UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: August 2015

Module Number: EE7241   **Module Name: Optimization**

[Three Hours]
[Answer all questions]

Q1 a) Explain the steps involved in solving the assignment problem using Hungarian Method.
[2 Marks]

b) A software company has four vacancies in their offices in Galle, Kandy, Matale and Vavunia. However, they managed to hire only 3 programmers, Namal, Kamal and Raja. One programmer can be assigned only to one office. The cost of assigning a programmer to an office is given in the table below.

Table Q1: Assignment costs of programmers

	Offices			
	Galle	Kandy	Matale	Vavunia
Namal	800	1100	1200	1000
Kamal	500	1600	1300	800
Raja	500	1000	2300	1500

Find the assignment that will minimize the total cost of allocation. (Note: there will be one office without a programmer)

[8 Marks]

Q2 a) Explain how to modify the transportation algorithm when one or more routes are unacceptable.   [3 Marks]

b) A company has three warehouses in Matale, Badulla and Vavunia and four stores in Kandy, Galle, Matara and Gampola. Monthly capacities of the three warehouses in Matale, Badulla and Vavunia are 100, 40 and 60 units respectively. Monthly demand in the stores Kandy, Galle, Matara and Gampola are 30, 50, 55 and 45 units respectively. Table Q2 shows the transportation costs between warehouses and stores.

Find the least cost distribution system. (Answers without supporting calculations carry no marks).

Table Q2: Cost of transportation between supply and demand points

	Kandy	Galle	Matara	Gampola
Matale	8	9	4	6
Badulla	5	6	8	4
Vavunia	7	9	6	8

[9 Marks]

Q3 a) Discuss three situations where 0-1 Kanpsack problem can be applied in allocating limited resources.

[3 Marks]

b) Government received a 25 million grant to provide Wi-Fi facilities to rural villages. Table Q3 shows the earmarked villages, their population in thousands and the cost in millions of providing the facility.

Find what villages need to be supplied with Wi-Fi facility so that the maximum number of people are benefitted.

Table Q3: Population and cost of the earmarked villages

Village	Cost	Population
1	7	6
2	4	8
3	3	4
4	5	8
5	7	3
6	5	2
7	1	9
8	4	5

[8 Marks]

Q4 a) In Kalawewa area there are 6 farms connected by village roads. Table Q4 shows the distance between these farms. What is the shortest distance between farm 1 and 6.

[3 Marks]

b) The Government has decided to install cable television network connecting all villages. What is the minimum length of cable required to connect all villages.

[3 Marks]

c) The development plan changed to add a new farm No. 7. The distance between farm 7 and farms 3, 4 and 5 are 4,5 and 6 respectively. Under this changed plan what is the minimum length of cable required?

Table Q4: Distance between farms

From	To	Distance
1	2	8
1	3	10
2	3	4
2	4	9
2	5	5
3	4	6
3	5	2
4	5	3
4	6	6
5	6	5

[3 Marks]

Q5 A leading telecommunication company provides customer support between 9 am and 7 pm. Their staff requirement on a typical working day is given on the table Q5. The company has the following policy on recruiting customer support staff.
  - Staff can start work at 0900, 1100, 1300 or 1500
  - Part-time personnel hours are limited to a maximum of 40% of the day's total requirement.
  - Full-time employees work for 8 hours (1 hour for lunch included) per day. Thus, a full-timer's productive time is 35 hours per week.
  - Part-timers work for at least 4 hours per day but less than 8 hours and are not allowed a lunch break.
  - Fifty percent of the full-timers go to lunch between 11 A.M. and noon, and the remaining 50% go between noon and 1 P.M.
  - The shift starts at 0900 and ends at 1900. (i.e., overtime is limited to 2 hours). Any work left over at 7 P.M. is considered holdover for the next day.
  - A full-time employee is not allowed to work more than 5 hours overtime per week.

Average cost per full time personnel hour is 100
Average cost of overtime personnel hour is 120
Average cost of part time personnel hour is 80

You need to determine how many employees to start at each time in order to minimize the total cost, while still meeting or exceeding staffing requirements of the hour.

a) Develop a mathematical model for the above problem. Your model should clearly indicate the variables, objective function, decision variables, functional constraints and non negativity constraints [5 Marks]
b) Translate the mathematical model developed above into a Lingo model.
[3 Marks]

Table Q5: Staff requirements

Time	0900 to 1100	1100 to 1300	1300 to 1500	1500 to 1700	1700 to 1900
Required	12	32	41	23	10