



**UNIVERSITY EXAMINATIONS 2016/2017**

**EXAMINATION FOR THE DEGREE OF BACHELOR OF BUSINESS  
ADMINISTRATION AND BACHELOR OF COMMERCE**

**BMS 4307: OPERATIONS RESEARCH I**

**END OF SEMESTER EXAMINATIONS**

**SERIES: SEPTEMBER 2016**

**DATE: SEPTEMBER 2016**

**DURATION: 2 HOURS**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO**

**QUESTION ONE**

- (a) i.) Give a brief historical background of Operations Research. **(4 marks)**
- ii.) Define the following terminologies used in Operations Research
- Feasible solution **(2 marks)**
- Optimal Solution **(2 marks)**
- iii.) Give the phases of an Operations Research study. **(2 marks)**
- iv.) Give brief explanations of the following two phases of an OR study-
- Problem definition and **(3 marks)**
- Model construction. **(3 marks)**

(b.) A manufacturer is to market a new fertilizer which is to be a mixture of two ingredients **A** and **B**. The properties of the two ingredients are:

	Ingredient Analysis				
	Bone Meal	Nitrogen	Lime	Phosphates	Cost/Kg
Ingredient <b>A</b>	20%	30%	40%	10%	1.2p
Ingredient <b>B</b>	40%	10%	45%	5%	0.8p

It has been decided that

- the fertilizer will be sold in bags containing 100 kgs
- it must contain at least 15% nitrogen
- it must contain at least 8% phosphates
- it must contain at least 25% Bone Meal

The manufacturer wishes to meet the above requirements at the minimum cost possible.

Required:

- i.) Formulate the problem as a linear programming model. **(4 marks)**
- ii.) Find the dual formulation of (i.) above. **(4 marks)**
- iii.) Find the shadow prices using the arithmetic method **(4 marks)**
- iv.) Give an interpretation of the shadow price. **(2 marks)**

## QUESTION TWO

a.) Differentiate the various steps used in solving a transportation problem by applying North West corner rule and least cost method. **(8 marks)**

b.) Sunray Transport Company ships truckloads of grain from three silos to four mills. The supply (in truckloads) and the demand (also in truckloads) together with the unit transport costs per truckload on the different routes shown below. The unit transport cost,  $C_{ij}$  (shown in the northeast corner of each box) are in hundreds of dollars. The model seeks the minimum-cost shipping schedule between the silos and the mills, using the Northwest corner method.

**(12 marks)**

### Sunray Transport Model

mill

Silo	1	2	3	4	Supply
1	10 $X_{11}$	2 $X_{12}$	20 $X_{13}$	11 $X_{14}$	15
2	12 $X_{21}$	7 $X_{22}$	9 $X_{23}$	20 $X_{24}$	25
3	4 $X_{31}$	14 $X_{32}$	16 $X_{33}$	18 $X_{34}$	10
Demand	5	15	15	15	

## QUESTION THREE

a.) Draw a flow chart of the simplex method. **(6 marks)**

b.) A company can produce three products **A**, **B** and **C**. The products yields a contribution of \$8, \$5 and \$10 respectively. The products use a machine which has 400 hours capacity in the next period. Each unit uses 2, 3 and 1 hour respectively of machine's capacity. There are only 150 units available in the period of a special component which is used singly in product **A** and **C**. 200 kgs only of a special alloy is available in the period. Product **A** uses 2 kgs per unit and product **C** uses 4 kgs per unit.

There is an agreement with a trade association to produce no more than 50 units of product **B** in the period. The company wishes to find out the product plan which maximizes contribution.

Required:

i.) using the simplex method, find the product plan which maximizes contribution. **(10 marks)**

ii.) perform a sensitivity analysis. **(4 marks)**

#### QUESTION FOUR

- a.) Describe (i.) Give a definition of the Transportation model. **(4 marks)**  
(ii.) the classical assignment model. **(4 marks)**  
(iii.) the general assignment model. **(4 marks)**

b.) Use a simple solution algorithm called the Hungarian method, to solve the problem below:

Joe Odongo's four children, John, Karen, Tom and Terri, wants to earn some money for personal expenses. Mr Odongo has chosen four chores for his children: mowing the lawn, painting the perimeter fencing, cleaning the house and washing the family cars. To avoid anticipated sibling completion, he asks them to submit individual (secrete) bids, in \$, for what they feel is fair pay for each of the three chores. **(8 marks)**

#### Odongo's Assignment Problem

	Mow	Painting	Clean	Wash
John	1	4	6	3
Karen	9	7	10	9
Tom	4	5	11	7
Terri	8	7	8	5

#### QUESTION FIVE

- a.) Give a definition of what is Game Theory. **(5 marks)**  
b.) Explain what is optimal solution of Two-Person Zero-sum Game. **(4 marks)**  
c.) Two companies, A and B, sell two brands of flu medicine. Company A advertises in radio ( $A_1$ ), television ( $A_2$ ), and newspaper ( $A_3$ ). Company B, in addition to using radio ( $B_1$ ), television ( $B_2$ ), and newspaper ( $B_3$ ), also mails brochures ( $B_4$ ). Depending on the effectiveness of each advertising campaign, one company can capture a portion of the market from the other. The following matrix summarizes the percentage of the market captured or lost by company A.

	$B_1$	$B_2$	$B_3$	$B_4$
$A_1$	8	-2	9	-3
$A_2$	6	5	6	8
$A_3$	-2	4	-9	5

Required:

Find the solution of the game based on the principle of securing the best of the worst for each player. **(11 marks)**