

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

FACULTY OF THE BUILT ENVIRONMENT

DEPARTMENT OF QUANTITY SURVEYING

**AQS 4102: Construction Planning Simulation and Scheduling**

**September 2011 Supplementary Examinations**

**Time 3 Hours**

**TOTAL MARKS: 100**

Answer **ALL** questions in section A and any **THREE** from section B

**SECTION A**

1. Define the following terms:  
(a) Critical path,  
(b) Decision variable,  
(c) Float,  
(d) Surplus,  
(e) Feasible solution. **[2+2+2+2+2Marks]**
2. After graduating from the National University of Science and Technology, you find yourself at a business lunch with the managing director of the company employing you. You know that he started as a tea-boy 40 years ago and rose through the ranks of the company (without any formal education) to his present position. He believes that all a person needs to succeed in business are (innate) ability and experience. What arguments would you use to convince him that the linear programming as a decision-making technique dealt with in this course is of value? **[10marks]**
3. A shop needs to assign four jobs it has just received to four workers. The varying skills of the workers give rise to varying costs for performing the jobs. The table below summarises the cost data of the assignments.

<b>Job</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Worker</b>				
<b>1</b>	\$50	\$50	\$30	\$20
<b>2</b>	\$70	\$40	\$20	\$30
<b>3</b>	\$90	\$30	\$50	\$60
<b>4</b>	\$70	\$20	\$60	\$70

Determine the optimal assignment.

**[10Marks]**

4. The following table represents a plan for a project:

Activity	Preceding activities	Required time(weeks)		Cost(\$000s)	
		Normal	Crash	Normal	Crash
A	-	4	2	10	11
B	A	3	2	6	9
C	A	2	1	4	6
D	B	5	3	14	18
E	B,C	1	1	9	9
F	C	3	2	7	8
G	E,F	4	2	13	25
H	D,E	4	1	11	18
I	H,G	6	5	20	29

- (a) What is the critical path and the estimated completion time of the project?  
 (b) To shorten the project by three weeks, which tasks will be shortened and what would the final total project cost be? **[5+5marks]**

### SECTION B

Answer ANY THREE questions in this section

**Q5.** ZB manufacturing company is considering opening a drive through window for customer service. Management estimates that customers will arrive at the rate of fifteen per hour. The teller who will staff the window can service the customers at the rate of one every three minutes. Assuming a Poisson arrivals and exponential service, find

- (a) Utilisation of the teller,  
 (b) Average number in the waiting line,  
 (c) Average number in the system,  
 (d) Average waiting time in line,  
 (e) Average waiting time in the system, including service. **[4+4+4+4+4Marks]**

**Q6.** (a) State two advantages and three disadvantages of simulation.

(b) A warehouse contains 100 bags of cement, of which 10% are of PPC type, 40% are of PMC type and 50% of the Portland type, develop a simulation model for the process of drawing bags of cement at random from the warehouse. Each time a bag of cement is drawn and its type is noted, it is replaced. Use the following random numbers as you desire.

26768	66954	83125	08021
42613	17457	55503	36458
95457	03704	47019	05752
95276	56970	84828	05752

Simulate drawing 10 bags of cement from the warehouse. Show clearly the random numbers you have used. **[5+15marks]**

7. A cement manufacturer produces two types of cement, namely granules and powder. He cannot make more than 1600 bags a day due to a shortage of vehicles to transport the cement out of the plant. A sales contract means that he must produce at least 500 bags of powdered cement per day. He is further restricted by a shortage of time; the granulated cement requires twice as much time to make as the powdered cement. A bag of powdered cement requires 0.24 minutes to make and the plant operates an 8 hour day. His profit is \$4 per bag for granulated cement and \$3 per bag for the powdered cement.

- (i) Formulate the problem as a linear program.
- (ii) Solve this linear program graphically. **[10+10marks]**

8. (a) Briefly describe the advantages of using a software package to solve a linear Program with three or more variables, over a judgemental approach. **[10marks]**

(b) Mwemba Construction Company produces construction materials in three locations, Mutare, Rusape and Nyanga. These materials are to be transported to four destinations, Bulawayo, Gweru, Gwanda and Nkayi at low cost. The transportation costs are as listed in the table below.

Origin \ Destination	Bulawayo	Gweru	Gwanda	Nkayi	Supply
Mutare	3	2	7	6	5000
Rusape	7	5	2	3	6000
Nyanga	2	5	4	5	2500
Demand	6000	4000	2000	1500	

- (a) Formulate a network diagram for Mwemba Construction Company..
- (b) Solve using this transportation problem using:
  - (i) North-West Corner method,
  - (ii) Least Cost method. **[5+5Marks]**

**END OF EXAMINATION**