Indian Institute of Technology Patna
Department of Electrical Engineering
EE3101 - Power Systems-I
Autumn - 2025
End Semester Exam
November 27, 2025
There are 5 questions. They carry equal marks.

$(5 \times 10 = 50)$

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1. A 50 MVA generating station is connected to a three-phase line having impedance $Z = 300\angle 75^\circ\ \Omega$ and admittance $Y = j0.0010\ \mho$. The power at the generating station is 50 MVA at upf at a voltage of 220 kV. There is a load of 25 MW at upf at the mid point of the line. Find the

   (a) line voltage at the receiving end.

   (b) complex power at the receiving end.

   Use nominal-T model for the transmission line.

2. A three-phase, 50 Hz transmission line is 400 km long. The voltage at the sending end is 220 kV. The line parameters are r = 0.125 Ω/km, x = 0.4 Ω/km and y =2.8×10^{-6} ℧/km. Use nominal-π model.

   (a) Find the sending-end current and receiving-end voltage when there is no load on the line.

   (b) Find the maximum permissible line length if the receiving-end no-load voltage is not to exceed 235 kV.

   (c) Find the maximum permissible line frequency if the receiving-end no-load voltage is not to exceed 250 kV.

3. A 50 Hz, three-phase 275 kV line of length 400 km has the following parameters:

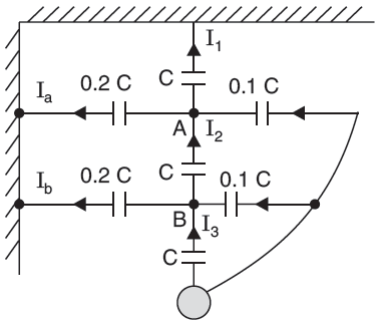
   $$r = 0.035\ \Omega/\text{km};\ L = 1\ \text{mH/km};\ C = 0.01\ \mu\text{F/km}$$

   The line is represented by the nominal-π model. With the magnitudes of the sending end and the receiving end voltages of the line (denoted by V_S and V_R, respectively) maintained at 275 kV, find the following.

   (a) the phase angle difference (δ) between V_S and V_R required for maximum possible active power to be delivered to the receiving end, in degree.

   (b) the active and reactive power that can be delivered to the receiving end under this condition.

4. Consider the following suspension insulator with guard ring.



   (a) Determine the voltage across each disc of suspension insulators as a percentage of line voltage to earth.

   (b) Determine the string efficiency.

5. Determine the real power loss of the following three phase radial distribution system. Perform two iterations of the backward and forward sweep algorithm to find the voltages and currents.