

JK Lakshmipat University, Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, December 2025

B. Tech., Semester VII, 2025-26

Roll No.....

AS1201: OPERATIONS RESEARCH

Time: 2.5 hours

Max. Marks: 30

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Mention all the assumptions for your answers clearly. You may use non-programmable calculator.

- Q. 1 A manufacturing company uses an item at a constant rate of 4000 per year. Each unit costs Rs 2. The company estimates that it will cost Rs 50 to place an order and the carrying cost is 20% of stock value per year. Find economic order quantity and the Total Cost. 2.0
(CO3)
- Q.2 Consider a two-component standby system with A as normally operating component and B as standby component. The reliability of component A is 0.90 while the reliability of component B given that A has failed is 0.95. Assume that the switch can fail only at the time of changeover with a probability of failure 0.03. Evaluate the reliability of the system. 2.0
(CO4)
- Q. 3 Pauline is a gardener and has created a sprinkler system in the given fig. 1. Using Prim's algorithm, determine the network that will connect all the sprinklers with the least amount of piping and determine the total length of piping needed. Each vertex represents a sprinkler, and the weight of each edge represents the distance in meters. 2.0
(CO1,)

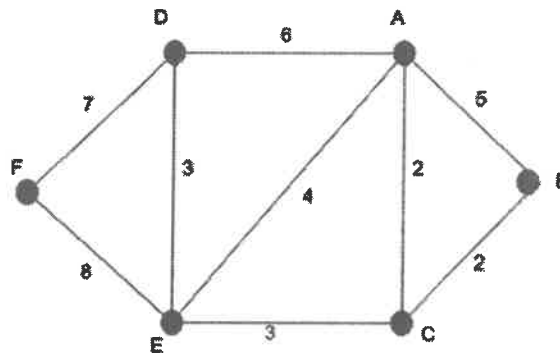


Fig.1: Network diagram.

- Q. 4 A data center company wants to optimize the transfer of data packets from a main server (source node 'S') to a backup server (sink node 'T') through a network of intermediate routers. Each connection (link) between routers has a bandwidth capacity that limits the amount of data (in Mbps) that can pass through it. The objective is to determine the maximum possible data flow from the main server to the backup server without exceeding the given link capacities. The network structure and capacities between nodes are shown below fig. 2. 3.0
(CO1,6)

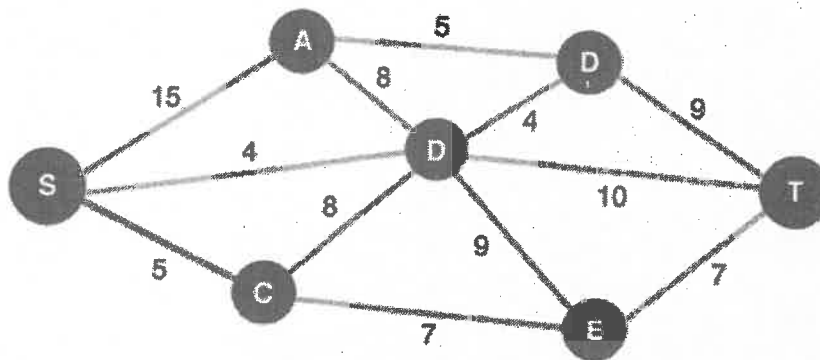


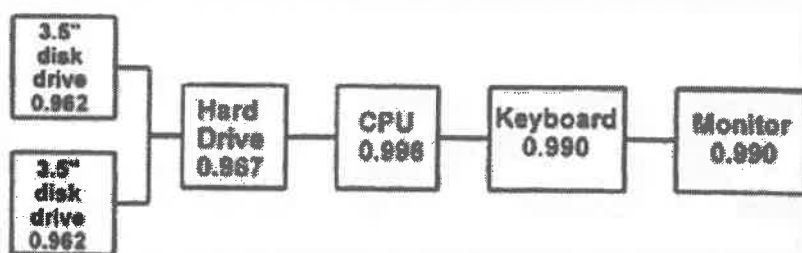
Fig. 2: Network Flow

- Apply the Ford–Fulkerson algorithm to compute the maximum flow from S to T.
- Show the residual network after each iteration.
- Interpret your results in terms of data transfer efficiency in the network.

