

Total No. of Questions : 8]

SEAT No. :

P4463

[4860]-50

[Total No. of Pages : 3

M.E. (Civil) (Structure) (Theory)
c-STRUCTURAL RELIABILITY
(2008 Course) (Semester-II) (Elective-III) (501411)

Time : 3 Hours]

[Max. Marks : 100

Instructions to the candidates:

- 1) *Answers to the two Sections should be written in separate answer books.*
- 2) *Answer any three questions from each section.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right side indicate full marks.*
- 5) *Use of calculator is allowed.*
- 6) *Assume suitable data if necessary.*

SECTION-I

- Q1)** a) Differentiate between Discrete Variables and Continuous Variables with respect to their probability laws and simple illustrative examples. [6]
- b) The cube strength of concrete, X , follows the normal distribution with the mean and the standard deviation values as 25 N/mm^2 and 5 N/mm^2 respectively. Calculate the probability of getting a value for strength less than 20 N/mm^2 . [6]
- c) Derive an expression for probability of failure for the case of load (S) and resistance (R) following the log normal distribution. [5]
- Q2)** a) Compare critically the conventional methods of structural design with respect to evaluation of safety. [6]
- b) The test results of the cube strength and cylinder strength of seven batches of concrete laid in footings in a day on a construction site are given below: [5]

Sr. No. of Batch	1	2	3	4	5	6	7
Cube Strength (N/mm^2)	22.07	19.07	24.55	22.39	19.97	18.02	15.75
Cylinder Strength (N/mm^2)	14.25	12.02	15.30	14.55	12.25	11.47	10.05

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Determine the sample covariance and correlation coefficient between cube strength and cylinder strength of concrete.

- c) Define the term 'Structural Reliability' with explanation of each significant element in that definition. [5]

Q3) a) Enlist the sources of uncertainty contributing the variation in the strength of concrete. Briefly explain Chi-Square Test to be applied while selecting a probabilistic model fit to the given data. [6]

- b) Derive the expression for 'Reliability Index' for the case of load (S) and resistance (R) following normal distribution. [6]

- c) Derive the expressions for the reliability of a series system and a parallel redundant system. [5]

Q4) a) Explain the terms Probability of Failure, Failure rate, Mean Time to Failure. [6]

- b) It is given that the ratio of the mean value of the cube strength of M15 Concrete (design mix) to its characteristic strength is 1.4 and the coefficient of variation of the strength of concrete is 0.18. Determine the allowable stress for the probability of failure of concrete equal to 0.001 and coefficient K value equal to (-3.091) for the given probability. [5]

- c) What is meant by the Lifetime Maximum Sustained Load? Enumerate the assumptions used in the stochastic analysis of it. [5]

SECTION-II

Q5) a) Explain Monte Carlo Method with respect to its objective and procedural steps? [6]

- b) Explain the procedure stepwise to generate normal variates from the distribution of Y following the normal distribution with mean μ and variance σ^2 . [6]

- c) Write a short note on decision models with designed risk level. [5]

- Q6)** a) Derive the expression for generating log normal variates from the distribution of Y following the lognormal distribution with median of Y (i.e \hat{Y}) and standard deviation of lognormal Y (i.e $\sigma_{\ln Y}$). [6]
- b) What is meant by Safety Checking Formats for a design code? Explain in brief CEB & LRFD formats. [5]
- c) Explain how the system reliability concept can be extended for decision making with design risk. [5]
- Q7)** a) Derive the expression for partial safety factors specified with respect to the mean values of random variables in the reliability based design of Civil Engineering Structures. [6]
- b) Explain in brief the steps involved in the development of reliability based design criteria. [6]
- c) Write short note on Reliability based design criteria for RCC beams in limit state of collapse calibrated in IS code. Comment on the observations and conclusion on safety factors. [5]
- Q8)** a) Explain how to analyze the risk associated with a decision. [6]
- b) Explain the steps in the development of a reliability based design criteria, to determine the revised partial safety factors for RCC design, as an improvement over the provisions specified in IS: 456. [5]
- c) Write short note on decision tree analysis. [5]

