

19.5.14

# Electrical / IV CBSGS

## Elements of Power System

QP Code : NP-19676

(3 hours)

[ Total Marks : 80

- N.B.** (1) Question No. 1 is compulsory.  
 (2) Attempt any **three** questions from the remaining **five** questions.  
 (3) Assume **suitable** data if **necessary**.

1. Solve any four :- 20

- (a) Why the transmission systems are operated at high voltages ?
- (b) The ac resistance of conductor for overhead line is greater than its dc resistance. Explain.
- (c) What is per unit system ? How are the base quantities selected ?
- (d) What is sag in overhead line ? Which factor affect sag in the overhead lines ?
- (e) Explain classification of cables based on voltage.

2. (a) Derive the expression for inductance of a composite conductor line. Explain the concept of self GMD and mutual GMD. 10

(b) A 3- $\phi$  double circuit line has the configuration shown in the fig (1) below. The radius of each conductor is 0.9 cm. Find the inductance per phase per km of line length. 10

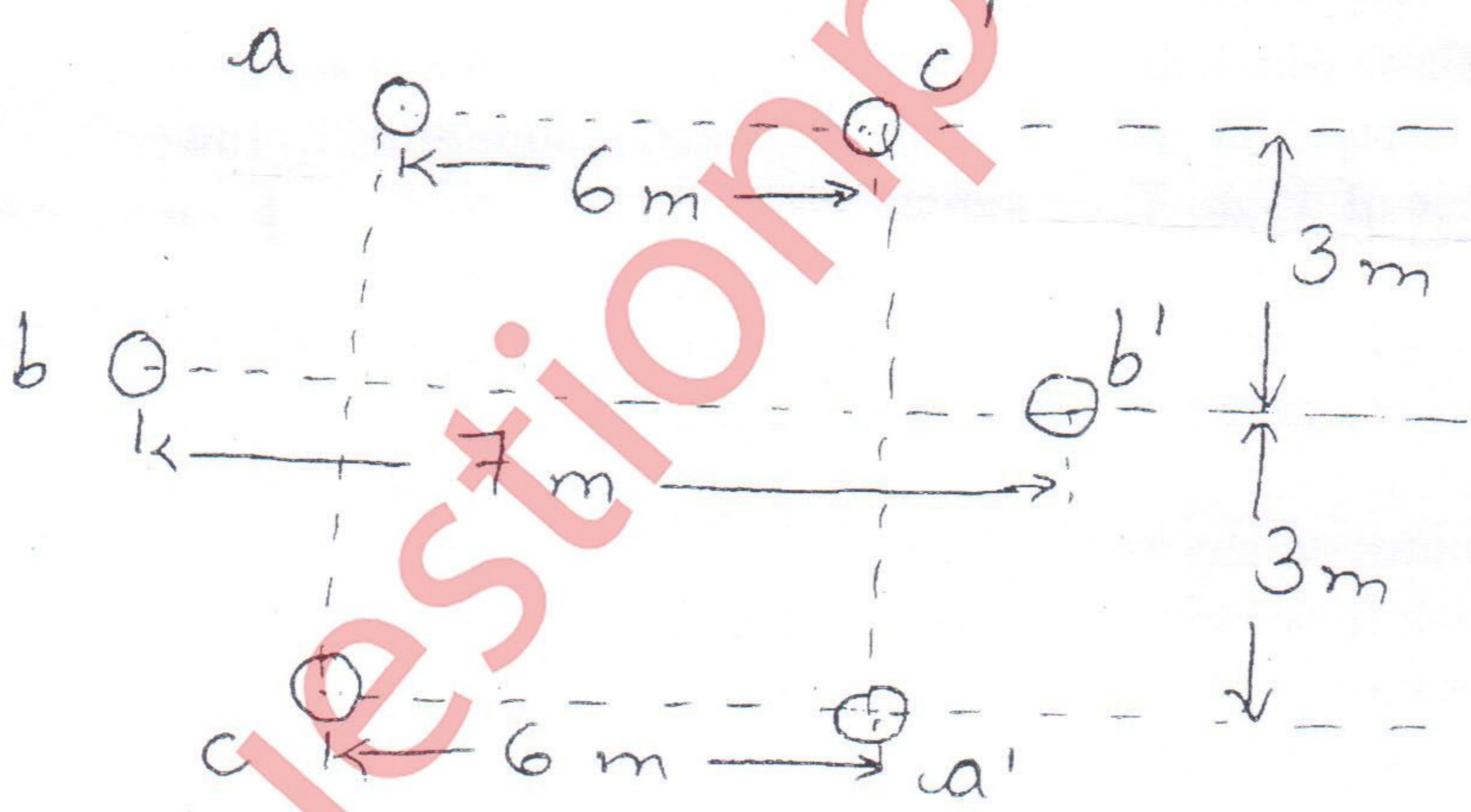


Fig. (1)