Q.5 A home computer has two 3.5 inch disk drives. What is the probability of the computer operating successfully (with at least one disk drive) for 1000 hours. (CO1,2,5) 4.0

Assume the following estimated reliability values of the components.
(where $R(t) = e^{-\lambda t}$)

Component	3.5 inch Disk Drive	Hard Drive	CPU Board	Keyboard	Monitor
Failure Rate	39/10 ⁶ hr.	34/10 ⁶ hr.	4/10 ⁶ hr.	10/10 ⁶ hr.	10/10 ⁶ hr.
Reliability (1000 hours)	0.962	0.967	0.996	0.990	0.990



Q. 6 Trader behavior for two companies, Petroco and National, provides in table 1. The following table shows the probability of trade in Month 3 (i.e., after one year of observation): (CO1) 5.0

Starting State	Probability of Trade in Month 3		
	PETROCO	NATIONAL	SUM
Petroco	.44	.56	1.00
National	.28	.72	1.00

Table 1: Transition Probability Matrix.

A trader can start with either company in Year 1 and may shift to the other in the following year based on these probabilities. Assume this transition probabilities remain constant every year.

- Draw the probability tree diagram for two years.
- Compute the joint probabilities of the trader being with each company at the end of Year 2, given they started with:
 - (a) Petroco
 - (b) National
- Interpret your results — which company is more likely to retain traders after two years?

- Q. 7 The Computer Science Department maintains an inventory of various hardware and software components used for laboratory and research purposes. To ensure efficient control of inventory, the department intends to perform an ABC Analysis based on the annual consumption value of each item. The following table provides details of the items, their annual usage, and unit costs.

5.0
(CO1,2,3)

Rank	Item	Annual usage	Unit cost (Rs)
1	Desktop PC	10	55,000
2	Server RAM (32GB)	40	12,000
3	High-end GPU	8	45,000
4	Network Switch (24-port)	5	30,000
5	Router	6	15,000
6	SSD 1TB	60	8,000
7	OS License	50	4,000
8	Antivirus License (yr)	200	800
9	USB Drive 64GB	150	600

Table 2: Inventory Data

- Compute the annual consumption value for each item.
- Calculate the cumulative consumption value percentage and cumulative item percentage. Then, classify the items into A, B, and C categories according to ABC Analysis principles.
- Interpret the results and suggest suitable control measures for each category.

Q.8 The Department of Computer Science is planning to develop a Web-Based Student Management System for internal use. The project involves several stages given in Table 3, including requirement gathering, design, development, testing, and deployment. As the project manager, you are responsible for scheduling the tasks, identifying dependencies, and determining the total project duration using the Critical Path Method (CPM). 7.0
(CO1,2,4,6)

Activity	Activity Description	Immediate Predecessors	Estimated Duration
A	Gather system requirements	-	2 weeks
B	Design database schema	A	3 weeks
C	Design user interface	A	2 weeks
D	Develop backend APIs	B	5 weeks
E	Develop frontend modules	C	4 weeks
F	Integrate frontend with backend	D,E	3 weeks
G	Perform system testing	F	4 weeks
H	Fix bugs and finalize system	G	2 weeks
I	Deploy the system	H	1 weeks

Table 3: Project Activities for the Web-Based Student Management System

The details of the project activities are given below:

- Draw the Project Network Diagram based on the given data.
- Identify all possible paths from the start to the end of the project.
- Determine the Early Start, Early Finish, Late Start, Late Finish, and Total Float for each activity involved in the project.
- Determine the Critical Path and calculate the Total Project Duration

Be Neat! Be Legible!!All the Best!!!!