



M.E DEGREE EXAMINATIONS: NOV/ DEC 2024

(Regulation 2024)

First Semester

CONSTRUCTION MANAGEMENT

24CNI501: Quantitative Techniques for Management

COURSE OUTCOMES

- CO1:** apply the concepts of Linear Programming to solve construction-related optimization problems.
- CO2:** evaluate allocation models to optimize resource distribution in construction projects using transportation and assignment methods.
- CO3:** evaluate decision theories to recommend the best course of action under various risk scenarios in construction management.
- CO4:** apply job sequencing and replacement schedules to improve operational efficiency in construction management
- CO5:** apply simulation models to assess the impact of different strategies in construction

Time: Three Hours

Maximum Marks: 100

PART A (4*20 = 80 Marks)

1. a) Critically analyze how Linear Programming helps address resource allocation challenges in large-scale infrastructure projects, citing real-world examples. 05 CO1 [K₄]
- b) You are managing a construction project that requires allocating resources to two critical activities: Excavation and Masonry. The company has two available resources: Labor Hours and Machine Hours. The profit generated from each unit of the activities and the resource consumption are provided in the table below. 15 CO1 [K₄]

Activity	Labor Hours per Unit	Machine Hours per Unit	Profit per Unit (₹)
Excavation	4	3	10
Masonry	3	4	12

Formulate a Linear Programming Model that helps the company determine the optimal number of Excavation and Masonry units to be completed, in

order to maximize the total profit by using Simplex method, while considering the following constraints:

- i. Labor Hours available: 120 hours
- ii. Machine Hours available: 100 hours

2. a) You are managing a large construction project that requires sourcing critical materials from three suppliers: S1, S2, and S3. There are several uncertainties involved, such as variations in supplier reliability, potential cost fluctuations, and delivery delays. The following details are available for each supplier: Supplier S1 has a reliability probability of 0.8, cost fluctuation probability of 0.1, and a 20% chance of delivery delay. Supplier S2 has a reliability probability of 0.6, cost fluctuation probability of 0.3, and a 40% chance of delivery delay. Supplier S3 has a reliability probability of 0.9, cost fluctuation probability of 0.2, and a 15% chance of delivery delay. The material costs from each supplier are: ₹100 per unit for S1, ₹110 per unit for S2, and ₹95 per unit for S3. In terms of quality, Supplier S1 offers a score of 7, S2 offers a score of 8, and S3 offers a score of 6. For delivery speed, Supplier S1 delivers in 10 days, S2 in 12 days, and S3 in 8 days. 20 CO3 [K4]

Question

Analyze the decision-making process under risk by assigning probabilities to the reliability, cost fluctuations, and delivery delays for each supplier. Using these probabilities, evaluate the suppliers based on cost, quality, and delivery speed, and recommend the best supplier for the project

3. a) Apply the replacement policy for assets that deteriorate, considering the deterioration rate and maintenance cost. Provide a simple model for determining the optimal replacement time. 10 CO4 [K3]
- b) Using the data below, sequence the jobs to minimize the total processing time on two machines using Johnson's Algorithm. Apply the algorithm step-by-step to determine the optimal job sequence. Calculate and present the total processing time and idle time for both machines clearly. 10 CO4 [K3]

Job	Machine 1 (Time)	Machine 2 (Time)
A	3	8
B	7	4
C	5	6
D	6	7

4. a) You are managing a construction project with uncertainties in labor productivity, material delivery, and weather conditions. Explain how simulation modeling can assess the impact of these uncertainties on project completion time. Discuss how different probability distributions (normal, uniform, exponential) are chosen based on the type of uncertainty and their effect on simulation results. 10 CO5 [K₄]
- b) Analyze the advantages and limitations of Monte Carlo Simulation for risk assessment in construction projects. How does simulation modeling support decision-making and help manage uncertainties in project planning? 10 CO5 [K₄]

Answer any ONE Question
PART B (1*20 = 20 Marks)

5. a) A construction company needs to transport materials from 5 suppliers to 4 project sites. 10 CO2 [K₃]

Supply/ Destination	D1	D2	D3	D4	Supply
S1	10	12	15	8	40
S2	9	7	14	10	50
S3	8	10	12	11	60
S4	11	9	8	12	30
S5	12	14	10	9	20
Demand	50	40	60	50	

The transportation costs (₹ per unit), supply at each supplier, and demand at each site are shown in the table above. Calculate the Initial Basic Feasible Solution (IBFS) using the following methods:

- i. Northwest Corner Method (NWC)
- ii. Least Cost Method (LCM)
- iii. Vogel's Approximation Method (VAM)

- b Find the final optimal transportation cost using the optimality test (Modified Distribution Method). Provide detailed calculations and explain each step. 10 CO2 [K₃]

OR

6. a) Solve the Assignment problem using the HAM Method to achieve optimality. 15 CO2 [K₃]

Worker/Task	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
Worker 1	15	25	30	10	20	40
Worker 2	20	30	25	35	15	45
Worker 3	35	40	20	30	25	50
Worker 4	30	15	25	20	35	30
Worker 5	25	20	30	25	10	35
Worker 6	10	15	20	40	30	25

- b) Discuss the advantages and limitations of the Hungarian Algorithm in real-world construction project scenarios, particularly when dealing with large teams and multiple tasks 5 CO2 [K₃]
