

(3 hours)

- N.B. (1) Attempt any four questions out of six questions
 (2) Assume any additional data if necessary and state it clearly
 (3) Figures to the right indicate full marks

- 1 a) For a particular project, it was estimated that 1 lakh cement bags would be required. The ordering cost is Rs. 2000/- per order. The unit cost of cement bag was estimated Rs. 350/- Inventory carrying cost is 20% of the average annual inventory. During the project, it was found that only 1,05,000 bags were required. Also, the cost of cement bags increased to Rs. 370/- The ordering cost reduced to Rs. 1800/-, whereas the inventory carrying cost remains increased to 23%. Find out how much % increase or decrease in cost would be incurred due to variation. [06]
- b) A tendered is bidding for construction works, averagely 10 nos. in a year for the past 10 years. Find the probability that: [08]
- (i) He gets atleast 8 works (ii) He gets exactly 4 works
 (iii) He does not get any work (iv) He does not get more than 3
- Also find the mean, standard deviation and frequency of successes for the maximum probable event in the above scenario
- c) If 1% of windows manufactured by a factory are defective, find the probability that in a batch of 500 doors delivered to a residential project [06]
- (i) no door is defective (ii) 15 doors are defective
 (iii) 20 doors are defective (iv) 50 doors are defective
- 2 a) Explain how Cox model and Nunnally model can help in equipment downtime analysis. [10]
- b) Write down the applications of Total Probability Theorem and Bayes theorem in Civil Engineering. [5]
- c) Comment on the application of Normal distribution in Civil Engineering [5]
3. a) Decide the optimum no. of associated units for the prime mover based on the following data: [14]
- i. Mean cycle time of the prime mover = 6 minutes
 ii. Mean haul time of the associated unit = 10 minutes
 iii. Haul Unit capacity - 5 cu.m.
 iv. Hourly cost of prime mover, $C_P = \text{Rs. } 3500/-$
 v. Hourly cost of associated unit, $C_A = \text{Rs. } 1000/-$
- Based on conventional practice, for this work, 8 associated units were assigned to 2 prime movers. Using Griffi's waiting line model, decide whether the associated units assigned are optimum or adding unnecessary.
- b) In 25 years of a truck driver's career, it has been recorded that he has encountered 24 accidents. His average journey is 50 kms/day. What is the probability that, if he has embarked on a journey to deliver goods on a construction site, 20 kms from the manufacturing yard, that he will be involved in an accident? [6]

- 4 a) For the construction of a fence, the contractor used concrete which was desired to be M25. The following compressive strengths in N/mm^2 were recorded for each batch. [12]

Batch no. vs Compressive strength

Batch no.	Comp. strength(N/mm^2)
1	22.5
2	21.2
3	27.3
4	24.5
5	27.5
6	27.3
7	21.2
8	21.4
9	30.3
10	25.6

You are the quality control in-charge from the client's side. Based on the above data and your assumed benchmark, decide whether you will accept or reject the concrete work. Also suggest some recommendations to the contractor for improving the concrete quality.

- b) Comment on linear and multi-linear regression equations with suitable examples from civil engineering [08]
- 5 a) Explain the concept of random variable [06]
5. b) Table below gives the properties of 10 concrete mix batches used for construction on site. [14]

Data pertaining to a sample of 10 concrete mixes used for construction

Sr. No.	Cement content (X) (kg/m^3)	W/C ratio (Y)	Compressive strength (Z) (N/mm^2)
1	355	0.467	35.4
2	357	0.462	35.8
3	351	0.461	36.7
4	358	0.463	36.2
5	355	0.463	36.1
6	357	0.456	36.3
7	357	0.449	39.5
8	349	0.463	36.9
9	351	0.460	35.4
10	356	0.444	39.8

Find out the Karl-Pearsons Simple co-relation coefficient that exists between:

- i. Cement Content(X) and Compressive strength (Z)
- ii. w/c ratio(Y) and Compressive strength (Z)

Also check for probable error and find coefficient of determination. Comment on the physical significance of C.D obtained.

6. a) Prepare a simulation model based on Monte-Carlo simulation to generate a range of random numbers, for the mean for the actual cost of 10 projects of similar nature as given below. Select suitable range for each. Run the simulation. (refer random number table given below) [12]

Project No.	Project cost (in Lakh Rs.)
01	54
02	103
03	56
04	42
05	113
06	38
07	69
08	87
09	18
10	75

Random Number Table

11164 36318 75061 37674 26320 75100 10431 20418 19228 91792 21215
 91791 76831 58678 87054 31687 93205 43685 19732 08468 10438 44482
 66558 37649 08882 90870 12462 41810 01806 02977 36792 26236 33266
 66583 60881 97395 20461 36742 02852 50564 73944 04773 12032 51414
 82384 38370 00249 80709 33827 92873 02953 85474 65285 97198 12138
 53010 94601 15838 16805 61004 43516 17020 17264 57327 38224 29301
 31381 38109 34976 65692 98566 29550 12645 62000 78137 98768 04689
 87130 79225 08153 84967 64539 79493 74917

- b) Based on the performance of the deliveries of certain construction materials on previous projects, 6 vendors from an area were analyzed and given marks for their performance. Find out to what extent these vendors' performances are co-related using Spearman's Rank co-relation coefficient. [08]

Sr. No	Vendor	Marks for sand (100)	Marks for cement (100)
1	Vendor 1	65	73
2	Vendor 2	43	39
3	Vendor 3	82	72
4	Vendor 4	91	81
5	Vendor 5	73	78
6	Vendor 6	59	67