3. (a) Derive the expression for capacitance of a double circuit line with conductors placed at the vertices of a hexagon. 10

(b) The fig.(2) below shows a generator feeding two motors through transformers and line. The ratings and reactances are as under, 10

- Generator** : 100 MVA, 11 KV, 3- $\phi$ , X = 20%
- Transformer T<sub>1</sub>** : 3- $\phi$ , 100 MVA, 11 / 132 kV
- Transformer T<sub>2</sub>** : Bank of 3 single phase transformers each rated at 35 MVA, 66 / 11 KV, X = 4%.
- Motor M<sub>1</sub>** : 40 MVA, 3- $\phi$ , 10 KV, X = 20%
- Motor M<sub>2</sub>** : 60 MVA, 3- $\phi$ , 11 KV, X = 15%.

[ TURN OVER

The line reactance is 80 ohms.  
 Take generator rating as the base.  
 Draw the p.u. reactance diagram.

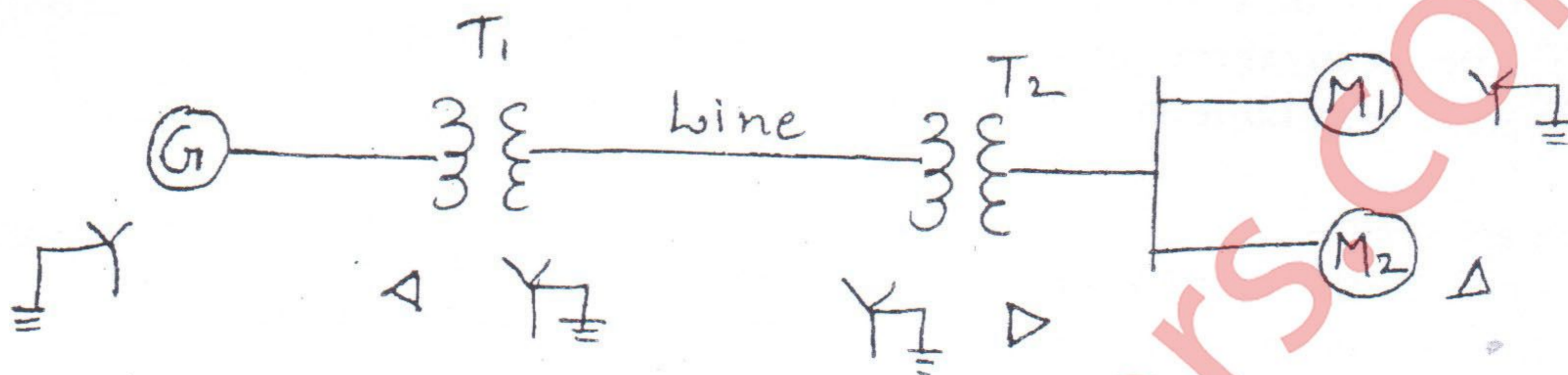


Fig. (2)

4. (a) Derive the A, B, C, D constants for Nominal  $\pi$  circuit of a transmission line. Also draw the phasor diagram. 10
- (b) An 80-km, 3- $\phi$ , line is supplying 24 MVA at 66 kV and 0.8 lagging p.f. Line resistance is  $0.12 \Omega / \text{km} / \text{phase}$ . Outside radius of conductors is 1.5 cm. Conductor spacing is 2.5 m and equilateral. Use Nominal  $\pi$  method to find the efficiency and regulation. 10
5. (a) Define string  $\eta$ . Derive the expression for voltage distribution over the insulator string. Show which disc will have the maximum voltage across it. 10
- (b) A high voltage line has a span of 350 m and is supported by towers having a level difference of 35 m. The ultimate strength of conductor is 8500 kg and factor of safety is 3.5. Find the clearance between conductor and ground at a point midway between the towers. The heights of towers are 50 m and 85 m above ground and weight of conductor is 0.82 kg per meter length. 10
6. Write short notes on any two :- 20
  - (a) Power flow through transmission lines
  - (b) Grading of cables
  - (c) Methods of Neutral grounding.