EEL 303 Power Engineering I
Nov 25, 2014.

Major Exam

Maximum Marks: 40

Only one handwritten A 4 sized sheet of paper full of formulae allowed. No one is allowed to share anything, including calculators, paper etc. Anybody found using unfair means will be expelled from the exam.
If thought required, ignore the effect of earth on the line capacitances unless otherwise mentioned. All lines are transposed.

15

1. Fill in the blanks
   a) Salient pole machines are used in _____ power stations. *(Thermal/Hydro/Nuclear)*
   b) The rotor excitation current in a small diesel generator (grid connected) is increased. The terminal voltage will _____ *(increase/decrease/remain same)*
   c) The controller responsible for maintaining the speed of a generator is the _____ *(turbine/exciter/governor/stabilizer)*
   d) A TCSC is located in _____ with the load *(parallel/series)*
   e) Bundling of conductors is done to reduce _____ *(skin effect/ corona loss/voltage regulation/ power factor)*
   f) The theory of symmetrical components was developed by _____ *(C L Fortescue/Charles Concordia/ Narain Hingorani)*
   g) Capped cores are used in _____ *(distribution transformers/potential transformers/current transformers/reactors/hydro generators)*
   h) The transducer used to measure voltages in the range of 400 kV is a _____ *(capacitor coupled voltage transformer/potential transformer/voltage transformer)*
   i) Transmission tower footing resistance should be as _____ as possible *(high/low)*
   j) Damper bars are located on the _____ *(inter-leaved stator windings/rotor pole face/air gap/stator end iron)*

3

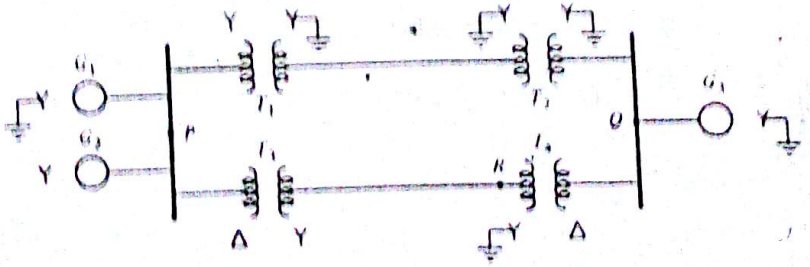
2. X/R ratio in high voltage transmission systems is more than ten times higher than that in low voltage distribution systems. Why?

8

3. A 50 Hz, 132 kV 3-phase transmission line is 225 miles *long*. The distributed parameters are $r = 0.1690\Omega/mi$, $l = 2.093mH/mi$, and $c = 0.01427\mu F/mi$. The transmission line delivers 40 MW at 130 kV with 95% power factor lagging. Find the sending end voltage and current. Find the transmission line efficiency.

5

4. Consider the network shown below.



Suppose loads driving critical processes are connected at P, Q and R. What precautions should be taken so that these loads are not disrupted by the occurrence of an LG fault anywhere on the network?

