Benha University
Faculty of Engineering (Shoubra)
Electrical Engineering Department
2nd Year Power

Final Term Exam (Model Answer)
Date: 29/5/2017
Electrical Power Engineering
Duration: 3 Hours

- Answer all the following questions.
- Illustrate your answers with sketches if necessary.
- Number of questions: 6
- The exam consists of two pages.

Q.1 Write true or false with correcting the wrong statement ***(20 marks)***

1- The chief causes of overvoltages in electric systems are lightning and switching overvoltages. (True)
2- Electrical energy is superior to all other forms of energy due to its cleanliness only. (False)
3- The protection system must have at least the following qualities: selectivity, stability, sensitivity, speed, dependability, and security. (True)
4- The generating stations are classified as follows: renewable or non-renewable. (True)
5- High voltages require large conductors but low voltages require small conductors. (False)
6- The coefficient of reflection of voltage for an open-ended line is negative one. (False)
7- As compared to a C.B., a fuse has a breaking capacity which is high. (False)
8- In Egypt, the overhead transmission lines are generally aluminum conductor. (False)→ACSR
9- In the power system, the transmission capacity of a line at 60 Hz is being higher than that at 50 Hz. (True)
10- At the generating station a transformer is used to increase voltage and increase the current. (False)
11- The power of a 3-phase system is equal to the real power per phase. (False) -→ three times
12- The 3-phase transmission system is said to be balanced when the 3-phase currents are balanced. (False) -→ both 3-phase voltages and currents are balanced
13- Most of the protective relays, used on Egyptian power systems, are electronic type. (False) -→electromechanical type
14- A sub-station changes voltages, currents, frequency, and power factor. (True)
15- The highest transmission voltage used in Egypt is 400 kV. (False)-→500 kV
16- Most of Egyptian electricity production comes from hydro plants. (False) -→Steam
17- Egyptian power system has high penetration level for renewable resources based power plants. (False) -→low
18- The most suitable renewable resource for energy production in Egypt is tide waves. (False) -→Sun or Wind
19- When interconnected power systems operate with tie-line bias, they will respond to frequency changes only. (False) -→both frequency and tie line load changes
20- The main function of a circuit breaker is to control a relay. (False) -→interruption of supply in case of fault

With our best wishes

Prof. Dr. Ebtisam Mostafa Saied
Dr. Eng. Mohamed Ahmed Ebrahim
Dr. Mohamed Adel Mandour

Question # 2: **(15 marks)**

(i) Along the power transformer.

$Z_1 = Z_{Trans} = 250\ \Omega$

$Z_2 = Z_{Cable} = 50\ \Omega$

$$\gamma = \frac{Z_2 - Z_1}{Z_2 + Z_1} = \frac{50 - 250}{250 + 50} = -0.67$$

The reflected wave, $e_r = \gamma e = -0.67 \times 220 = -146.67$ kV

The transmitted wave, $e_t = (1 + \gamma)e = 0.333 \times 220 = 73.33$ kV

The reflected current wave, $I_r = \frac{e_r}{Z_1} = \frac{-146.67}{250} = -0.587$ kA

The transmitted current wave, $I_t = \frac{e_t}{Z_2} = \frac{73.33}{50} = 1.467$ kA

(ii) Along the cable

$Z_1 = Z_{Cable} = 50\ \Omega$

$Z_2 = Z_{Trans} = 250\ \Omega$

$$\gamma = \frac{Z_2 - Z_1}{Z_2 + Z_1} = \frac{250 - 50}{250 + 50} = 0.67$$

The reflected wave, $e_r = \gamma e = 0.67 \times 220 = 146.67$ kV

The transmitted wave, $e_t = (1 + \gamma)e = 1.67 \times 220 = 367.4$ kV

The reflected current wave, $I_r = \frac{e_r}{Z_1} = \frac{146.67}{50} = 2.93$ kA

The transmitted current wave, $I_t = \frac{e_t}{Z_2} = \frac{367.4}{250} = 1.47$ kA

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Question # 3: **(15 marks)**

$L = 1\ mH$

$C = 1\ \mu F$

$\frac{1}{2}Li^2 = \frac{1}{2}Cv^2$

$v = \sqrt{\frac{L}{C}}i = 3.162\ kV\ r.m.s$

$E_{max} = \sqrt{2} \times 3.162 = 4.472\ kV$

Expression for restriking voltage

$e = E_{max}\left(1 - cos\frac{t}{\sqrt{LC}}\right) = 4.472(1 - cos\frac{t}{31.62 \times 10^{-6}})$

$e_{max} = 2 \times 4.472 = 8.944\ kV$

Time for peak restriking voltage:

$t = \sqrt{LC} \times \pi = 31.62 \times 10^{-6} \times \pi = 99.34\ \mu - sec$

(i) Max R.R.R.V $= \frac{E_{max}}{\sqrt{LC}} = \frac{4.472}{31.62 \times 10^{-6}} = 0.141\ kV/\mu - sec$

(ii) Frequency oscillations $f_n = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi \times 31.62 \times 10^{-6}} = 5.03\ Kc/sec$

(iii) Time for maximum R.R.R.V $t = \frac{\pi}{2}\sqrt{LC} = 49.67\ \mu - sec$

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Q.4 ***(20 marks)***

a) Mention the protective equipment used in power systems for protection against lightning.

b) Define the insulation coordination and mention the type of over voltages that need to be considered when doing insulation coordination study.

Q.5 ***(20 marks)***

a) Mention the main advantages of DC transmission over AC transmission. Moreover, explain all types of DC links used in DC transmission systems.

b) A 200m long distributor is fed from both ends A and B at the same voltage of 250V. The concentrated test loads of 50, 40, 30 and 25A are coming on the distributor at distances 50, 75, 100, 150m respectively from end A. Determine the minimum potential and locate its position. Also, determine the current in each section of the distributor. It is given that the resistance of the distributor conductor is 0.08Ω per 100 meters for go and return.

Q.6 ***(10 marks)***

a) Discuss the advantages and disadvantages of interconnection of power systems. Also, discuss the different modes of tie line operation.

b) A single phase a.c distributor 500m long has a total impedance of 0.02+j0.04 and is fed from one end at 250V. It is loaded as under:

(i) 50A at unity power factor 200m from feeding point.

(ii) 100A at 0.8 p.f lagging 300m from feeding point.

(iii) 50A at 0.6 p.f lagging at the far end.

Calculate the voltage drop and voltage at the far end.

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