

Mid-West University

Examinations Management Office

End Semester Examinations-2080

Master level/Construction Management/1st Semester

Time: 3 hours

Subject: Operations Research in Construction Management (CMT514)

Full Marks: 60

Pass Marks: 30

- Attempt all questions
- Figures in the margin indicate full marks.
- Assume suitable values, with a stipulation, if necessary.
- Candidates are required to answer the questions in their own words as far as possible.

1. Consider a gravel production company that operates two pits, producing different mixes of sand and gravel. After computing the output, it is separated into three grades. A construction company has entered into a contract with the sand and gravel production company, to take 120 tons of fine grades, 80 tons of medium grade, and 240 tons of coarse grade per week. Cost of sand and gravel production is Rs 20000 per hour to operate one pit and Rs 25000 per hour to operate the others. In 8 hours per day operation, the first pit produces 20 tons fine, 20 tons medium, and 120 tons coarse material. The second pit produces 60 tons of fine, 20 tons of medium, and 40 tons of coarse material. The problem is to determine the number of hours each pit be operated by the production company in order to meet the weekly requirements in an economic manner, that is, to minimize the operating cost of production pits? Formulate the problem. [5]
2. A company has two grades of inspectors, I and II to undertake quality control inspection. At least 1, 500 pieces must be inspected in an 8-hour day. Grade I inspector can check 20 pieces in an hour with an accuracy of 96%. Grade II inspector checks 14 pieces an hour with an accuracy of 92%. Wages of grade I inspector are Rs. 5 per hour while those of grade II inspector are Rs. 4 per hour. Any error made by an inspector costs Rs. 3 to the company. If there are, in all, 10 grade I inspectors and 15 grade II inspectors in the company, find the optimal assignment of inspectors that minimise the daily inspection cost. [6]
3. Consider a case where the project manager is requested to optimize the resources of his client, who intend to construct three different building design types for accommodation type 1, 2 and 3. The property market information available to the project manager shows that design type-1 would attract Rs 1, 00,000-unit profit earning and design type 2 and 3 would attract 2, 00,000 and Rs 3, 00,000-unit profit earning respectively. With the available information, the project manager is required to advice his client the most optimal design selection. In order to meet up the projected demand by the different income groups, the employer further requested that:
 - Maximum number of the units of all design types should be 600units.
 - Design type-1 for low income earners should not be more than 200 units.
 - Design type-3 for high income earners should not be less than 100 units.Find the optimal solution by simplex method [10]
4. Department of Road, Surkhet has decided to carry out road repairs on four main arteries of the city. The government has agreed to make a special grant of Rs 50 lakh towards the cost with a condition that the repairs must be done at the lowest cost and quickest time. If conditions warrant, a supplementary token grant will also be considered favourably. The department of road has floated tenders and five contractors have sent in their bids. In order to expedite work, one road will be awarded to only one contractor.

Cost of Repairs (Rs in lakh)

		R1	R2	R3	R4
Contractor	C1	9	14	19	15
	C2	7	17	20	19
	C3	9	18	21	18
	C4	10	12	18	19
	C5	10	15	21	16

- Find the best way of assigning the repairs to the contractors and the associated cost.
- If it is necessary to seek supplementary grant, what should be the amount sought?
- Which of the five contractors will be unsuccessful in his bid?

[4+1+1]

5. Construction workers come to tool store room to receive special tools required by them for accomplishing the particular task given to them. The average time between two arrivals is 60 seconds and the arrivals are assumed to be in Poisson distribution. The average service time (of the tool room attendant) is 40 seconds. Find

- Average length of non-empty queues
- Average number of workers in the system including the workers being attended
- Mean waiting time of an arrival
- Average waiting time of an arrival (worker) who waits

[5]

$$\left[L_q = \frac{\lambda \cdot \lambda}{\mu \cdot \mu - \lambda}, W_n = \frac{1}{\mu - \lambda}, \int_0^t (\mu - \lambda) \cdot e^{-(\mu - \lambda)t} dt, L_n = \frac{\lambda}{\mu - \lambda}, \rho = 1 - \frac{\lambda}{\mu}, W_q = \frac{\lambda}{\mu(\mu - \lambda)}, L_s = \frac{\lambda}{\mu - \lambda} \right]$$

6. A company has received a contract to supply gravel for three new construction projects located in cities A, B and C. The construction engineers have estimated the required amounts of gravel at these construction projects as given below:

Project Locations	A	B	C
Daily Requirement (in truck loads)	144	204	82

The company has three gravel pits located in town X, Y and Z. The gravels required for construction is supplied by these pits. The amount of gravel that can be supplied is as follows:

Pit	X	Y	Z
Amount available (in truck loads)	152	164	154

The company has calculated the delivery costs as follows:

	A	B	C
X	10	30	30
Y	70	110	70
Z	30	70	110

Find the optimal solution using VAM.

[6]

Below is the annual production of cement (in thousand tons) of a factory.

Year	2015	2016	2017	2018	2019	2020	2021
Production	77	88	94	85	91	98	90

- Fit a straight line by the method of least squares and obtain the trend values
- Plot the given figures on a graph and show the trend line
- Estimate the production of sugar in the year 2024

[3+1+1]

8. Calculate the seasonal indices for the following data.

[5]

Year	Seasons			
	Spring	Summer	Fall	Winter
2010	87	106	86	125
2011	85	110	83	127
2012	84	105	87	128
2013	88	104	88	124

[4+4+4]

9. Write a short note any three
- Use of computer tools in OR
 - Goal Programming
 - Integer Programming
 - Application of OR in Construction Management

THE END