# BRAC University

## CSE230 : Discrete Mathematics

Duration : 1 hour 15 minutes (4:45 pm - 6:00 pm)

Total Marks : 50 Set: A

***[Answer any 5 out of 6 questions. Answer all the sub-parts of a question together. Please start each question in a new page]***

| **Student Name:** | **Student ID:** |
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**Q01: [CO2] [10 Marks]**

**(a)** Draw a Venn diagram using 3 sets Q, T and P. None of these 3 sets are pairwise disjoint. Moreover, $P \cap Q \cap T \neq \phi$. How many disjoint regions are there? Indicate which regions fall under $(T \cap Q)^c - P$. **[1+1=2 marks]**

**(b)** Find the domain of $f(x) = \sqrt{\frac{3-x}{x^2+2x}}$. Show the domain in a number line. **[4 marks]**

**(c)** Find the range of $g(x) = \frac{3x+7}{2-5x}$. What should be the domain of g(x)? **[3+1=4 marks]**

**Q02: [CO2] [10 Marks]**

A,B,C,D,E,F,G and H are eight students of CSE230 Fall 2022. They want to take pictures.

**a)** In how many ways can they stand in a straight line to take the picture? **[2 marks]**

**b)** Now consider B,C,D and E are close friends and they want to stay together in the group picture. How many ways can they take pictures keeping the "close" friends together? **[4 marks]**

**c)** Well, D has a "thing" for H. So he(D) wants to stay beside her(H). But he also wants to stay with his friends(B,C, and E). For example, A**BCDE**FG**H** is not allowed as D is not beside H although BCDE are together, but A**CEBDH**FG is allowed as D is with his friends and beside H too. Another allowed arrangement can be A**HDCBE**FG. In how many ways can they stand for taking the picture keeping all these scenarios into consideration? **[4 marks]**

**Q03: [CO1] [10 Marks]**

**a)** How many arrangements of the word "**tiamaria**" are possible so that no two consonants are side-by-side? How many of them start and end with the same letter? **[3+3=6 marks]**

**b)** In how many ways can you arrange the letters of the word "**normalize**" so that z always comes after m? For example, "o**mez**ranli" is acceptable, whereas "**z**arle**m**oni" is not. **[2 marks]**

**c)** Adnan and Binti are playing a game in which Binti chooses k numbers from the set {1,2,...,20}. If Adnan can find 2 numbers from Binti's chosen numbers whose sum is divisible by 10, then Adnan wins. What is the minimum value of k so that Adnan always wins? **[2 marks]**

**Q04: [CO3] [10 Marks]**

Read the following equations.

1) ${}^{7}C_{a} = {}^{7}C_{4}$ , a is an integer and $0 < a < 7$
2) $(x+y)^{n} = \sum_{r=0}^{n} {}^{n}C_{r}x^{n-r}y^{r}$, n is a non-negative integer.

Now, answer the following questions.

a) Find out all the possible values of a from the equation (1). **[2 marks]**

b) If $a < 4$, show that, the $(a+2)$-th term in the expansion of $(5x + \frac{1}{ax})^{8}$ is a constant. [Use value of a from eq. No.1] **[4 marks]**

c) If $a \geq 4$, find out the coefficient of $x^{a-1}y^{-1-a}$ in the expansion of $(3x + \frac{1}{ay})^{8}$ [Use value of a from eq. No.1] **[4 marks]**

**Q05: [CO4] [10 Marks]**

A deck of DIEZ Cards has 4 different colors which are Red, Green, Yellow and Blue. Each color has 1 Wild Card, 1 Reverse Card, 1 Block Card and 7 Normal Cards numbered from 1-7.

**a)** Find the probability of picking a normal card from the deck. **[2 marks]**

**b)** If 3 cards are picked at random from the deck, what is the probability of picking at least 1 Wild card? **[4 marks]**

**c)** Now, imagine one card is lost from the deck at random. If we pick a card from the deck, what is the probability of that card being a Reverse Card? **[4 marks]**

**Q06: [CO4] [10 Marks]**

The Graduate Record Examinations Test (GRE) is a requirement for all applicants of Msc Programs.

Suppose that a survey of GRE students reveals that among GRE scorers above 310, 52% took Magoosh (An Online Education Company) paid subscription, whereas among GRE scorers of less than 310 only 23% took the subscription. An applicant thinks that in order to get into a certain university he needs more than 310. The chance of obtaining more than 310 is $x\%$

**a)** Suppose $x = 10\%$. Given that he took Magoosh subscription, What is the probability of getting more than 310? **[6 marks]**

**b)** If the probability of getting more than 310 given that he has taken the Magoosh Subscription is 50%. Then what is $x$? **[4 marks]**