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Second Semester MCA Degree Examination, June/July 2019 Discrete Mathematical Structures and Statistics

Time: 3 hrs.

Max. Marks: 100

Note: Answer FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Prove the following conditional is a tautology.
 $[(p \leftrightarrow q) \wedge (q \leftrightarrow r) \wedge (r \leftrightarrow p)] \leftrightarrow [(p \rightarrow q) \wedge (q \rightarrow r) \wedge (r \rightarrow p)]$ (07 Marks)
- b. Given the following proposition, write
i) Direct proof ii) Indirect-proof
"If n is an odd integer, then $(n+11)$ – is an even integer." (07 Marks)
- c. Using the laws of logic prove the following conditional expression:
 $[(p \vee q) \wedge (p \vee \sim q)] \vee q \Leftrightarrow p \vee q$ (06 Marks)

OR

- 2 a. Prove the following argument is valid :
$$\begin{array}{l} p \rightarrow q \\ r \rightarrow s \\ \hline p \vee s \\ \hline \therefore q \vee s \end{array}$$
 (07 Marks)
- b. Negate and simplify the following:
i) $\exists x, [p(x) \vee g(x)]$ ii) $[\exists x, [p(x) \vee q(x)]] \rightarrow r(x)$ (07 Marks)
- c. Summarize the laws of logic. (06 Marks)

Module-2

- 3 a. Determine sets A and B, given that:
 $A - B = \{1, 2, 4\}$, $B - A = \{7, 8\}$ and $A \cup B = \{1, 2, 4, 5, 7, 8, 9\}$. (07 Marks)
- b. For any three sets A, B, C prove that
i) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
ii) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ (07 Marks)
- c. State and prove the addition theory in probability. (06 Marks)

OR

- 4 a. A problem is given to four students A, B, C, D whose chances of solving it are $1/2, 1/3, 1/4, 1/5$ respectively. Find the probability that the problem is solved. (07 Marks)
- b. The probabilities that three persons x, y, z hit a target in one attempt are $1/6, 1/4$ and $1/3$ respectively. If each of these shoots once at a target-find:
i) The probability that the target is hit
ii) The probability that the target is hit by exactly one person. (07 Marks)
- c. Prove the Demorgan laws, for any two sets:
i) $\overline{A \cup B} = \overline{A} \cap \overline{B}$ ii) $\overline{A \cap B} = \overline{A} \cup \overline{B}$ (06 Marks)

Module-3

- 5 a. Find the number of permutations of the letters of the word 'INSTITUTION'
- How many of these begin with I?
 - How many of these begin with I and end with N?
 - In how many the 3 T's are together? (07 Marks)
- b. Prove the following by using Mathematical induction for every positive integer n:
- $$1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{1}{6} n(n+1)(2n+1) \quad (07 \text{ Marks})$$
- c. Given the recurrence relation $a_n = a_{n-1} + 4$ with $a_1 = 2$ obtain an explicit formula for the given sequence. (06 Marks)

OR

- 6 a. Find the coefficient of x^4 – in the expansion of $\left(2x^2 - \frac{3}{x}\right)^8$. (07 Marks)
- b. A man has 7-relatives, 4-of them are ladies and 3-gentlemen. His wife has also 7-relatives 3-of them are ladies and 4-gentlemen. In how many ways can they invite a dinner party of 3-ladies and 3-gentlemen so that there are 3 – of the man's relative and 3 – of the wife's relatives? (07 Marks)
- c. The Fibonacci numbers are defined by $F_0 = 1, F_1 = 1$ and $F_n = F_{n-1} + F_{n-2}$ for $n \geq 2$. Evaluate F_2 to F_{10} . (06 Marks)

Module-4

- 7 a. The probability distribution of a finite random variable – X – is given by

X :	-2	-1	0	1	2	3
P(X) :	0.1	K	0.2	2K	0.3	K

- Find: i) The value of K ii) Mean iii) Variance and standard deviation. (07 Marks)
- b. In a certain town the duration of the shower is exponentially distributed with a mean 5-min. What is the probability that a shower will last for
- 10-min or more
 - less than 10-min
 - Between 10 and 12 min. (07 Marks)
- c. The weekly wages of workers in a company are normally distributed with mean of Rs.700 and standard deviation of Rs.50. Find the probability that the weekly wage of a randomly chosen worker is
- Between Rs.650/- and Rs.750
 - More than Rs.750/- (06 Marks)

OR

- 8 a. Obtain the mean and standard deviation of the Poisson distribution. (07 Marks)
- b. The probability density function of a variate X – is given by the following table:
- | | | | | | | | |
|-------|---|----|----|----|----|-----|-----|
| X : | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| P(X): | K | 3K | 5K | 7K | 9K | 11K | 13K |
- Find: i) The value of K ii) $P(X < 4), P(X \geq 5)$. (07 Marks)
- c. The number of telephone lines busy at an instant of time is a binomial variate with $P = 0.2$. If at an instant 10 lines are chosen at random what is the probability that
- 5-lines are busy
 - At most 2-lines are busy. (06 Marks)

Module-5

- 9 a. By the method of least squares, find the straight line that fits the following data: ($y = ax + b$)

x:	1	2	3	4	5
y:	14	27	40	55	68

(07 Marks)

- b. Find the correlation coefficient for the two groups,

x :	92	89	87	86	83	77	71	63	53	50
y :	86	83	91	77	68	85	52	82	37	57

(07 Marks)

- c. Define the terms

- i) Coefficient of correlation
- ii) Regression
- iii) Principle of least squares.

(06 Marks)

OR

- 10 a. Find the correlation coefficient 'r' and the equations of the lines of regression for the following values of x and y

x :	1	2	3	4	5
y :	2	5	3	8	7

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(10 Marks)

- b. Fit a curve of the form $y = ae^{bx}$, to the following data:

x:	5	15	20	30	35	40
y:	10	14	25	40	50	62

(10 Marks)
