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MOI UNIVERSITY

OFFICE OF THE DVC ACADEMIC AFFAIRS, RESEARCH AND EXTENSION

UNIVERSITY EXAMINATIONS
2015/2016 ACADEMIC YEAR

THIRD YEAR END OF SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF BUSINESS MANAGEMENT

EXAM CODE: BBM 351
EXAM TITLE: OPERTIONS RESEARCH I

DATE: 8TH AUGUST, 2016   **TIME:** 2.00 P.M. –5.00 P.M.

INSTRUCTION TO CANDIDATES

➢   SEE INSIDE

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BBM 351: OPERATIONS RESEARCH I
MAIN EXAMINATION

INSTRUCTIONS:-
- *Answer ALL Questions in SECTION A and ANY other TWO in SECTION B*
- *SECTION A carries 40 Marks.*
- *Time allowed: 3 hours*

SECTION A {Question ONE and TWO is Compulsory}

QUESTION ONE - COMPULSORY [20 MARKS]

a) Briefly explain FOUR applications of operations research tools within a business organization
[4 Marks]

b) Differentiate between the following terms as used in operations research
   i) Transportation problems and assignment problems   [2 Marks]
   ii) Zero-sum game and Nonzero-sum games   [2 Marks]

c) ABC Ltd. recently acquired a threshing machine with a useful life of 15 years. Over the useful life, the machine is likely to have periodic failures and breakdowns. Past data for similar machines indicate a probability distribution of failures as follows:

Number of failures	0	1	2	3
Probability	0.80	0.15	0.04	0.01

Required:
   i) Using the random numbers provided below, simulate the number of failures that will occur over the useful life of the machine.   [4 marks]
      Random numbers: 70, 88, 37, 12, 45, 99, 54, 71, 64, 93, 67, 80, 55, 34, 22
   ii) Determine the average annual failure rate.   [1 marks]

d) Duplex Textile Ltd. makes executive and standard dresses. An executive dress requires 60 minutes for cutting, 50 minutes for sewing, 40 minutes for finishing and 15 minutes for inspection and packaging. A standard dress requires 42 minutes for cutting, 30 minutes for sewing, 60 minutes for finishing and 6 minutes for inspection and packaging.
   The firm employs 35 tailors who spend a maximum of 630 hours for cutting, 600 hours for sewing, 708 hours for finishing and 135 hours for inspection and packaging every week.
   The profit contribution per dress is Shs. 1,500 for the executive dress and Shs. 1,350 for the standard dress.
   Required:
   i) Formulate the linear programming model.   [3 marks]
   ii) Solve the linear programming model graphically.   [4 marks]

QUESTION TWO - COMPULSORY [20 MARKS]

a) Explain the following terms used in network analysis:
   i) Network planning.   [1 mark]
   ii) Activities.   [1 mark]
   iii) Events.   [1 mark]
   iv) Critical path.   [1 mark]
   v) Float.   [1 mark]

(b) A small project consisting of eight activities has the following characteristics: -

Activity	Preceding activity	Time estimates in weeks		
		Most optimistic	Most likely	Most pessimistic
A	None	2	4	12
B	None	10	12	26
C	A	8	9	10
D	A	10	15	20
E	A	7	7.5	11
F	B, C	9	9	9
G	D	3	3.5	7
H	E, F, G	5	5	5

Required;
  (a) Calculate the expected duration and variance for each activity. [6 Marks]
  (b) Draw the PERT network for the project [3 Marks]
  (c) Identify the critical path [2 Marks]
  (d) Determine the total float for each activity [4 Marks]

SECTION B {Answer any TWO Questions}

QUESTION THREE [15 MARKS]
  a) Explain clearly the following concepts game theory:
      i)   Prisoner's dilemma [2 marks]
      ii)   Dominance principle [2 marks]
  b) Briefly explain FOUR assumptions of game theory [4 Marks]
  c) Determine the optimum strategies and the value of the 2 by 5 game whose pay-off table is given below:

Strategies for Y

Strategies for X
$$\begin{array}{c} \\ x1 \\ x2 \end{array} \begin{array}{ccccc} y1 & y2 & y3 & y4 & y5 \\ \begin{pmatrix} 3 & 6 & -3 & 0 & -1 \\ 2 & 3 & -1 & 2 & 4 \end{pmatrix} \end{array}$$

[7 marks]

QUESTION FOUR [15 MARKS]

  a) A firm has three shops with a total of 80 televisions. An order is received from the Local Authority for 70 sets to be delivered to 4 schools. The transportation costs from shops to schools are shown below together with the availabilities and requirements.

	Shops		Schools				
			A	B	C	D	
		Sets	20	30	15	5	Requirements
Available	Shop 1	40	2	4	1	6	
	Shop 2	20	4	3	3	3	Costs
	Shop 3	20	1	2	5	2	

Using least cost method, determine the optimal transportation schedule for the firm and hence the minimum cost of transportation. [8marks]

b) Ngara tailoring shop has one tailor specialized in men's shirts. The number of customers requiring stitching of shirts appears to follow a Poisson distribution with a mean arrival rate of 12 per hour. Customers are attended to by the tailor on a first come first serve basis and they are willing to wait for service if there be a queue. The time the tailor takes to attend a customer is exponentially distributed with a mean of four minutes. You are required to determine:

i.   The probability that the system is busy   **[1 Marks]**
ii.   The average time a customer spends in the system   **[2 Marks]**
iii. The average length of the queue   **[2 Marks]**
iv.   The probability that there will be five customers in the shop at a point in time
                                                                                 [2 Marks]

QUESTION FIVE [15 MARKS]

a) Consider the following primal problem

Maximize: $30x_1 + 40x_2$
Subject to: $6x_1 + 12x_2 \geq 120$
$\qquad\qquad 8x_1 + 5x_2 \geq 60$
$\qquad\qquad 3x_1 + 4x_2 = 50$

$\qquad\qquad x_1, x_2 \geq 0$

Obtain the dual of this primal (5 marks)

b) Solve the following linear programming problem
Maximize $2x_1 + 4x_2 + x_3 + x_4$
Subject to: $x_1 + 3x_2 + x_4 \leq 4$
$\qquad\qquad 2x_1 + x_2 \leq 3$
$\qquad\qquad x_2 + 4x_3 + x_4 \leq 3$

$\qquad\qquad x_i \geq 0$, i = 1,2,3,4.   **[10 marks]**

QUESTION SIX [15 MARKS]

(a)   Briefly explain **FOUR** characteristics of the Assignment problems.   **[4 Marks]**

(b)   A manufacturer of complex electronic equipment has just received a sizeable contract and plans to subcontract part of the job. He has solicited bids for 6 subcontracts from 4 firms. Each job is sufficiently large that any one firm can take only one job. The table below shows the bids and the cost estimates (in Sh. 10,000) for doing the jobs internally. Not more than two jobs can be performed internally

Firm	Job					
	1	2	3	4	5	6
1	48	72	36	52	50	65
2	44	67	41	53	48	64
3	46	69	40	45	45	68
4	43	73	37	51	44	62
Internal	50	65	35	50	46	63

Determine the optimal assignment   **[11 Marks]**