BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

BSc. Engineering Examinations (January 2021 Term)

Sub: **IPE 307** (Operations Research)

Full Marks: 20 Section Marks: 105 Time: 30 Mins

ASSUME RESONABLE VALUES FOR MISSING OR INCORRECT DATA, IF ANY

Q.1 Consider the following inventory problem related to life-saving blood of XYZ hospital at Dhaka during this COVID-19 crisis. There is need for a rare blood type, namely, type AB, Rh negative blood. The demand D (in pints) over any 3-day period is given by
$P\{D=0\} = 0.4$, $P\{D=1\} = 0.3$, $P\{D=2\} = 0.2$, $P\{D=3\} = 0.1$.

Note that the expected demand is 1 pint, since $E(D) = 0.3(1) = 0.2(2) = 0.1(3) = 1$. Suppose that there are 3 days between deliveries. The hospital proposes a policy of receiving 1 pint at each delivery and using the oldest blood first. If more blood is required than is on hand, an expensive emergency delivery is made. Blood is discarded if it is still on the shelf after 21 days. Denote the state of the system as the number of pints on hand just after a delivery. Thus, because of the discarding policy, the largest possible state is 7.

Required:

a) Construct the (one-step) transition matrix for this Markov chain. Explain any 10 current to future state from this matrix. (8)
b) Find the steady-state probabilities of the state of the Markov chain. (4)
c) Use the results from part *1*(*b*) to find the steady-state probability that a pint of blood will need to be discarded during a 3-day period. (*Hint*: Because the oldest blood is used first, a pint reaches 21 days only if the state was 7 and then $D = 0$). (4)
d) Use the results from part *1(b)* to find the steady-state probability that an emergency delivery will be needed during the 3-day period between regular deliveries. (4)

URGENT: Upload your scanned PDF. The document must be saved as per the instruction given in the assignment created on MS Team.