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BICEE-020

B.TECH. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

00591

June, 2013

BICEE-020 : RELIABILITY AND OPTIMIZATION OF STRUCTURES

Time : 3 hours *Maximum Marks : 70*

Note : *(i)* *All answers to be written in **English only**.*

(ii) *Attempt **any seven** questions **out** of **ten**.*

(iii) *Non programmable **calculators** are **allowed**.*

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1. (a) Define independent and mutually exclusive events. Can two events be mutually exclusive and independent simultaneously? Support your answer with an example. **4**

(b) An engineer applies for a job in two firms X and Y. He estimates that the probability of his being selected in firm X is 0.7, and being rejected at Y is 0.5, and the probability of at least one of his applications being rejected is 0.6. What is the probability that he will be selected in one of the firm ? **6**

2. (a) State Baye's theorem and express in Mathematical form. Why is this theorem known as posteriori probability ? **3**

(b) In a bolt factory, machines A, B, C manufacture respectively 25%, 35% and 40% of the total output. Of their output, 5%, 4% and 2% respectively are known to be defective bolts. A bolt is drawn at random from the product and is found to be defective. What are the probabilities that it was manufactured by : 7

(i) Machine A

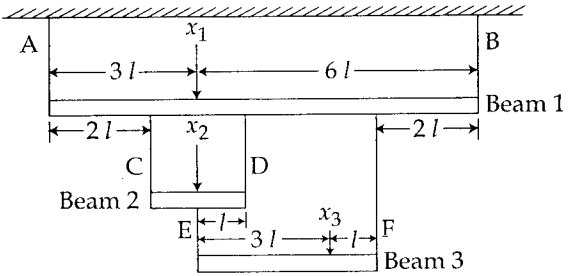
(ii) Machine C

3. (a) Write down Mathematical expression of probability function of Binomial distribution. State various condition under which Binomial distribution is valid. 4

(b) It is known from the past experience that in a certain plant, there are on the average 4 industrial accidents per month. Find the probability that in a given year there will be less than 4 accidents. Assume occurrence of accidents follows poission distribution. 6

4. (a) Explain design variables and design constraints in respect of optimization problem with suitable example. 3

(b) A scaffolding system consists of three beams and six ropes as shown in the figure. 7



Each of the top ropes A and B can carry a load of W_1, while each of the middle ropes C and D can carry a load of W_2, and each of the bottom ropes E and F can carry a load of W_3. If the loads acting on beams 1, 2 and 3 are x_1, x_2 and x_3 respectively, as shown in the figure, formulate the problem finding the maximum load that can be supported by the system. Assume that the weights of the beam 1, 2 and 3 are W_1, W_2 and W_3 respectively, and the weights of the ropes are negligible.

5. A firm manufactures two types of products A and B and sells them at a profit of Rs.2 on Type A and Rs. 3 on Type B. Each product is processed on two machines G and H. Type A requires one minute of processing time on G and two minutes on H; Type B requires one minute on G and one minute on H. The machine G is available for not more than 6 hour 40 minutes while machine is available for 10 hours during any working day. Formulate the problem as linear programming problem (LPP). **10**

6. (a) What do you mean by 'local minimum', 'local maximum' and 'global or absolute minimum' in a single variable optimization problem ? 3

(b) 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 $d f(x)/dx = f'(x)$ exists as a finite number at $x = x^*$, then $f'(x^*) = 0$. 7

7. (a) Express the scalar (standard) form of linear programming problem. 2

(b) Solve the following problem using Simplex method maximize $Z = x_1 + 2x_2 + x_3$ 8

Subject to ,

$$2x_1 + x_2 - x_3 \leq 2$$
$$-2x_1 + x_2 - 5x_3 \geq -6$$
$$4x_1 + x_2 + x_3 \leq 6$$
$$x_1, x_2, x_3 \geq 0$$

8. (a) State the necessary and sufficient conditions for the unconstrained minimum of a function. 3

(b) Why is the steepest descent direction not efficient in practices although the directions used are the best directions ? 4

(c) Explain 'Univariate Method' in brief. 3

9. (a) What do you understand by conjugate gradient method ? 2

(b) Using conjugate gradient method solve the following problem : 8

minimize

$$f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1 x_2 + x_2^2$$

Starting from the point $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$

10. (a) Define and describe the structural reliability with suitable illustration. 3

(b) Describe any two methods of computing structural reliability in brief. 3

(c) Compute the reliability of the system for the connection given in the following figure, if the reliability of A, B, C an D are 0.95, 0.99, 0.90 and 0.96 respectively. 4