

**CONFIDENTIAL**



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2014/2015**

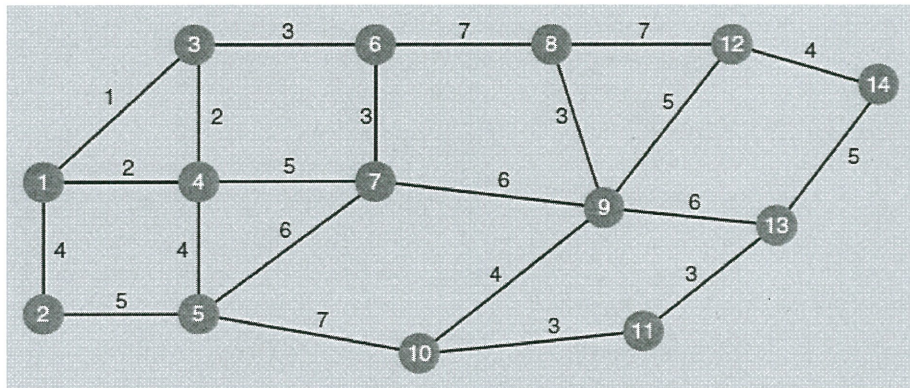
COURSE NAME	:	OPTIMIZATION AND OPERATIONS RESEARCH
COURSE CODE	:	BWB32203
PROGRAMME	:	3 BWQ
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

**CONFIDENTIAL**

**CONFIDENTIAL**

- Q1 (a)** A construction company is in the process of installing power lines to a large housing development. The project manager wants to minimize the total length of wire used, which will minimize his costs. The housing development is shown as a network in **Figure Q1 (a)**. Each house has been numbered, and the distances between houses are given in hundreds of feet. Give your recommendation to the project manager.



**Figure Q1 (a):** Housing Development Network (10 marks)

- (b)** To complete the wing assembly for an experimental aircraft, an engineer has laid out the major steps and seven activities involved. These activities have been labeled *A* through *G* in **Table Q1 (b)**, which also shows their estimated completion times (in weeks) and immediate predecessors. Assist the engineer to determine the critical path for the entire wing assembly project as well as the expected completion time and the variance for the total project.

**Table Q1 (b):** Activities for the Wing Assembly

Activity	<i>a</i>	<i>m</i>	<i>b</i>	Immediate Predecessors
<i>A</i>	1	2	3	--
<i>B</i>	2	3	4	--
<i>C</i>	4	5	6	<i>A</i>
<i>D</i>	8	9	10	<i>B</i>
<i>E</i>	2	5	8	<i>C, D</i>
<i>F</i>	4	5	6	<i>B</i>
<i>G</i>	1	2	3	<i>E</i>

(10 marks)

**CONFIDENTIAL**

**CONFIDENTIAL**

- Q2** A giant market has approximately 300 customers shopping in its store between 9 A.M. and 5 P.M. on Saturdays. In deciding how many cash registers to keep open each Saturday, the manager considers two factors: customer waiting time (and the associated waiting cost), and the service costs of employing additional checkout clerks. Checkout clerks are paid an average of RM8 per hour. When only one clerk is on duty, the waiting time per customer is about 10 minutes; when two clerks are on duty, the average checkout time is 6 minutes per person; 4 minutes when three clerks are working; and 3 minutes when four clerks are on duty. The market's management has conducted customer satisfaction surveys and has been able to estimate that the store suffers approximately RM10 in lost sales and goodwill for every hour of customer time spent waiting in checkout lines. Using the information provided, determine the optimal number of clerks to have on duty each Saturday to minimize the store's total expected cost.

(20 marks)

- Q3** The number of cars arriving per hour at Lundberg's Car Wash during the past 200 hours of operation is observed as shown in **Table Q3**.

**Table Q3:** Number of Cars Arriving

Number of Cars Arriving	Frequency
3 or fewer	0
4	20
5	30
6	50
7	60
8	40
9 or more	0
	Total 200

- (a) Set up a probability and cumulative probability distribution for the variable of car arrivals.
- (b) Establish random number intervals for the variable of car arrivals.
- (c) Simulate 15 hours of car arrivals and compute the average number of car arrivals per hour.

(10 marks)

(5 marks)

Use the random numbers 52, 37, 82, 69, 98, 96, 33, 50, 88, 90, 50, 27, 45, 81 and 66 for the simulation.

(5 marks)

**CONFIDENTIAL**

**CONFIDENTIAL**

- Q4** Mail Express, an overnight mail service, delivers mail to customers throughout the United States, Canada, and Mexico. Fortunately, Mail Express has additional capacity on one of its cargo planes. To maximize profits, Mail Express takes shipments from local manufacturing plants to warehouses for other companies. Currently, there is room for another 6 tons. **Table Q4** shows the items that can be shipped, their weights, the expected profit for each, and the number of available parts. Suggest the number of units for each item that Mail Express can ship.

**Table Q4:** Items to Be Shipped

Item	Items to be Shipped		
	Weight (tons)	Profit/Unit	Number Available
1	1	3	6
2	2	9	1
3	3	8	2
4	1	2	2

(20 marks)

- Q5** (a) Player *A* has a RM11 bill and a RM20 bill, and player *B* has a RM4 bill and a RM10 bill. Each player will select a bill from the other player without knowing what bill the other player selected. If the total of the bills selected is odd, player *A* gets both of the two bills that were selected, but if the total is even, player *B* gets both bills.
- (i) Develop a payoff table for this game by placing the sum of both bills in each cell.
- (ii) State the best strategy for each player.
- (iii) Point out the value of the game.
- (8 marks)
- (b) A game is shown in **Table Q5 (b)**. Determine the strategies for *X* and *Y*, and state the value of the game.

**Table Q5 (b):** Payoff Matrix

	$Y_1$	$Y_2$
$X_1$	6	-4
$X_2$	2	10

(12 marks)

**- END OF QUESTION -****CONFIDENTIAL**



**CONFIDENTIAL****FINAL EXAMINATION**

SEMESTER / SESSION : SEM II / 2014/2015  
 COURSE : OPTIMIZATION & OR

PROGRAMME : 3 BWQ  
 COURSE CODE : BWB32203

**FORMULAS**

Expected activity time  $t = \frac{1}{6}(a + 4m + b)$

Variance of activity completion time  $\sigma^2 = \frac{1}{36}(b - a)^2$

Earliest finish time = Earliest start time + Expected activity time

Latest start time = Latest finish time – Expected activity time

Slack time = Latest finish time – Earliest start time

The average number of customers in the system,  $L = \frac{\lambda}{\mu - \lambda}$

The average time a customer spends in system,  $W = \frac{1}{\mu - \lambda}$

The average number of customers in the queue,  $L_q = \frac{\lambda^2}{\mu(\mu - \lambda)}$

The average time a customer spends waiting in the queue,  $W_q = \frac{\lambda}{\mu(\mu - \lambda)}$

The utilization factor for the system,  $\rho = \frac{\lambda}{\mu}$

Transformation function,  $s_{n-1} = s_n + (b_n \times d_n)$

Return function,  $f_n = \max \{r_n + f_{n-1}\}$

**CONFIDENTIAL**