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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Second Semester, M. Tech - Civil Engineering (MCAD)

Semester End Examination; May/June - 2018

Reliability Analysis and Design of Structural Elements

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Use of CDF table for Normal distribution is permitted.

UNIT - I

1 a. Find the missing frequency for the frequency distribution. Given Mean = 33.5, Mode = 34, $\Sigma_{fi} = N = 230$. 10

CI	0-10	10-20	20-30	30-40	40-50	50-60	60-70
f_i	4	16	-	-	-	6	4

b. The following are the test results obtained ion an experiment.

2	7	9	10	20	21	22	13	14	13	19	26	28	15	16

Calculate the mean, standard deviation and coefficient of variation. Plot a histogram. Determine the chance of getting a value 10

(i) less than 6 (ii) between 12 & 18 (iii) greater than 24

2 a. Define the first four central moments about mean, show that the first central moment is equal to zero. 5

b. Write a short note on skewness and Kurtosis. 5

c. The cube strengths of concrete follow the normal distribution with mean of 42.28 N/mm^2 and standard deviation of 5.6 N/mm^2. Calculate the probability of getting a value for a strength less than 35 N/mm^2 5

d. The compressive strength of steel follows the 10g normal distribution with mean of 460 N/mm^2 and having a coefficient of variation of 20%. Determine the probability of the yield strength being less than 415 N/mm^2 5

UNIT - II

3 a. List the properties of correlation coefficient. 10

b. Fit an exponential curve of the form $y = abx$ to the following data. Estimate the population in the year 2006. 10

Year (x_i)	1931	1341	1951	1961	1971	1981	1991
Population (y) in lakhs	3.9	5.3	7.3	9.6	12.9	17.1	23.2

Contd…2

4 a. Calculate the correlation co-efficient between X and Y for the following data. What do you infer? 10

x	5	15	18	20	25	25	30	34	38	50
y	45	32	37	33	24	29	26	22	24	15

b. Fit a straight line of the form $y = a+bx$ to the following data: 10

x	71	68	73	69	67	65	66	67
y	69	72	70	90	68	67	68	64

UNIT - III

5 a. A tension member of a steel truss is subjected to an axial load Q. The strength of the member is given by fy.A. Where fy is the yield strength of steel and A is the area of cross section of the member. 10

Given: Q = N(20, 8) KN, $fy = N(286,28.6)\ N/mm^2$. Find the area of the member for the specified reliability of 0.99865 considering 3% variation in area.

b. A simply supported beam of span 'l' is subjected to a uniform distributed load of 'w' KN/m throughout the span. Establish the statistics of maximum deflection 10

Given: l = N(4.3, 0.35)m, w = N(32,2.6)KN/m

E=N (2×10^5, 0.2×10^5)N/mm^2, I = N(4.5×10^7, 230×10^6)mm^4

6 a. It is assumed that the strength of a RCC column is given by the sum of the strengths of concrete (f_{ck}) & reinforcing bars (f_y)

Given f_{ck} = N (25, 5) N/mm^2, f_y=N(460, 46) N/mm^2

If the size of the column is 250mm x 400mm and it is provided with 4 bars of 20 mm diameter bars. Determine the mean value of standard deviation of the strength of the column. The column is subjected to a Dead load & live load with distribution N (1500,200) kN and N(500,200) kN respectively. Compute the reliability of the column. 10

b. A cantilever beam of span 'l' is subjected to a uniformly distributed load of 10 kN/m throughout the span. Establish the statistics of maximum Bending moment. (Given: l = N(4,0.35)m, w=N(25, 2.5) kN/m 10

UNIT - IV

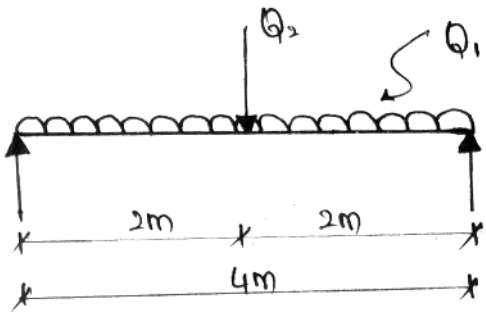
7. Calculate the reliability index and probability of failure by FDSM method, of the beam against the limit state of collapse in flexture shown in figure subjected to a self weight of Q_1 and a live load Q_2. The flexural resisting moment capacity of the beam is R. It is given that : 20

Q_1=N(400,10) N

Q_2= N(5000,2000) N

R= N(10,000, 1000) N.m

Contd…3



8. Determine the reliability index by FOSM method for a steel tension member having tensile strength R, subjected to a tensile load Q.

Given R = N(280,28) N/mm^2

Q = N(5000,2000) N

D = N(6,0.6) mm

The member is circular in cross section of diameter D. The safety margin is given by (i) $M = \frac{\pi D^2}{4} - \frac{Q}{R}$ (ii) $M = D - 2\sqrt{\frac{Q}{\pi R}}$ 20

UNIT - V

9 . Determine the reliability index by AFOSM (Hasofer-lind) method for a steel tension member having tensile strength R, subjecteds to a tensile load Q.

Given R = N (280, 28) N/mm^2

Q = N(5000,2000) N

D = N(6,0. 6) mm

The member is circular in cross section of diameter D. failure function is given by (i) $R = \frac{4Q}{\pi D^2} = 0$ 20

10. The strength R of an axially located column is given by R = 83750C + 1250F

Where C is the compressive strength of concrete. F is the yield strength of steel. The variable C & F are normally distributed with parameters N(19.54, 4.1) N/mm^2 and N (469, 46.9) N/mm^2 respectively. Determine the statistics of R using Monte Carlo method (10 values) Compare the values with the theoretical value and find the percentage error. 20

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