UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	INTRODUCTION TO OPTIMIZATION
COURSE CODE	:	BPB 2092
PROGRAMME	:	3 BPA
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 A manufacturer produces two different products X_1 and X_2 using three machines M_1, M_2 and M_3. Each machine can be used only for a limited amount of time. Production times of each product on each machine are given in **Table Q1 (a).** The objective is to maximize the combined time of utilization of all three machines.

Table Q1 (a): Production times

Machine	Production time (hours per unit)		Available time (hours)
	X_1	X_2	
M_1	1	1	8
M_2	1	3	18
M_3	2	1	14
Total	4	5	

Given that every production decision must satisfy the constraints on the available time.

(a) Formulate the problem as a linear programming problem.

(12 marks)

(b) State the optimal solution and the slack quantities, where the final simplex tableau for the linear programming problem is shown in **Table Q1 (b)** with s_1, s_2 and s_3 are slack variables.

Table Q1 (b): Final simplex tableau

Basic	x_1	x_2	s_1	s_2	s_3	z	quantity
x_1	1	0	1.5	-0.5	0	0	3
x_2	0	1	-0.5	0.5	0	0	5
s_3	0	0	-2.5	0.5	1	0	3
z	0	0	3.5	0.5	0	1	37

(8 marks)

Q2 **Table Q2** shows the initial simplex tableau for a linear programming maximization problem, where s_1 and s_2 are slack variables added to the original problem.

Table Q2: Initial simplex tableau

Basic	x_1	x_2	s_1	s_2	z	quantity
s_1	2	1	1	0	0	40
s_2	1	3	0	1	0	30
z	-9	-7	0	0	1	0

Demonstrate the following optimal solution ($x_1 = 18$, $x_2 = 4$ and z = RM190) by using Simplex Method.

(20 marks)

Q3 A linear programming problem given can be solved by using Two-Phase Method.

$$\begin{aligned} \text{Minimize} \quad & Z = 4x_1 + x_2 \\ \text{subject to} \quad & \\ & 3x_1 + x_2 = 3 \\ & 4x_1 + 3x_2 \geq 6 \\ & x_1 + 2x_2 \leq 4 \\ & x_1, x_2 \geq 0 \end{aligned}$$

(a) Demonstrate that Phase I will terminate with a zero artificial basic variable.

(12 marks)

(b) Determine the optimal solution by carrying out Phase II with the zero artificial variables as part of the starting basic solution.

(8 marks)

Q4 A furniture company makes tables (T), chairs (C), and bookcases (B). The following linear programming model is applied to maximize the profit (P):

$$\begin{aligned} \text{Maximize} \quad & P = 20X_T + 15X_C + 15X_B \\ \text{subject to} \quad & \\ \text{(wood)} \quad & 10X_T + 3X_C + 10X_B \leq 100 \\ \text{(labor)} \quad & 5X_T + 5X_C + 5X_B \leq 60 \\ & X_T, X_C, X_B \geq 0 \end{aligned}$$

(a) Let C be the cost spent, and Y_W and Y_L be the dual decision variables. Formulate the dual linear programming model.

(14 marks)

(b) Determine the dual surplus quantity for each table (Y_T), chair (Y_C) and bookcase (Y_B) given that $Y_W = 5/7$, $Y_L = 18/7$ and $C = \$1580/7$.

(6 marks)

Q5 (a) A farmer is planning to install a complete water system connecting all of the various stables and barns. The location of the facilities and the distances (in kilometer) between them are given in the network shown in **Figure Q5 (a)**.

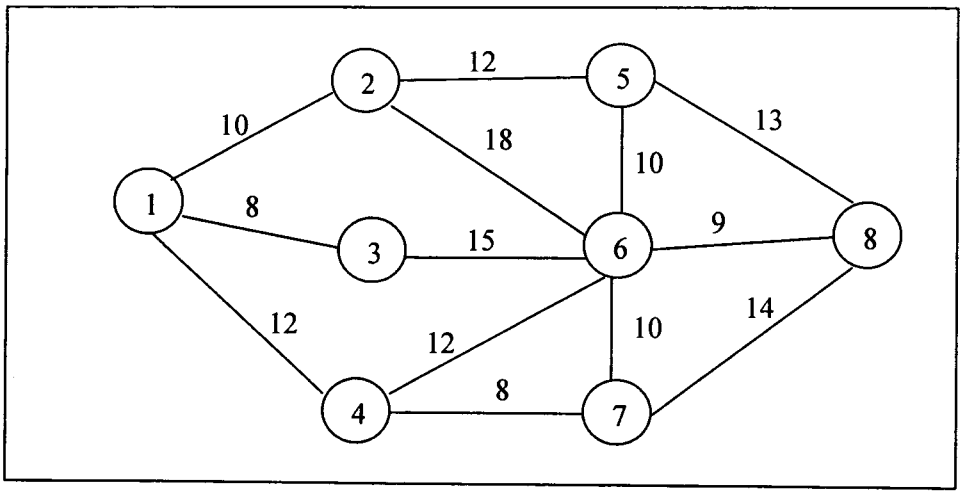

Figure Q5 (a): Water system network

Determine the least expensive way to provide water to each facility.

(10 marks)

(b) A city is in the process of completing a computer bus network that will connect computer facilities throughout the city. The prime objective is to string a main cable from one end of the computer to the other through underground network. This network is shown in Figure **Q5 (b)**, where the distance between them is in hundreds of meter.

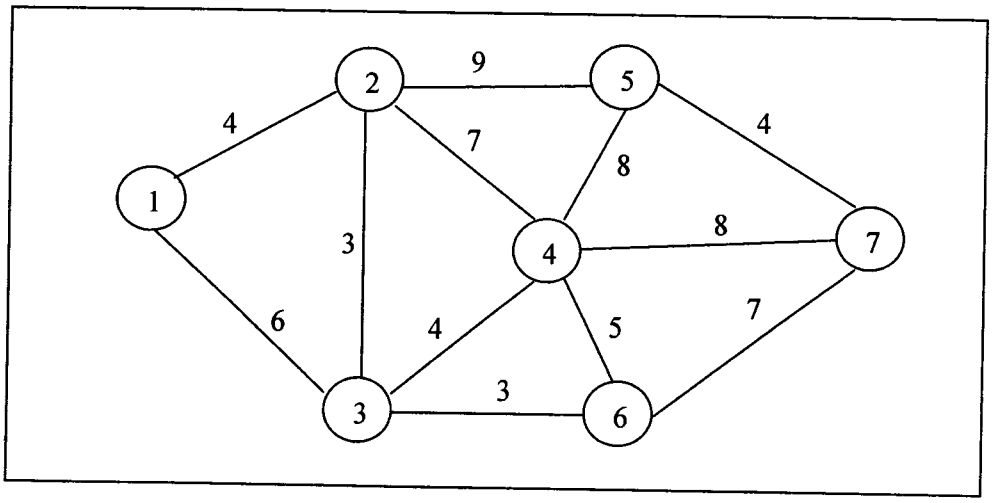

Figure Q5 (b): Computer bus network

Determine the shortest route from node 1 to node 7.

(10 marks)

END OF QUESTION PAPER