FINAL EXAMINATION  
FIRST SEMESTER SESSION 2011/2012

COURSE CODE / NAME: SQQP3023/PEMODELAN PEMUTUSAN
DATE: 7 JANUARY 2012
TIME: 9.00 – 1130 AM (2 hours and 30 minutes)
VENUE: DSB K. MAS

INSTRUCTION:
1. The exam script contains NINE (9) questions on TEN (10) printed pages excluding the cover page and the formula.
2. A list of formula is given on page 11.
3. Please answer all questions in the provided spaces.
4. You are not allowed to remove the exam scripts from the examination hall.

MATRIC NO: ____________________________ (with word) ____________________________ (with number)
IDENTIFICATION CARD NO.: ____________________________
LECTURER: __________________________________
GROUP: __________ TABLE NO.: __________

DO NOT OPEN THIS EXAMINATION PAPER UNTIL INSTRUCTED

CONFIDENTIAL
Question 1 (5 marks)

State whether each of the following statements is TRUE (T) or FALSE (F)

a) The decision modeling solution process indicates whether or not the model solution should be implemented. ________

b) The basic feasible solution in the initial simplex tableau where all decision variables are equal to zero. ________

c) All the constraint coefficients in a transportation problem are one. ________

d) Customers must be served faster than they arrive or an infinitely large queue will build up. ________

e) When using the shortest route problem, you can determine the shortest distance path between a single originating point and any destination path in the network. ________

Question 2 (13 marks)

EmMKay Manufacturing Company makes two products. EmMKay's factory is divided into three work centers with the following weekly capacity. Center A has available a maximum of 180 hour/week, center B has 240 hours, and center C has 50 hours. Producing one unit of the first product requires 6 hours of center A, 4 hours of center B, and no time at center C. The second product requires 3 hours of center A, 8 hours of center B, and 2 hours at center C. The marginal profits of the two products are RM15/unit on the first, and RM 20/unit on the second. EmMKay executives ask the following questions: How much units should we decide to make of each product to maximize the profit? How much is the maximum profit?

i) Formulate the problem mathematically. (5 marks)
ii) Solve the problem by using the graphical method.

(5 marks)

iii) Based on solution in part (ii), answer the questions asked by the EmMKay executives.

(3 marks)
Question 3 (13 marks)

a) The following tableau is the initial tableau for a linear programming (LP) problem. Formulate the LP problem in its standard form. (4 marks)

<table>
<thead>
<tr>
<th>Basic Variable</th>
<th>( C_i )</th>
<th>( X_1 )</th>
<th>( X_2 )</th>
<th>( S_1 )</th>
<th>( S_2 )</th>
<th>RHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( S_2 )</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>( S_1 )</td>
<td>0</td>
<td>5</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>( Z_j )</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( C_j - Z_j )</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

b) i) Fill out the following tableau (7 marks)

<table>
<thead>
<tr>
<th>Basic Variable</th>
<th>( C_i )</th>
<th>( X_1 )</th>
<th>( X_2 )</th>
<th>( S_1 )</th>
<th>( S_2 )</th>
<th>( S_3 )</th>
<th>RHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( X_1 )</td>
<td>4</td>
<td>0.5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>( S_2 )</td>
<td>0</td>
<td>-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>124</td>
</tr>
<tr>
<td>( S_3 )</td>
<td>0</td>
<td>2</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>( Z_j )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>480</td>
</tr>
<tr>
<td>( C_j - Z_j )</td>
<td></td>
<td></td>
<td>1.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(ii) The tableau is not optimal, why? (1 mark)

(iii) What are the entering non basic variable, and the leaving basic variable? (1 mark)
Question 4 (7 marks)

The following table is a portion of QM for Windows solutions for a max LP problem.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
<th>Reduced Cost</th>
<th>Original Val</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>560</td>
<td>0</td>
<td>1</td>
<td>0.8929</td>
<td>1.25</td>
</tr>
<tr>
<td>X2</td>
<td>240</td>
<td>0</td>
<td>1.25</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Constraint</td>
<td>Dual Value</td>
<td>Slack/Surplus</td>
<td>Original Val</td>
<td>Lower Bound</td>
<td>Upper Bound</td>
</tr>
<tr>
<td>Raw material 1</td>
<td>0.125</td>
<td>0</td>
<td>4480</td>
<td>4320</td>
<td>5600</td>
</tr>
<tr>
<td>Raw material 2</td>
<td>0</td>
<td>160</td>
<td>2080</td>
<td>1920</td>
<td>Infinity</td>
</tr>
<tr>
<td>Raw material 3</td>
<td>0.1875</td>
<td>0</td>
<td>1600</td>
<td>1280</td>
<td>1640</td>
</tr>
</tbody>
</table>

