

# EC5.102: Information and Communication

## Quiz-1

Typeset from the Original Paper,  
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Duration: 45 mins,

Marks: 15

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1. A musical concert is being recorded using a microphone. The maximum frequency of human audible range is 20 kHz.
  - (a) (1 point) At what frequency should the signal be sampled so that it can be recovered without distortion ?
  - (b) (3 points) Suppose a 256-level analog-to-digital converter is used for quantizing this signal and sampling is performed at the minimum frequency required to avoid distortion, how many bits are required to store a music clip of 1 second ?
2. Answer the following questions related to random variables (RV).
  - (a) (2 points) Write down the precise definition of a RV.
  - (b) (2 points) Let  $X$  be an RV. Is  $|X|$  also a RV ?
  - (c) (2 points) If  $X$  is an RV that takes only non-negative values, is  $\sqrt{X}$  also a RV ?
3. Consider the following experiment. A coin is tossed till exactly  $r$  heads appear. Assuming all the coin tosses are independent and identically distributed with probability of head  $p$ , answer the following:
  - (a) (1 point) Write the sample space.
  - (b) (4 points) Assume that the event space is the set of all possible subsets, define a random variable which maps an outcome to the number of tosses in the outcome. Calculate the probability mass function of this random variable. Verify that its a valid probability mass function.