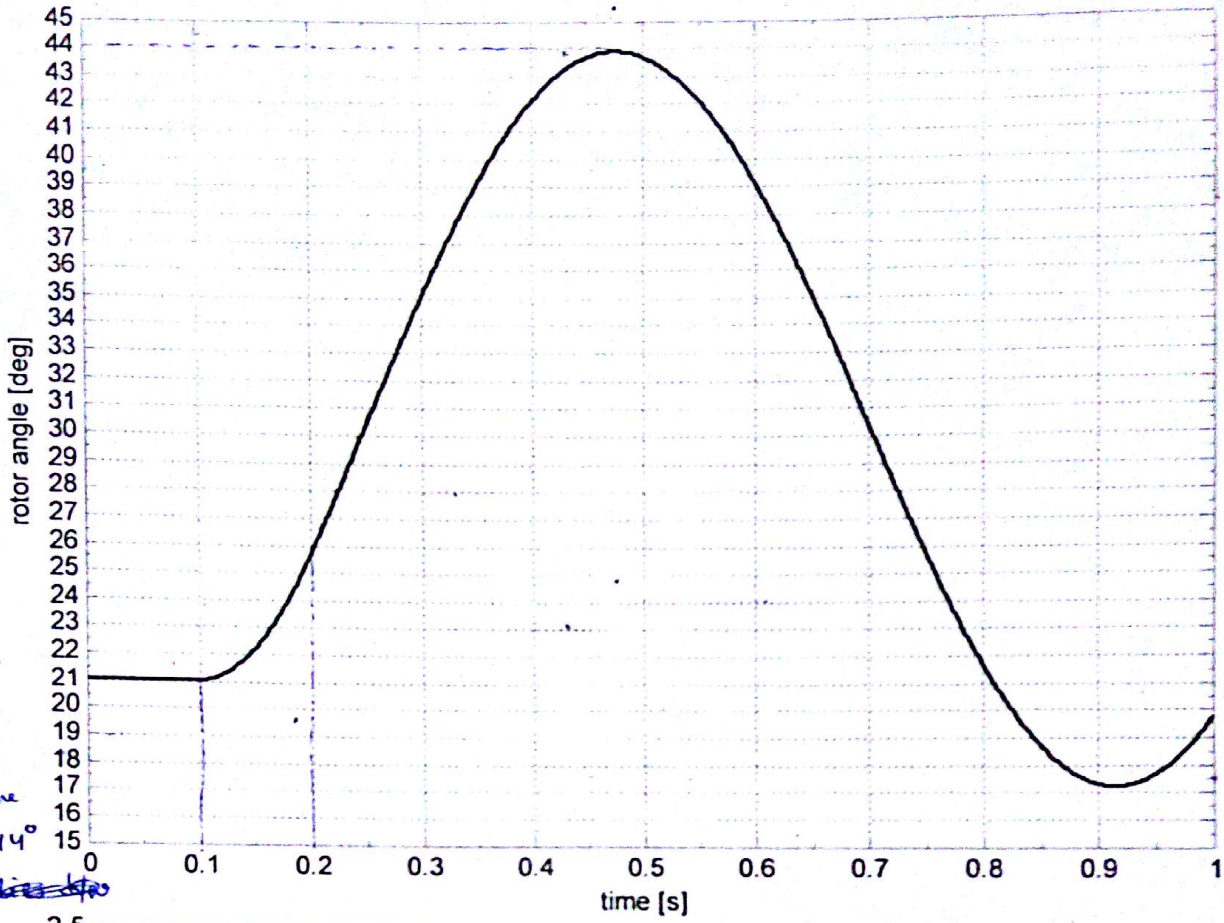
9+3 = 12

7. A single machine is connected to an infinite bus through a double circuit line. A three phase high impedance fault occurs at t=0.1s. It is cleared at 0.2 s, by tripping one of the parallel lines. The power-angle curves for the pre-fault operating condition, fault-ON operating condition and the post-clearing operating condition are given along with the time variation of the rotor angle of the machine.
   a) Sketch the accelerating and the decelerating areas, neatly.
   b) Verify the equal area criterion approximately.

