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BICEE-020

B.Tech. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

June, 2015

00690

BICEE-020 : RELIABILITY AND OPTIMIZATION OF STRUCTURES

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) Discuss the functions of random variables. *4*

(b) What do you understand by conditional probability ? Examine the validity of the following statement :

If P(A/B) = P(A), then events A and B are independent. *5*

(c) For two events A and B, prove that

$$P(A \cup B) \leq P(A) + P(B).$$ *5*

2. (a) Explain Bayes' theorem and derive its formula. *4*

(b) Discuss the principle of De Morgan's Law. *5*

(c) What is meant by gamma distribution ? Why is it important for the reliability of structures ? 5

3. (a) Discuss the load as a stochastic process. Write the various types of loads that act on a structure. 8

(b) Write down the mathematical expression of probability function of Binomial distributions. 6

4. (a) The axial load carrying capacity of a column, R, is normally distributed with μ_R = 1000 kN and σ_R = 200 kN. The column is subjected to an axial load, S, which is normally distributed with μ_S = 700 kN and σ_S = 300 kN. Calculate the reliability of the column assuming R and S are independent. 6

(b) Derive an expression for the probability of failure when S (say action due to wind) follows external (largest) distribution and R (say strength of steel) follows the lognormal distribution. Given 8

$$F_R(r) = \phi\left[\frac{ln(r/R)}{\sigma\ ln(R)}\right] \quad r \geq 0$$

$$F_S(s) = k/\mu \left(\frac{\mu}{s}\right)^{k+1} \exp\{-(\mu/s)^k\} \quad s \geq 0$$

5. (a) Prove that, if a function f(x) is defined in the interval of $a \leq x \leq b$ and has a relative minimum at $x = x^*$, where $a < x^* < b$ and if the derivative $df(x)/dx = f'(x)$ exists as a finite number at $x = x^*$, then $f'(x^*) = 0$. *10*

(b) Differentiate between Hasofer's and Lind's methods. *4*

6. (a) Discuss the formulation of optimization problems. What are the various design variables used in the formulation of optimisation of structure ? *6*

(b) Explain the Quasi-Newton method. Write about the steepest descent method also. *4*

(c) Discuss the simplex method. Why is it used in linear programming ? *4*

7. (a) Describe any two methods of computing structural reliability. *6*

(b) Write short notes on any ***two*** of the following : *2×4=8*

(i) Pattern Search Method

(ii) Log-normal Distribution

(iii) Discrete Variables

(iv) Dual Simplex Method
