UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Year 2003/2004

September 2003

MGM 551 – Operations Research
Time : 3 hours

Please ensure that this exam paper consists of **FOUR** [4] printed pages before you begin the exam.

Answer all **FIVE** questions.

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1. Define Linear Programming Problem.

A menswear firm produces 4 different types of ties. One is an expensive all-silk tie, one is an all-polyester tie, and two are blends of polyester and cotton. The following table illustrates the cost and availability (per monthly production planning period) of the 3 materials used in the production process

Material	Cost per yard ($)	Material available per month (in Yards)
Silk	21	800
Polyester	6	3,000
Cotton	9	1,600

The firm has fixed contracts with several major department store chains to supply ties. The contracts require that the firm supply a minimum quantity of each tie, but allow for a large demand if the firm chooses to meet that demand. The table below summarizes the contract demand for each of 4 styles of ties, the selling price per tie, and the fabric requirements of each variety.

Type of tie	Selling price per tie ($)	Minimum requirement	Monthly demand	Material required per tie (Yards)	% of material requirements
All silk	6.7	6,000	7000	0.125	100% silk
All polyester	3.55	10,000	14,000	0.08	100% polyester
Poly-cotton Blend # 1	4.31	13,000	16,000	0.10	50% polyester 50% cotton
Poly-cotton Blend # 2	4.81	6,000	8,500	0.10	30% polyester 70% cotton

To maximize the total profit, formulate the problem as a Linear Programming Problem.

[10 Marks]

2. Solve the following problem by graphical method and check the result by solving the problem in Simplex Method

$$\text{Maximize } 3x_1 + 3x_2$$

Subject to

$$x_1 + 2x_2 \geq 6$$
$$2x_1 + x_2 \leq 16$$
$$2x_1 - x_2 \leq 8$$
$$x_1 \geq 0; x_2 \geq 0.$$

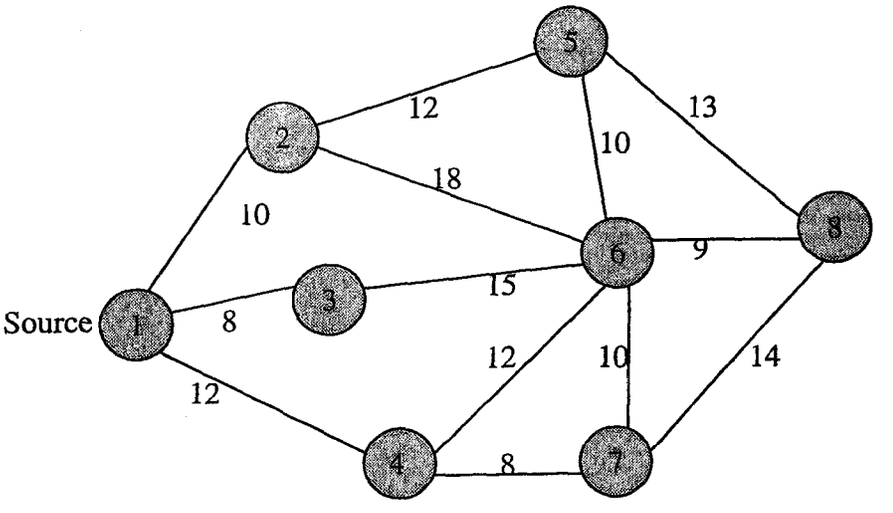
[14 Marks]

3. Define two-person zero-sum game. Reduce the following matrix by dominance principle and then solve it.

$$\begin{pmatrix} 3 & 3 & 2 & 3 \\ 1 & 4 & 4 & 4 \\ 5 & 7 & 6 & 1 \end{pmatrix}$$

[12 Marks]

4.(a) An owner of a large horse breeding farm is planning to install a complete water system connecting all of the various stables and barns. The location of the facilities and the distances between them is given in the following network. Determine the least expensive way to provide water to each facility.



(b) In order to complete the wing assembly for an experimental aircraft, Scott DeWitte has laid out the major steps and seven activities involved. These activities have been labeled A through G in the following table, which also shows their estimated completion times and immediate predecessors. Determine the expected time and variance for each activity and hence find out the critical path and critical activities and the project completion time with standard deviation.

Activity	*a* *(Optimistic)*	*m* *(Most-Likely)*	*b* *(Pesimistic)*	Immediate Predecessors
A	1	2	2	-
B	2	3	3	-
C	4	5	6	A
D	8	9	11	B
E	2	5	5	C, D
F	3	5	6	B
G	1	2	3	E

[14 Marks]

5. Define Hamilton circuit. Applying a heuristic technique find near optimal solution of the following Traveling Salesperson Problem:

Nodes	1	2	3	4	5	6
1	∞	2	3	4	3	7
2	1	∞	5	2	4	6
3	5	2	∞	5	4	3
4	2	3	4	∞	2	4
5	7	6	3	4	∞	5
6	3	7	2	6	8	∞

[10 Marks]

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