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BICEE-020

B.Tech. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

00365

June, 2014

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 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) Given three identical boxes I, II, III, each containing two coins. In box I, both coins are gold coins, in box II both are silver coins and in the box III, there is one gold coin and one silver coin. A person chooses a box at random and takes out a coin. If the coin is of gold, what is the probability that the other coin in the box is also of gold ? *7*

   (c) Explain Bayes' theorem and express it in mathematical form. *3*

2. (a) Ten eggs are drawn successively with replacement from a lot containing 10% defective eggs. Find the probability that there is at least one defective egg. *8*

(b) Probability that a truck stopped at a roadblock will have faulty brakes or badly torn tyres are 0·23 and 0·24 respectively. Also, the probability is 0·38 that a truck stopped at the roadblock will have faulty brakes and/or badly working tyres. What is the probability that a truck stopped at this roadblock will have faulty brakes as well as badly worn tyres ? *6*

3. (a) Three machines E_1, E_2, E_3 in a certain factory produce tubelights which are 50%, 25% and 25% respectively of the total daily output. It is known that 4% of the tubes produced on each of machines E_1 and E_2 are defective, and that 5% of those produced on E_3 are defective. If one tube is picked up at random from a day's production, calculate the probability that it is defective. *8*

(b) Write down the mathematical expression of probability function of Binomial distribution. Explain Poisson distribution and Gamma distribution. *6*

4. (a) What do you mean by 'local minimum', 'local maximum', and global or 'absolute minimum' in a single variable optimization problem ? *4*

(b) Prove that, if a function f(x) is defined in the interval of $a \le x \le b$ 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*

5. (a) Using Simplex method, maximise

$z = x_1 + 2x_2 + x_3$

subject to,

$$2x_1 + x_2 - x_3 \le 2$$
$$-2x_1 + x_2 - 5x_3 \ge -6$$
$$4x_1 + x_2 + x_3 \le 6$$
$$x_1, x_2, x_3 \ge 0$$ *8*

(b) Explain unimodal functions with suitable examples. What is Quasi – Newton method ? *6*

6. (a) Discuss multi variable optimization with no constraints with respect to

(i) necessary condition.

(ii) sufficient condition. *6*

(b) Derive the one-dimensional minimisation problem for the following case :

Minimise $f(x) = (x_1^2 - x_2)^2 + (1 - x_1)^2$ from the starting point $x_1 = \begin{Bmatrix} -2 \\ -2 \end{Bmatrix}$ along the search direction $S = \begin{Bmatrix} 1{\cdot}00 \\ 0{\cdot}25 \end{Bmatrix}$. *8*

7. (a) Define and describe the structural reliability with suitable illustration. *4*

(b) Describe any two methods of computing structural rediability. *6*

(c) A switch has two failure modes :

(i) failure open

(ii) fail-short

The probability of switch open-circuit failure and short-circuit failure are 0·1 and 0·2. A system consists of n switches wired in series. Find maximum system reliability $R_s(n)$. *4*