**THE INSTITUTE OF
CHARTERED ACCOUNTANTS OF SRI LANKA**

SCHOOL OF ACCOUNTING AND BUSINESS
BSc. (APPLIED ACCOUNTING) GENERAL / SPECIAL DEGREE PROGRAMME

YEAR II SEMESTER II – INTAKE V/VI (GROUP A)
END SEMESTER EXAMINATION – JULY 2017

QMT 20330 Operational Research

Date	:	26th July 2017
Time	:	1.00 p.m. - 4.00 p.m.
Duration	:	Three (03) Hours

Instructions to Candidates:

- Answer **ALL** questions.
- All questions carry equal marks.
- The total marks for the paper is 100.
- Use of scientific calculator is allowed.
- Answers should be written neatly and legibly

Question No. 01

The management of an industry, in which some machines are under employed, considers the case to produce the products X, Y and Z during the idle time of the machines. This time is estimated at 500, 350 and 150 machine hours per week for machine types A, B and C respectively. The machine hours needed for the production of each product unit are presented in the table given below. The sales department estimates that the demand of products X and Y are higher than the production capacity, while the sales of product Z cannot exceed 20 units per week. This department also predicts that the profits from the sale of each unit of product X, Y and Z are Rs. 3000, Rs 1200 and Rs. 2500 respectively. Use an appropriate mathematical model to identify the quantities of products that should be produced, in order to maximize the net profit of the industry.

Machines	Product		
	X	Y	Z
A	9	3	5
B	5	4	0
C	3	0	2

Question No. 02

A calculator company produces a scientific calculator and a graphing calculator. Long-term projections indicate an expected demand of at least 1000 scientific and 800 graphing calculators each month. Because of the limitations on production capacity, no more than 2000 scientific and 1700 graphing calculators can be produced monthly. To satisfy a supplying contracts, a total of at least 2000 calculators must be supplied each month. If each scientific calculator sold results in Rs.2300 profit and each graphing calculator sold produces Rs.2700 profit, how many of each type of calculators should be made monthly to maximize the net profit.

Question No. 03

Three refineries named as A, B and C with maximum daily capacities of 6, 5, and 8 million gallons of oil respectively, supply three distribution areas with daily demands of 4, 8 and 7 million gallons. Oil is transported to the three distribution areas through a network of pipes. The transportation cost is 1 rupee per 100 gallons per mile. The mileage table below shows that refinery A is not connected to distribution area Z. Formulate the problem as a transportation model and solve it by selecting an efficient approach.

		Distribution Area		
		X	Y	Z
Refinery	A	120	180	-
	B	300	100	80
	C	200	250	120

Question No. 04

'Alpha Industries Pvt. Limited' is a well-known electronic company in the city. They need to complete an urgent construction project for their manufacturing process. The table given below gives a part of the information on the activities, the predecessor activity, normal duration, normal cost, crash duration and the crash cost listed in a tender received by the 'Alpha Industries Pvt. Limited'.

The construction contract was offered with the following conditions;
- The scheduled completion time is 25 weeks.
- A penalty of Rs. 150,000 must be paid for each week delay.
- A bonus of Rs. 100,000 for each week early.

Activity	Predecessor	Normal Time (weeks)	Normal Cost (Rs. 000)	Crash Time (weeks)	Crash Cost (Rs. 000)
A	(None)	8	400	6	600
B	(None)	5	150	4	200
C	(None)	6	250	4	300
D	A	4	180	3	200
E	A, B	6	100	5	120
F	C	7	200	5	300
G	A	5	300	3	600
H	D, E, F	8	450	5	900
I	C	9	600	4	1000
J	D, E, F	6	600	4	800
K	G, H	4	200	3	260
L	D, E, F	6	300	3	900
M	I, J	4	800	2	1200

i.   Show your network diagram.

ii. Find the normal completion time and the critical path.

iii. Determine the schedule that minimizes your total cost for this project, including any penalty or bonus.

   a. How did you decide when to stop trying shortening the completion times?

   b. How many weeks in total should the project take?

   c. What will your total cost be?

   d. Which activities will be shortened from their normal times, and by how much?

   e. Which activities are critical to the least cost schedule?

Question No. 05

A publisher has just signed a contract for the publication of a book. The following table gives the information on the tasks, prerequisites and the time estimates in weeks. By answering the below given questions you are requested to find the earliest time that the book can be ready for distribution.

Activity	Task	Precedence	Most Likely	Optimistic	Pessimistic
A	Appraisal of book by reviewers	-	8	4	10
B	Initial pricing of book	-	2	2	2
C	Assessment of market ability	A,B	2	1	3
D	Revisions by author	A	6	4	12
E	Editing of final draft	C, D	4	3	5
F	Typesetting of text	E	3	3	3
G	Plates for art work	E	4	3	5
H	Designing and printing of jacket	C, D	6	4	9
I	Printing and binding of book	F, G	8	6	16
J	Inspection and final assembly	I, H	1	1	1

  i. For this PERT network, find the expected task durations and the variances of task durations.
 ii. Draw a network and find the critical path. What is the expected length of the critical path, and what is the variance?
iii. What is the probability that the length of the critical path does not exceed;
     a. 31 weeks?
     b. 35 weeks?

$$t = \frac{a + 4m + b}{6} \qquad \sigma_i = \sqrt{\left(\frac{b - a}{6}\right)^2} \qquad \sigma = \sqrt{\sum \sigma_i^2}$$