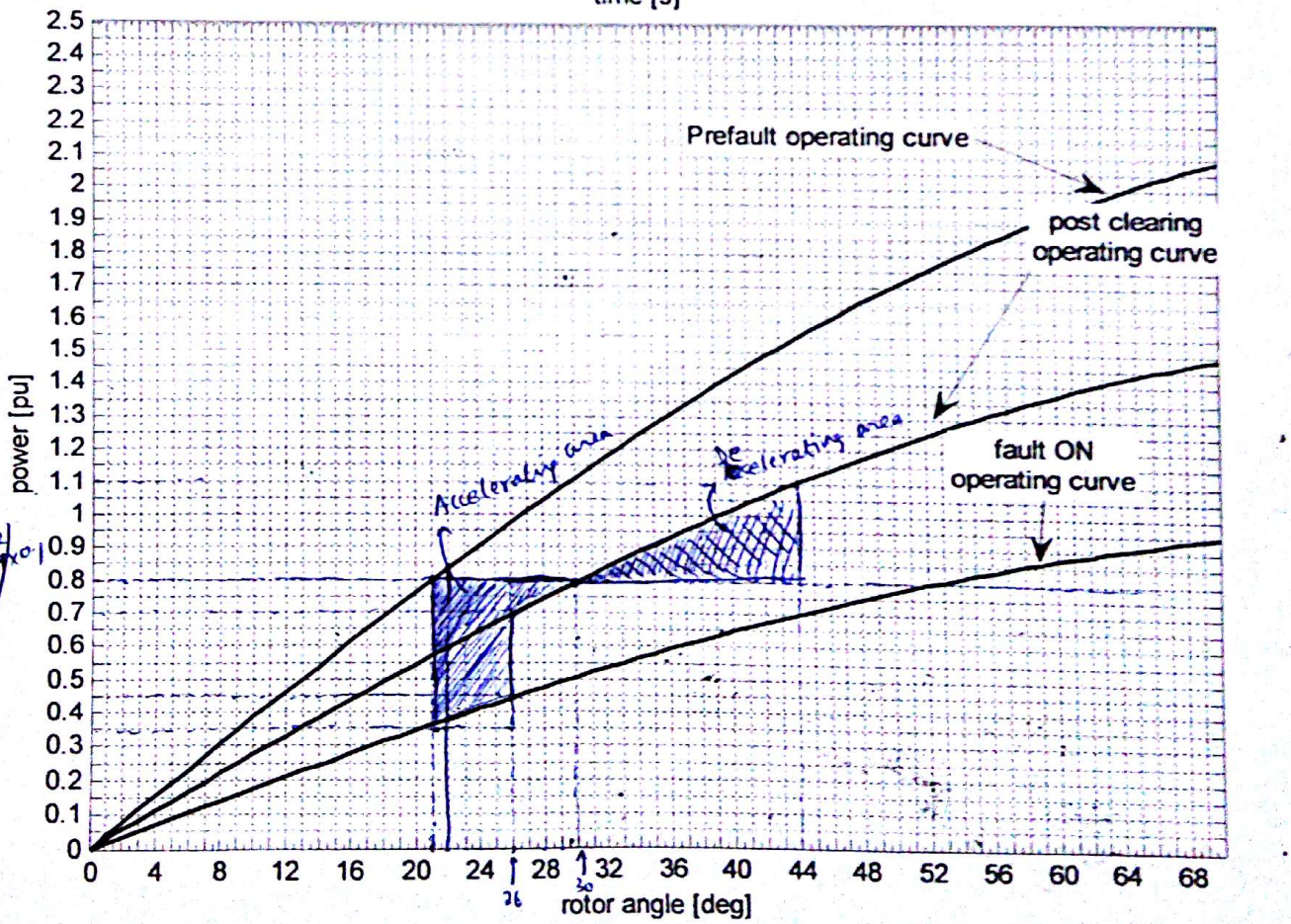
(c) Mark on the upper graph, where the rotor angle will finally settle.

V↑ I↓ A↑ R↑ ∴

Please refer to answer script for explanation



at $t = 0.1$ sec.
$\delta_0 = 21°$
at $t = 0.2$ sec. fault clears
$\delta_{cl} = 26°$
from the above graph $\delta_{max} = 44°$



From graph
at $\delta_0 = 21°$
Pre fault
$P_e = 0.8$ pu

Acc. area
$= (6 \times 0.8) + \frac{1}{2} \times 2 \times 0.1$
$= 4.8 + 0.2$
$= 5$ pu. deg