Based on the table,

i) State the optimal solution to the problem. (3 marks)

ii) Is it possible to reduce the supply of raw material 1 to 4400 units? What would be this action effect the value of the objective function? (2 marks)

iii) Specify the optimality range for the first objection function coefficient. Interpret your answer. (2 marks)

Question 5 (14 marks)

a) Describe the general characteristics of a transportation problem. (1 mark)

b) How to convert an assignment problem to a transportation problem? (1 mark)
c) Given the following linear programming problem
\[ \text{Min } Z = 10AX + 5AY + 9AZ + 4BX + 7BY + 6BZ + 3CX + 5CY + 9CZ \]
Subject to
\[ AX + AY + AZ = 800 \]
\[ BX + BY + BZ = 300 \]
\[ CX + CY + CZ = 200 \]
\[ AX + BX + CX = 400 \]
\[ AY + BY + CY = 600 \]
\[ AZ + BZ + CZ = 300 \]

i) Set up the transportation tableau for this problem, and determine the initial solution. 
(7 marks)

ii) Solve this problem using MODI 
(5 marks)
Question 6 (6 marks)

Mr Zack, the owner of Chelong farming is planning to install a complete water system connecting all of the various stables and barns. The location of the facilities and the distance between them are given in the following network.

(6 marks)

Mr Zack must determine the least expensive way to provide water to each facility. What do you recommend?
Question 7 (19 marks)

a) The PERT network described in the following set of activities. Compute the expected activity time and variance for each activity, and indicate the critical path and expected project completion time for the network.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Immediate predecessors</th>
<th>Time estimates (weeks)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>optimistic</td>
<td>likely</td>
</tr>
<tr>
<td>A</td>
<td>-</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>B</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>C</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>C</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>G</td>
<td>D, E</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>H</td>
<td>E, G</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
b) The following network represents a launch of the first Malaysian space shuttle. The time for each activity (in weeks) is given for each branch. (6 marks)

How many weeks will it take to launch the shuttle?

Question 8 (9 marks)

a) State any two important factors in analyzing a queuing system. (2 marks)

b) The Green Car rental Company has over 500 cars that rented daily in a large metropolitan area. The cars break down at the rate of one every 16 hours. When a car breaks down, the car is towed to a shop and a mechanic repairs it. An average of 12 hours is required to fix a car. The company loses an average of RM50.00 per hour the car is out of service.

i) Find the average time a car in the system and the incurred cost. (3 marks)
ii) The company is thinking of contracting a second auto repair shop which would increase existing repair costs by RM750 per day. If the company has two repair shops, the average time a car in the system is 14 hours. Should the company contract with this second shop? (4 marks)

Question 9 (14 marks)

Given the following discrete probability distribution for arrival at a local restaurant (in minutes).

<table>
<thead>
<tr>
<th>Arrival Interval, X</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>P(X)</td>
<td>0.15</td>
<td>0.15</td>
<td>0.30</td>
<td>0.20</td>
<td>0.20</td>
</tr>
</tbody>
</table>

i) Determine the random number ranges that would be appropriate to use in the Monte Carlo simulation model of the restaurant. (3 marks)

ii) Based on your answer in (i), compute the expected value of this random variable. (3 marks)
iii) Simulate the arrival process for 10 arrivals using the following random numbers: 23, 58, 89, 54, 34, 27, 34, 36, 98, 37. What is the average arrival interval? (7 marks)

iv) Why are these two values (ii and iii) different? (1 mark)
LIST OF FORMULA

1. \( P_0 = 1 - \frac{\lambda}{\mu} \)

2. \( L = \frac{\lambda}{\mu - \lambda} \)

3. \( W = \frac{1}{\mu - \lambda} \)

4. \( l_s = \frac{\lambda^2}{\mu(\mu - \lambda)} \)

5. \( W_q = \frac{\lambda}{\mu(\mu - \lambda)} \)

6. \( U = \frac{\lambda}{\mu} \)

7. \( t = \frac{a + 4m + b}{6} \)

8. \( v = \left( \frac{b - a}{6} \right)^2 \)