack
2	0.5	0.2	1+j0.0	PQ
3	0.4	0.3	1+j0.0	PQ
4	0.3	0.1	1+j0.0	PQ

Determine the voltage at the end of first iteration using Gauss-seidal method. Take a = 1.6.

4. Attempt any **two** :— **(10×2=20)**

(a) Differentiate between steady state stability and transient state stability of power system. Derive an expression for maximum power system between 2 nodes. Show that this power is maximum when $X = \sqrt{3}\,R$, where X is the reactance and R is the resistance.

(b) Derive the expression of critical clearing angle; A 50 Hz generator is delivering 50% of power that is capable of delivering through a transmission line to an infinite bus; A fault occurs that increases the reactance between generator and infinite bus to 500% of value before fault; when fault is isolated, the maximum power that can be delivered is 75% of original maximum value. Determine Critical Clearing Angle for condition described.

(c) Develop Swing Equation; A 50 Hz 4 pole turbo-generator rated 20 MVA, 13.2 kV has an inertia constant of H = 9.0 kW-sec/kVA. Determine the KE stored in the rotor at synchronous speed. Determine the acceleration if the input less the rotational losses is 25000 HP and the electric power developed is 15000 kW. If the acceleration computed for the generator is constant for a period of 15 cycles, determine the change in torque angle in that period and the rpm at the end of 15 cycles. Assume that the generator is synchronized with a large system and has no accelerating torque before the 15 cycle period begins.

5. Attempt any **two** :— **(10×2=20)**

(a) Discuss Protection of Equipments and line against travelling waves.

(b) Deduce the General expression for reflection and refraction of travelling waves.

(c) An overhead line with a surge impedance 500 ohm bifurcates into two lines of surge impedance 500 ohm and 50 ohm respectively. If a surge of 25 kV is incident on overhead line, determine the magnitude of voltage and current which enter the bifurcated lines.