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Probability Methods in Engineering
Final-Term Examination, Spring 2020

INSTRUCTIONS
1. The maximum time allowed is 3 hours (11 am to 2 pm). Total marks for this exam are 50.
2. Write your name and registration number on every page of your answer sheet(s).
3. **You have to submit pictures of your answer sheet, clearly legible and understandable, by email.**

Question 1: **RANDOM VARIABLE AND PMF (CLO 2 / C3 / PLO 3) [10 marks]**

In this question, *a*, *b*, *c* and *d* denote any four distinct numbers of your choice between 1 and 9. A uniform random variable *V* has four possible values such that the set $S_V = \{-a, b, c, d\}$. **Use** the concept of Random Variables and **solve** the problem of finding the mean of *Z*, where $Z = V^3$.

Question 2: **MOMENTS AND FUNCTIONS OF RANDOM VARIABLE**

The voltage of a signal is represented by a uniform random variable *V* having three possible values such that $S_V = \{-3, 1, 3\}$. The signal power is given by random variable *P* such that $P = V^2 / R$ with $R = ½$.

a) Find the mean signal power, $E[P]$. [**5 marks**]

b) Find the standard deviation, $STD[P]$. [**5 marks**]

Question 3: **RANDOM VARIABLE AND CDF [10 marks]**

The number *N* of customers arriving in *t* seconds at a bank is a Poisson random variable with $\alpha = \lambda t$ where λ is the average arrival rate [customers/second]. Assume that the mean arrival rate is 3 customers per minute. Find the probabilities of the following events: (i) more than 1 customer in 30 seconds; (ii) less than or equal to 1 customer in 2 minutes.

Question 4: **TRANSFORM METHODS AND MOMENTS [10 marks]**

Find the characteristic function of the exponential random variable *X*. Find the first and second moments of *X* by applying the moment theorem.

Question 5: **TRANSFORM METHODS AND ENTROPY (CLO 3 / C3 / PLO 5) [10 marks]**

Apply transform methods to determine the probability generating function of a uniform random variable *X* with $S_X = \{-2, -1, 1, 2\}$. **Demonstrate** that the entropy of RV *X* in bits is less than or equal to 16.