

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT  
 TEST -2 EXAMINATION- 2026  
 B.Tech.-III Semester (CS/IT)

COURSE CODE (CREDITS): 25B11MA314 (3)

MAX. MARKS: 25

COURSE NAME: Mathematical Foundations for Artificial Intelligence and Data Science

COURSE INSTRUCTOR: RKB

MAX. TIME: 1.5 Hrs

Note: (a) All questions are compulsory.

(b) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems. (c) Use of calculator is not allowed.

No.	Question	Qo	Marks
Q1	Examine whether or not the vectors $(-1,1,2)$ , $(1,2,3)$ and $(0,0,0)$ are linearly independent.	1	2
Q2	Given that $M: \mathbb{R}^2 \rightarrow \mathbb{R}^2$ be a linear transformation defined by $M(x, y) = (x + y, 3x - 2y)$ . Obtain the matrix representation of $M$ with respect to basis $\{(1, 1), (2, -1)\}$ .	1	3
Q3	A factory machine can fail due to overheating or due to power fluctuations. There is a 30% chance that the machine fails due to overheating. There is a 40% chance that it fails due to power fluctuations. Also, there is a 15% chance that both overheating and power fluctuations occur simultaneously. What is the probability that the machine does not fail at all?	2	3
Q4	At a plant, 20% of all the produced parts are subject to a special electronic inspection. It is known that any produced part which was inspected electronically has no defects with probability 0.95. For a part that was not inspected electronically this probability is only 0.7. A customer receives a part and find defects in it. What is the probability that this part went through an electronic inspection?	2	4
Q5	From a sack of fruit containing 4 oranges, 2 apples and 3 bananas, a random sample of 4 pieces of fruit is selected. Suppose $X$ is the number of oranges and $Y$ is the number of apples in the sample. Find the joint probability distribution of $X$ and $Y$ and find $P(X + Y \leq 2)$ .	2	4
Q6	A random variable $X$ has the probability density function: $f(x) = \begin{cases} 2x & , 0 \leq x < 1 \\ 0 & , \text{otherwise} \end{cases}$ Find (i) $P(\frac{1}{4} < X < \frac{1}{2})$ (ii) $P(X > \frac{3}{4}   X > \frac{1}{2})$ .	2	4
Q7	An AI image-classification system has an error probability of $p = 0.15$ on unseen test. (a) Find the probability that the AI system makes no errors when classifying 10 independent images. (b) Find the probability that the AI system makes more than 3 errors when classifying 20 independent images. (c) System evaluators require that, on average, at least 5 errors be observed each day to properly analyze failure cases. Under the binomial model, find the minimum number of images the system must classify daily to meet this requirement.	2	5