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**GARISSA UNIVERSITY**

**UNIVERSITY EXAMINATION 2020/2021 ACADEMIC YEAR THREE**

**SECOND SEMESTER EXAMINATION**

**SCHOOL OF BUSINESS AND ECONOMICS**

**FOR THE DEGREE OF BACHELOR OF BUSINESS MANAGEMENT**

**COURSE CODE: BBM 351**

**COURSE TITLE: OPERATION RESEARCH**

**EXAMINATION DURATION: 2 HOURS**

**DATE: 17/08/2021 TIME: 3.00-5.00 PM**

**INSTRUCTION TO CANDIDATES**

* **The examination has FIVE (5) questions**
* **Question ONE (1) is COMPULSORY**
* **Choose any other TWO (2) questions from the remaining FOUR (4) questions**
* **Use sketch diagrams to illustrate your answer whenever necessary**
* **Do not carry mobile phones or any other written materials in examination room**
* **Do not write on this paper**

**This paper consists of FIVE (5) printed pages *please turn over***

**QUESTION ONE (COMPULSORY)**

1. Define the following term
2. Optimal solution.
3. Feasible solution
4. Jockeying
5. Service in random order **[4 Marks]**
6. A company can produce three products A, B and C. The product yields a contribution of Kshs 8, Kshs 5 and Kshs 10 respectively. The products use a machine which has 400 hours’ capacity in the next period. Each unit of the products uses 2, 3 and 1 hours respectively of the machine’s capacity. There are only 150 units available in the period of a special component which is singly used in product A and C. 200kgs only of a special alloy is available in the period. Product A uses 2kgs per unit and C uses 4kgs 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 production plan which maximizes the contribution. **[15 marks]**
7. There is a congestion of the platform of the railway station. The trains arrive at a rate of 30 train per day. The waiting time for any train to hump is exponentially distributed with an average of 36 minutes. Calculate
8. The mean queue size
9. The probability that the queue size exceeds 9 **[6 Marks]**
10. Find the dual program of the following linear programming problem



Subject to 





 is unconstrained **[5 marks]**

**QUESTION TWO (20 MARKS)**

1. Consider the simplified scenario for the development of a consumer product through the market test phase shown in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Activity | Symbol | Preceding activities | Time estimated  (weeks) |
| Design promotion campaign  Initial pricing analysis  Product design  Promotional costs analysis  Manufacture prototype models  Product cost analysis  Final pricing analysis  Market test | A  B  C  D  E  F  G  H | -  -  -  A  C  E  B, D, F  G | 3  1  5  1  6  1  2  8 |

1. Draw the network for this project.
2. Calculate the slacks and interpret their meaning.
3. Determine the critical path and interpret its meaning.
4. Construct a time chart and identify scheduling flexibilities. **[14 Marks]**
5. Solve the following transportation problem using the Vogel’s approximation method.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Destinations | | | | | |  |
| Sources |  | 1 | 2 | 3 | 4 | Supply |
| A | 12 | 8 | 3 | 5 | 100 |
| B | 3 | 6 | 4 | 6 | 80 |
| C | 11 | 10 | 4 | 2 | 40 |
|  | Demand | 50 | 100 | 30 | 70 |  |

**[6 Marks]**

**QUESTION THREE (20 MARKS)**

You have decided to build a rabbit hatch in the next three months that will involve the following activities.

|  |  |
| --- | --- |
| Activity | Time for completion (Days) |
| Obtain materials | 4 |
| Painting finishing | 6 |
| Lay foundation | 3 |
| Roofing | 3 |
| Prepare doors and windows | 4 |
| Erect poles | 1 |

1. Prepare a precedence table for this project. **[5 marks]**
2. Draw a project network diagram and use it to solve the different parameters of a project.

**[7 marks]**

1. Do you think this project can be completed in 17 days? Justify your answer **[8 marks]**

**QUESTION FOUR (20 MARKS)**

1. Define the following terms
2. Linear Programming
3. Optimal solution
4. Infeasible Solution **[3 Marks]**
5. A firm produces two products, X and Y with a contribution of Kshs. 8 and Kshs 10 per unit respectively. Production data are: (per unit)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Labour Hours | Material A | Material B |
| X | 3 | 4 | 6 |
| Y | 5 | 2 | 8 |
| Total Available | 500 | 350 | 800 |

1. Formulate the linear programming model in the standardized manner
2. Solve the model in part (i) using graphical method
3. Calculate the shadow prices of the binding constraints and interpret it  **[12 Marks]**
4. Consider the following payoff table and obtain the best course of action using EOL criterion. **[5 Marks]**

|  |  |  |  |
| --- | --- | --- | --- |
| State of nature | | | |
| Action | S | S | S |
| A | 60 | 100 | 120 |
| B | 90 | 60 | 110 |
| C | 80 | 110 | 90 |
| Prob | 0.5 | 0.3 | 0.2 |

**QUESTION FIVE (20 MARKS)**

1. A company has 4 salesmen and 5 customers. The company has estimated the cost in dollars associated with assigning a particular salesman to a given specific client. These estimates are given in the table below

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Client | | | | | |
| Salesmen |  | 1 | 2 | 3 | 4 | 5 |
| A | 32 | 50 | 37 | 36 | 49 |
| B | 35 | 48 | 35 | 47 | 46 |
| C | 32 | 58 | 40 | 38 | 40 |
| D | 30 | 54 | 39 | 40 | 50 |

Determine who should be assigned which client and the minimum cost the company can incur **[12 marks]**

1. A branch of a Nationalized bank has only one typist, since typing work varies in length, the typing rate is randomly distributed approximating a Poisson distribution with a mean service rate of 8 letters per hour. The letter arrives a rate of 5 per hour during the entire 8-hour workday, the typist is valued at Ksh. 150 per hour. Determine
2. Equipment utilization
3. The percent time an arriving letter has to wait
4. Average system time
5. Average idle time cost of the typist per day. **[8 Marks]**