CBCS SCHEME

USN | | | | | | | | | | |

21MATCS41

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Mathematical Foundations for Computing, Probability and Statistics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Tautology. Prove that for any proposition p, q, r the compound proposition given by $[(p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)] \rightarrow r$ is a tautology. **(06 Marks)**

b. Test the validity of the following statement:
If I study, I will not fail in the examination.
If I do not watch TV in the evening, I will study.
I failed in the examination
$\therefore$ I must have watched TV in the evenings **(07 Marks)**

c. Give a direct proof for each of the following : for all integers K and ℓ, if K and ℓ are both even, then i) K $+ \ell$ is even ii) Kℓ is even. **(07 Marks)**

OR

2 a. Prove that following using laws of logic :
i) $[(\sim p \vee \sim q) \rightarrow (p \wedge q \wedge r)] \Leftrightarrow p \wedge q$
ii) $[(p \vee q) \vee (\sim p \wedge \sim q \wedge r)] \Leftrightarrow (p \vee q \vee r)$ **(06 Marks)**

b. Determine whether the following argument is valid or not :
No engineering student of I or II semester studies logic
Anil is an engineering student who studies logic
$\therefore$ Anil is not in II Semester **(07 Marks)**

c. Determine the truth value of each of the following quantified statements ; the universe being the set of all non-zero integers :
i) $\exists x, \exists y, [xy = 1]$ ii) $\exists x, \forall y, [xy = 1]$ iii) $\forall x, \exists y, [xy = 1]$
iv) $\exists x, \exists y, [(2x + y = 5) \wedge (x - 3y = -8)]$ v) $\exists x, \exists y, [(3x - y = 17) \wedge (2x + 4y = 3)]$ **(07 Marks)**

Module-2

3 a. Let A = {1, 2, 3, 4, 6, 8, 12}, on A, define the partial ordering relation R by xRy iff x/y. Prove that R is a partial order on A. Draw the Hasse diagram for R. **(06 Marks)**

b. Let f: R $\rightarrow$ R be defined by $f(x) = \begin{cases} 3x - 5, & x > 0 \\ -3x + 1, & x \le 0 \end{cases}$ find $f^{-1}(0)$, $f^{-1}(1)$, $f^{-1}(3)$, $f^{-1}([-5, 5])$ **(07 Marks)**

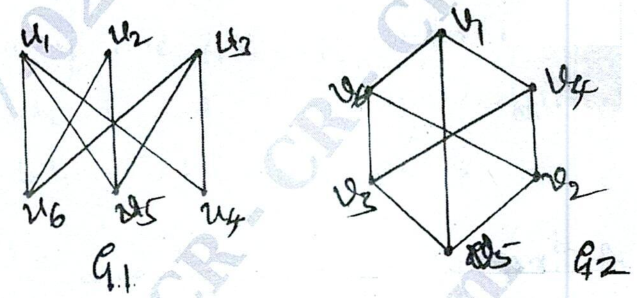
c. Define : i) Simple graph ii) Complete graph iii) Subgraph iv) Spanning subgraph. Give one example for each. **(07 Marks)**

OR

4 a. Consider a function f : R $\rightarrow$ R defined by f(x) = 2x + 5 and a function g : R $\rightarrow$ R defined by $g(x) = \frac{1}{2}(x - 5)$. Prove that g is an inverse of f. **(06 Marks)**

b. Let A = {1, 2, 3, 4}, R = {(1, 3), (1, 1), (3, 1), (1, 2), (3, 3), (4, 4)} be a relation on A. Determine whether the relation R is reflexive, irreflexive, symmetric, anti-symmetric or transitive. Hence verify R is an equivalence relation or not. **(07 Marks)**

c. Define Isomophrism. By labelling the graphs, show that the following graphs are is isomorphic.



(07 Marks)

Module-3

5 a. The following are the percentage of marks in Mathematics (x) and statistics (y) of nine students. Calculate the rank correlation coefficient.

x	38	50	42	61	43	55	67	46	72
y	41	64	70	75	44	55	62	56	60

(06 Marks)

b. Fit a second degree parabola $y = a + bx + cx^2$ for the data :

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

(07 Marks)

c. Find the lines of regression and hence calculate the coefficient of correlation for the following data:

x	23	27	28	28	29	30	31	33	35	36
y	18	20	22	27	21	29	27	29	28	29

(07 Marks)

OR

6 a. In a partially destroyed laboratory record, the lines of regression of y on x and x on y are 4x – 5y + 33 = 0 and 20x – 9y = 107. Calculate $\bar{x}$ and $\bar{y}$ and the coefficient of correlation between x and y. **(06 Marks)**

b. Fit a curve of the form $y = ax^b$ for the following data :

x	1	5	7	9	12
y	10	15	12	15	21

(07 Marks)

c. Ten participant in a contest are ranked by 2 judges as follows :

x	1	6	5	10	3	2	4	9	7	8
y	6	4	9	8	1	2	3	10	5	7

Calculate the rank correlation coefficient. **(07 Marks)**

Module-4

7 a. A random variable X has the following probability function :

x	0	1	2	3	4	5	6	7
P(x)	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2 + k$

Find k and evaluate $P(x < 6)$, $P(x \geq 6)$ and $P(3 < x \leq 6)$. **(06 Marks)**

b. Obtain the mean and Standard Deviation of the Binomial distribution. **(07 Marks)**

c. In a normal distribution, 31% of items are under 45 and 8% are over 64. Find the mean and standard deviation given that $\phi(0.5) = 0.19$ and $\phi(1.4) = 0.42$. **(07 Marks)**

OR

8 a. Find the constant K such that $f(x) = \begin{cases} kx^2, & 0 < x < 3 \\ 0, & \text{otherwise} \end{cases}$ is a probability density function.

Also compute : i) $P(1 \leq x \leq 2)$ ii) $P(x \leq 1)$ iii) $P(x > 1)$. **(06 Marks)**

b. If the probability of a bad reaction from a certain injection is 0.001, determine the chance that out of 2000 individuals, more than two will get a bad reaction. **(07 Marks)**

c. An airline knows that 5% of people making reservation on a certain flight will not turn up. Consequently their policy is to sell 52 tickets for a flight that can hold 50 people. What is the probability that there will be a seat for every passenger who turns up? **(07 Marks)**

Module-5

9 a. The joint probability distribution of 2 discrete random variables X and Y is given by $f(x, y) = k(2x + y)$ where X and Y are integers such that $0 \leq x \leq 2$, $0 \leq y \leq 3$. i) find K ii) find marginal distributions of X and Y. **(06 Marks)**

b. A sample of 100 students is taken from a large population. The mean height of the students in this sample is 160 cm. Can it be reasonably regarded that in the population, the mean height is 165 cm and S.D is 10 cm at 5% level of significance. **(07 Marks)**

c. A certain stimulus administered to each of the 12 patients resulted in the following change in blood pressure : 5, 2, 8, -1, 3, 0, 6, -2, 1, 5 , 0 and 4. Can it be concluded that the stimulus will increase the blood pressure? ($t_{0.05} = 2.201$ for 11 d.f) **(07 Marks)**

OR

10 a. Explain the terms i) Null hypothesis ii) Significance level iii) Type – I and Type – II errors. **(06 Marks)**

b. A coin is tossed 1000 times and head turns up 540 times. Decide on the hypothesis that the coin is unbiased (Given $Z_{0.01} = 2.58$). **(07 Marks)**

c. A die is thrown 264 times and the number appearing on the face (x) follows the following frequency distribution :

x	1	2	3	4	5	6
f	40	30	26	56	52	60

Calculate the value of ψ^2. **(07 Marks)**