Mansoura university
Faculty of Engineering
Electrical Engineering Dept.
Course Title: Elective course 3 – Power System Planning

Allowed Time: 3 Hours
Code: EE 2424
Year: 4th Year
Total Degree: 70
12th June 2013

Final Term Exam (2013)

Answer all the following questions (assuming any missing data)

Question (1)

New generation facilities, namely 400 and 600 MW, in 5 year and 10 year times, respectively, are required. Based on the system data and the economic terms given in the Table.1 and Table.2, find the total cost of the decided generation expansion plan which suggests that the generation requirements are fulfilled through neighboring systems. However, an equivalent of 500 MVA km transmission line should be constructed within the second period.

Table.1

Type	Investment cost	Operation cost	Fuel cost	Life (year)
Gas fueled units	L.E 250 /kW	L.E 20 /kW year	L.E 30 /MWh	25
Transmission lines	L.E 5 /kVA km	L.E 0.025 / kVA km year	-	50

The system losses will be increased by 12 MW in the first period and 18 MW in the second period. The interest rate is assumed to be 15%, and the cost of losses to be L.E 800/kW. The cost of meeting loads through neighboring systems is L.E 0.1/kWh and L.E 0.7/kWh for the first and the second period respectively. The load factor is 0.8 for both periods. The investment costs are incurred at year 3 and year 7, in the first and second period respectively.

Table.2

Notation	Formula	Notation	Formula	Notation	Formula
$(P/F,i,n)$	$(1+i)^{-n}$	$(A/F,i,n)$	$\frac{i}{(1+i)^n-1}$	$(P/A,i,n)$	$\frac{1-(1+i)^{-n}}{i}$
$(F/P,i,n)$	$(1+i)^n$	$(F/A,i,n)$	$\frac{(1+i)^n-1}{i}$	$(A/P,i,n)$	$\frac{i}{1-(1+i)^{-n}}$

(20-degrees)

Question (2)

a) Define the concept of electric load forecasting and its driving parameters.
b) What is the basis of "spatial load forecasting" technique, and what is the meaning of the "coincidence factor"?
c) Show with a diagram the model and the concept of the "end user" load forecasting method.

(15-degrees)

Question (3)

For a single bus generation expansion planning problem, consider three candidate power plants: A: 150 MW thermal power plant (with oil fuel), B: 250 MW thermal power plant (with coal fuel), and C: 100 MW gas turbine power plant. The existing capacity is 500 MW (of two already committed units each D = 250 MW). It is desired to determine the required generation capacity for a single stage of one year with the peak forecasted load of 1000 MW (assumed flat load curve), and a reserve margin of 20%. Consider the plants data given in Table.3 find out the generation expansion results and the total cost (when considering all the planning costs given). Please explain the reasons of your choice.

Table.3

Unit name	Investment cost (L.E/kW)	Fixed cost (L.E/MWh)	Fixed O&M cost (L.E/kW month)	Life (year)
A	300	20.409	1	20
B	350	14.000	3	30
C	250	25.953	2.5	25
D	-	14.355	-	-

(20-degrees)

Question (4)

a) In the substation expansion problem, what are the factors deciding the overall cost?
b) Develop the mathematical formulation of the substation expansion optimization problem, and what are the required data for the optimum solution?
c) Show in details the method of cost analysis of the substation downward grid using an example of the line selection curves.

(15-degrees)

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Best wishes

Dr. K. M. Abo-Al-Ez