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MEIC/MEPE/MEHP/MEPS/MTPS/ MEDC/MEMT/MEVD-101

M.E./M.Tech., I Semester

Examination, December 2020

Advanced Mathematics

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.
ii) All questions carry equal marks.

1. a) Solve by method of Separation of variables.

$$\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0$$

b) Find the numerical solution of Poisson's equation

$\frac{\partial^2 U}{\partial x^2} + \frac{\partial^2 u}{\partial x^2} = f(x, y)$ using finite difference method.

2. a) Prove that the Poisson's distribution is a limiting form of Binomial distribution when p (or q) is very small and n is very large so that the average number of successes np is a finite constant m (say).

b) A coin was tossed 400 times and the head turned up 316 times. Test the hypothesis that the coin is unbiased.

3. a) Define Stochastic process and Markov process with example.

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b) In a railway marshalling yard, goods arrive at a rate of 30 trains per day. Assuming that the inter arrival time follows a exponential distribution and service time distribution is also exponential with the average 36 minutes. Then calculate :

i) The mean queue size.

ii) The probability that the queue size exceeds 10.

If the input of trains increases to average 33 per day what will be change in (i) and (ii).

4. a) Define fuzzy set and membership functions with example.

b) Verify De Morgan's law $(A \cup B)' = (A)' \cap (B)'$ for the fuzzy set given by

X = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}

A = {(1, 0), (2, 0.1), (3, 0.3), (4, 0.5), (5, 1), (6, 0.2), (7, 0.4), (8, 0.6), (9, 0.8), (10, 0)}

B = {(1, 0), (2, 0), (3, 0.2), (4, 0.4), (5, 0.6), (6, 0.8), (7, 1), (8, 0), (9, 0), (10, 0)}

5. a) Define mean time to failure and constant Hazard model. Find mean time to failure in constant Hazard model.

b) The failure rate of a certain component is $h(t) = \lambda_0 t$ where λ_0 is a given constant. Determine the reliability R(t) of the component.

6. a) The mean and variance of Binomial distribution are 4 and $\frac{4}{3}$ respectively. Find

i) the probability of 2 successes.

ii) the probability of more than two successes.

Contd...

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b) Consider the following Markov chain

$$P = \begin{pmatrix} 0.2 & 0.4 \\ 0.6 & 0.4 \end{pmatrix}$$

Determine $\alpha^{(1)}$, $\alpha^{(4)}$ given that $\alpha^{(0)} = (0.7,\ 0.3)$.

7. a) Write the short notes on the following:

i) Theory of hypothesis

ii) Haar transform

b) Let A and B be two fuzzy numbers whose membership functions are given by

$$A(x) = \begin{cases} \frac{(x+2)}{2} & \text{for } -2 < x \le 0 \\ \frac{(2-x)}{2} & \text{for } 0 < x < 2 \\ 0 & \text{otherwise} \end{cases}$$

$$B(x) = \begin{cases} \frac{(x-2)}{2} & \text{for } 2 < x \le 0 \\ \frac{(6-x)}{2} & \text{for } 0 < x < 6 \\ 0 & \text{otherwise} \end{cases}$$

Calculate the fuzzy numbers A + B, A – B, A B, $\frac{A}{B}$, Min. (A, B) and Max. (A, B).

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8. Define each of the following :
   i) Null Hypothesis
   ii) Test of significance
   iii) Markov chain
   iv) Traffic intensity

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