Menoufia University
Faculty of Engineering
Shebin El-Kom
Second Final Semester Exam.
Academic Year: 2017-2018
Code No.: ELE 322B

Electrical Engineering Department
Course: Optimal methods for Electrical Power Systems (Elective course)
Third year
Time Allowed: 3 hours
Date: 4 / 6 /2018
Total Marks: 100

Answer of the following questions and assume any missing data.

Question One: (25 Marks) **ILOs = (a1, a3, a5, b1, b2,c1, d2, d3)**

1. a) Defined the follows:

Load forecasting terms – End-use load forecasting method - Electrical power reserve – Reliability and Security of power system.

b) The line data, power injection and generation data for a sample power system shown in Fig. 1 are presented in Tables 1 and 2. Determine the optimal power dispatch for the power generations using two iterations of linear programming technique.

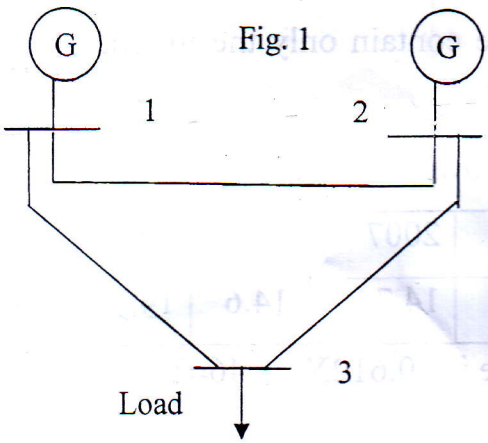

Fig. 1

Table 1 Line data

Line No.	Initial power flow (MW)	Max. power flow (MW)	D-coefficient
1-2	5	8	$0.2PG_1+0.5PG_2$
1-3	47	45	$0.3PG_1+0.4PG_2$
2-3	36	34	$0.4PG_1+0.5PG_2$

Table 2 Power injections

Code bus	Power injection		Initial Volt
	MW	MVAR	
1	52	-30	1.06
2	32	-22	1.02
3	-80	56	0.976

Code bus	Min limit MW	Max limit MW	Ramp rate in 10 mint MW	Cost function $/hr
1	20	70	7.0	$0.025 P_1^2 + 2.1 P_1+30$
2	10	50	5.0	$0.03 P_2^2+1.8 P_2+25$
Total loads + losses = 84 Mw				
MVA_{base} = 100 , KV_{base} = 110				

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Question Two: (20 Marks) **ILOs = (a1, a3, b1, b2, b3, c1, d1, d2, d3)**

2. a) Find the different optimal load sharing between the power generation units.

b) Find the optimal load shedding to be shed for 5-bus system contains three power generations supplying three load buses, if the load and the power losses are sudden increased to be 220 MW using two iterations of linear programming technique. However, the initial load and power losses are equal to 195MW. Considering the total load shedding, which will be shed, is an objective function according to the priority of their buses. The system data are shown in Tables 3 and 4.

Table 3 Power generations date

Bus No.	Min limit MW	Max limit MW	Initial power generations MW	Ramp rate in 10 min MW
1	20	130	90	9
2	10	100	60	6
5	10	80	40	4

Table 4 Load buses shedding data

Line No.	Min. Limit (MW)	Max. Limit (MW)	Priority to be shedd
3	2	5	3
4	2	6	2
5	3	8	1

Question Three: (20 Marks) **ILOs = (a1, a3, b1, b3, c1, d1, d2)**

3. a) Write about the different emergency conditions and their effects on power system.

b) Find the economical generation dispatch for three units for load demand equals 850 MW, which the fuel rate for the three power generations are:

$F_1 = 0.00142\ P_1^2 + 7.2\ P_1 + 510.0$ M Btu/h

$F_3 = 0.00482\ P_3^2 + 7.97\ P_3 + 78.0$ M Btu/h

$F_2 = 0.00194\ P_2^2 + 7.85\ P_2 + 310.0$ M Btu/h

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The maximum and minimum limits are:

$150 \leq P_1 \leq 600$ $100 \leq P_2 \leq 400$ $50 \leq P_3 \leq 200$

The fuel cost for each unit is:

cost1 = 0.9 \$/M Btu/h, cost2 = 1.0 \$/M Btu/h and cost3 = 1.0 \$/M Btu/h

Question Four: (15 Marks) **ILOs = (a1, a3, b1, b2, b3, c1, d1, d2, d3)**

4. a) Write the objective function for unit commitment of power generations.

b) Obtain the economic schedule of unit commitment for three units using the dynamic programming technique to supply a load of 3 MW, in step 1 MW. The production costs of these units are:

$C_1=0.8\ P_1^2+25\ P_1$ $C_2=1.2\ P_2^2+22\ P_2$ $C_3=P_3^2+23\ P_3$

Question five: (20 Marks) **ILOs = (a1, a3, b2, b3, c1, c2, c3, d2, d3)**

5. a) Find the optimal method to reduce a large power system which contains internals, boundaries and externals buses to be contain only the internals and boundaries buses.

b) The peak load demand against the years for a power system are given as:

Year	2005	2006	2007	2008	2009
Peak Load Demand in p.u	13	13.8	14.7	14.6	14.7

And the equation of the straight-line trend curve is $0.612X+8.46=Y$

i) Calculate the errors in the prediction.

ii) Calculate the standard deviation and variance of the estimate.

iii) Predict the values of the peak load demand in the years 2015 and 2020.

Good Luck

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