**TECHNICAL UNIVERSITY OF MOMBASA**

**UNIVERSITY EXAMINATIONS 2015/2016**

**EXAMINATION FOR THE DEGREE OF BACHELOR OF COMMERCE**

**BMS 4405: OPERATIONS RESEARCH II**

**END OF SEMESTER EXAMINATIONS**

**SERIES: SEPTEMBER 2016**

**DATE: SEPTEMBER 2016** **A** **DURATION:** 2 HOURS

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

**QUESTION ONE**

(a.) Give a definition of the Dual Problem **(4 marks)**

(b.) Give a schematic representation of the starting and simplex tableau **(6 marks)**

(c.) Explain the two methods of determining the dual values **(6 marks)**

(d.) (i.) Use the M-method to solve the following LP problem

Minimise $z = 4x_1 + x_2$

Subject to

$$3x_1 + x_2 = 3$$
$$4x_1 + 3x_2 \geq 6$$
$$x_1 + 2x_2 \leq 4$$
$$x_1, x_2 \geq 0$$

**(8 marks)**

(ii.) Find the dual solution to the LP problem in (i.) above **(6 marks)**

**QUESTION TWO**

(a.) Define a Markov Chain **(4 marks)**

(b.) Explain a Markov Process **(4 marks)**

(c.) Every year, during the March-through-September growing season, a gardener uses a chemical test to check soil condition. Depending on the outcome of the test, productivity for the new season can be one of three states: (1.) good, (2.) fair, and (3.) poor. Over the years, the gardener has observed that last year's soil condition impacts current year's productivity and that the situation can be described by the following Markov chain:

$$\boldsymbol{P_0} = \text{State of the system this year} \begin{array}{c} \\ \left\{ \begin{array}{c} 1 \\ 2 \\ 3 \end{array} \right. \end{array} \begin{array}{c} \text{(State of the system next year)} \\ \begin{array}{ccc} \mathbf{1} & \mathbf{2} & \mathbf{3} \end{array} \\ \begin{pmatrix} 0.2 & 0.5 & 0.3 \\ 0 & 0.5 & 0.5 \\ 0 & 0 & 1 \end{pmatrix} \end{array}$$

The transition probabilities show that the soil condition can either deteriorate or stay the same but never improve. The gardener alters the transition probabilities $\boldsymbol{P_1}$ by using organic fertilizer. In this case, the transition matrix becomes

$$\boldsymbol{P_1} = \begin{array}{c} \\ \left\{ \begin{array}{c} 1 \\ 2 \\ 3 \end{array} \right. \end{array} \begin{array}{c} \begin{array}{ccc} \mathbf{1} & \mathbf{2} & \mathbf{3} \end{array} \\ \begin{pmatrix} 0.30 & 0.60 & 0.10 \\ 0.10 & 0.60 & 0.30 \\ 0.05 & 0.40 & 0.55 \end{pmatrix} \end{array}$$

The initial condition of the soil is good - $a^{(0)} = (1, 0, 0)$. Determine the absolute probabilities of the three states of the system after

(i.) 1 year **(3 marks)**

(ii.) 2 years **(4 marks)**

(iii.) 3 years **(5 marks)**

**QUESTION THREE**

(a.) Describe the recursive nature of Dynamic Programming. **(4 marks)**

(b.) Show how the recursive computation can be expressed mathematically. **(4 marks)**

(c.) Explain the Principle of Optimality. **(3 marks)** (d.) You are required to select the shortest highway route between two cities. The network in Figure 1-1, provides the possible routes between the starting city at node 1 and the destination city at node 7. The routes pass through intermediate cities designated by nodes 2 to 6. Decompose the problem by Dynamic Programming into stages and carry out the computation of each stage separately using backward recursion. **(9 marks)**

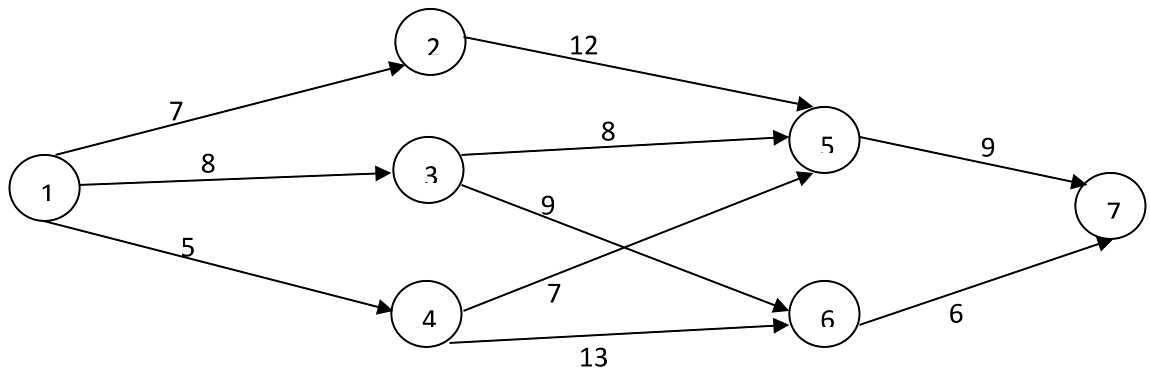


Figure 1-1: Route Network

**QUESTION FOUR**

(a.) Two Network methods designed to assist in planning, scheduling and control are:

(i.) Critical Path Method (CPM) **(5 marks)**

(ii.) Program Evaluation and Review Technique (PERT) **(5 marks)**

Explain the two methods giving phases for project planning with CPM-PERT.

(b.) Determine the critical path for the project network in Figure 1-2. All the durations are in days. **(10 marks)**

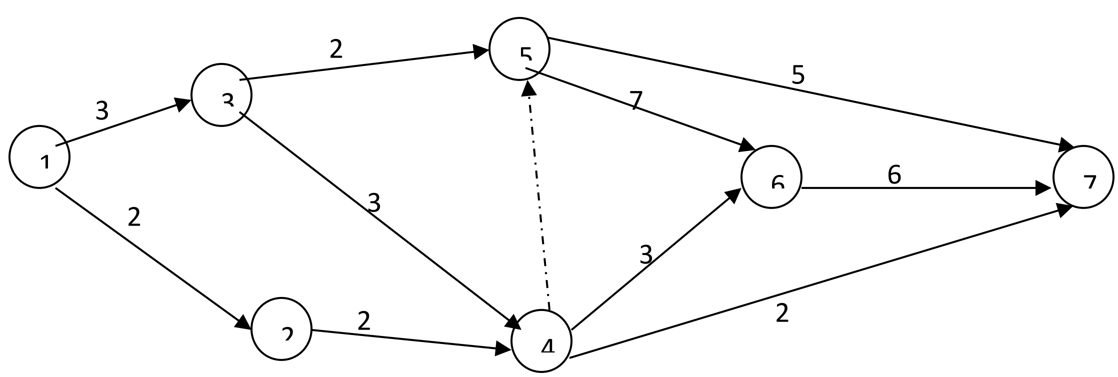

Figure 1-2: Project Network

**QUESTION FIVE**

(a.) There are two types of algorithms for the unconstrained problem: direct search and gradient. Describe the

(i.) direct search method. **(4 marks)**

(ii.) gradient method. **(4 marks)**

(b.) Maximize $f(x)=\begin{cases} 3x, 0 \le x \le 2 \\ \frac{1}{3}(-x+20), 2 \le x \le 3 \end{cases}$

Use the

(i.) Dichotomous Algorithm **(6 marks)**

(ii.) Gradient Section Algorithm **(6 marks)**

to identify the interval of uncertainty, which is known to include the optimum solution point.