Birla Institute of Technology and Science, Pilani

Mid-semester test (close book), second semester 2016-17

Power Systems (EEE F312)

Max. Marks – 75 **Duration- 90 minutes** **March 10, 2017**

Instructions: *Additional answer sheet will not be provided; Write your assumptions clearly with justifications;*

Doubts are a part of questions. So, no clarification please!

Q1. A three phase, transmission line is delivering 25 MVA at 0.8 lagging power factor to a balanced load at 132 kV. Find the voltage regulation with and without resistive component of the transmission line and compare the % change in voltage regulation for the following conditions:

a) The transmission line is a short transmission line (*20-50km range*)
b) The transmission line a medium transmission line (*100-250km range*) represented as nominal-***T*** method and nominal-$\boldsymbol{\pi}$ method

Hint: You can use approximate method with proper justification. Note: Use only Bar chart representation for comparison purpose *[30]*

Q2. A 275 kV transmission line has the following line constants;

A = 0.85 ∟5°; B = 200 ∟75°

a) Determine the power at unity power factor that can be received if the voltage profile at each end is to be maintained at 275 kV.
b) Determine the rating of the compensation equipment required if the load is 150 MW at unity power factor with the same voltage profile as in part (a). *[15]*

Q3. Consider the synchronous machine defined in the following table:

Three phase synchronous machine data

Ratings

V_{line} = 480V I_{line} = 120.3A S_{3ph} = 100kVA

Stator frequency = 60 Hz Rotor type: *SALIENT*

Synchronous speed = 1800 rpm No. of poles = 4 DC excitation voltage = 125V

Equivalent circuit values (R, X in Ω)

$\boldsymbol{Ra}$ = 0.0; $\boldsymbol{R_F}$ = 7.8125 $\boldsymbol{X_d}$ = 2.543 $\boldsymbol{X_q}$ = 1.647

Plot the power transfer with varying rotor angle (**δ**) when (a) excitation emf (E_f) is 0.985 pu and (b) excitation emf (E_f) is 1.80 pu. Calculate the average % increase in power transfer due to saliency of rotor in the interval (***45°< δ< 90°).***

Note: Marks will be awarded only when the values of power transfer are correct at δ=45°, δ=90° and δ= 135°. *[30]*