

# CBCS SCHEME

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BCS602

## Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026 Machine Learning

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.  
2. M : Marks, L: Bloom's level, C: Course outcomes.*

| Module – 1 |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       | M     | L    | C     |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
|------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|------|-------|--------|--------|----------|--------|------|----------|---|----|-------|-----|----|----|-------|----|-----|-----|---|-----|-------|----|----|----|-------|-----|--------|----|---|----|-------|-----|----|----|-------|----|--------|-----|---|----|------|----|-----|-----|-------|----|--------|----|---|----|-------|-----|-----|-----|-------|----|-----|-----|--|--|
| Q.1        | a.    | Explain the machine learning process and its applications with a suitable diagram.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6     | L2    | CO1  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
|            | b.    | Explain the purpose of dimensionality reduction and its importance in the domain of machine learning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 8     | L2    | CO1  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
|            | c.    | Write short notes on the following :<br>i) Min-Max Scaling    ii) Z-score    iii) Mean    iv) Standard Deviation<br>v) Median    vi) Dispersion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6     | L2    | CO1  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| OR         |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |       |      |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| Q.2        | a.    | Explain the elements of Big Data, data types, and Big Data analytics in relation to Machine Learning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6     | L2    | CO1  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
|            | b.    | Explain data collection and data pre-processing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 8     | L2    | CO1  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
|            | c.    | Explain the removal of noise or outlier data with a suitable example.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6     | L2    | CO1  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| Module – 2 |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |       |      |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| Q.3        | a.    | Explain the Gaussian Elimination Algorithm and Solve the following problem<br>$x + y + z = 2$<br>$x + 2y + 3z = 5$<br>$2x + 3y + 4z = 11$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 10    | L3    | CO2  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
|            | b.    | Explain the Types of Machine Learning (ML)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4     | L2    | CO2  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
|            | c.    | Illustrate PCA, why it is important, and write the PCA Algorithm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6     | L3    | CO2  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| OR         |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |       |      |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| Q.4        | a.    | Solve the problem using the Find – S Algorithm :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 10    | L3    | CO2  |       |        |        |          |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
|            |       | <table><tr><th>S. No</th><th>Horns</th><th>Tail</th><th>Tusks</th><th>Paws</th><th>Fur</th><th>Color</th><th>Hooves</th><th>Size</th><th>Elephant</th></tr><tr><td>1</td><td>No</td><td>Short</td><td>Yes</td><td>No</td><td>No</td><td>Black</td><td>No</td><td>Big</td><td>Yes</td></tr><tr><td>2</td><td>Yes</td><td>Short</td><td>No</td><td>No</td><td>No</td><td>Brown</td><td>Yes</td><td>Medium</td><td>No</td></tr><tr><td>3</td><td>No</td><td>Short</td><td>Yes</td><td>No</td><td>No</td><td>Black</td><td>No</td><td>Medium</td><td>Yes</td></tr><tr><td>4</td><td>No</td><td>Long</td><td>No</td><td>Yes</td><td>Yes</td><td>White</td><td>No</td><td>Medium</td><td>No</td></tr><tr><td>5</td><td>No</td><td>Short</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Black</td><td>No</td><td>Big</td><td>Yes</td></tr></table> | S. No | Horns | Tail | Tusks | Paws   | Fur    | Color    | Hooves | Size | Elephant | 1 | No | Short | Yes | No | No | Black | No | Big | Yes | 2 | Yes | Short | No | No | No | Brown | Yes | Medium | No | 3 | No | Short | Yes | No | No | Black | No | Medium | Yes | 4 | No | Long | No | Yes | Yes | White | No | Medium | No | 5 | No | Short | Yes | Yes | Yes | Black | No | Big | Yes |  |  |
| S. No      | Horns | Tail                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Tusks | Paws  | Fur  | Color | Hooves | Size   | Elephant |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| 1          | No    | Short                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Yes   | No    | No   | Black | No     | Big    | Yes      |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| 2          | Yes   | Short                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No    | No    | No   | Brown | Yes    | Medium | No       |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| 3          | No    | Short                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Yes   | No    | No   | Black | No     | Medium | Yes      |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| 4          | No    | Long                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | No    | Yes   | Yes  | White | No     | Medium | No       |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |
| 5          | No    | Short                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Yes   | Yes   | Yes  | Black | No     | Big    | Yes      |        |      |          |   |    |       |     |    |    |       |    |     |     |   |     |       |    |    |    |       |     |        |    |   |    |       |     |    |    |       |    |        |     |   |    |      |    |     |     |       |    |        |    |   |    |       |     |     |     |       |    |     |     |  |  |

|                 | b.                   | Write a short note on Binomial Distribution, Poisson Distribution and Bernoulli Distribution.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4               | L2               | CO2       |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
|-----------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------|-----------|----------------------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|----|-----|----|-----|----|-----|----|-----|-----|-----|----|-----|----|-----|----|-----|----|-----|----|----|----|-----|
|                 | c.                   | Explain LU Decomposition and solve the following problem<br>$A = \begin{bmatrix} 2 & 3 & 1 \\ 4 & 7 & 3 \\ 6 & 18 & 5 \end{bmatrix}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6               | L3               | CO2       |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Module – 3      |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Q.5             | a.                   | Explain the KNN algorithm and solve the following problem :<br>In the KPSC exam, candidates secured the following marks. Based on those obtained marks, categorize whether the candidate is eligible for the exam or not using K-Nearest Neighbors. Given instance as follows : <ul style="list-style-type: none"><li>General Studies X(O1) = 07</li><li>Computer Science Y(O2) = 6</li><li>Language = 4</li><li>K = 3 nearest neighbors</li></ul> Note : Training data is provided, where O represents observable values. <table><tr><th>General Studies</th><th>Computer Science</th><th>Languages</th><th>Eligible</th></tr><tr><td>4</td><td>3</td><td>5</td><td>Fail</td></tr><tr><td>6</td><td>7</td><td>8</td><td>Pass</td></tr><tr><td>6</td><td>8</td><td>6</td><td>Pass</td></tr><tr><td>5</td><td>5</td><td>4</td><td>Fail</td></tr><tr><td>8</td><td>8</td><td>9</td><td>Pass</td></tr></table> | General Studies | Computer Science | Languages | Eligible             | 4   | 3   | 5   | Fail | 6   | 7   | 8   | Pass | 6   | 8   | 6   | Pass | 5   | 5   | 4   | Fail | 8   | 8   | 9   | Pass | 10  | L3 | CO3 |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| General Studies | Computer Science     | Languages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Eligible        |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 4               | 3                    | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Fail            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 6               | 7                    | 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Pass            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 6               | 8                    | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Pass            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 5               | 5                    | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Fail            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 8               | 8                    | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Pass            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
|                 | b.                   | Explain the Local Weighted KNN, Logistic Regression, and Nearest centroid classifier algorithms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10              | L3               | CO3       |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| OR              |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Q.6             | a.                   | Explain Linear Regression and Polynomial Regression and solve a Linear Regression problem :<br>Apply linear regression technique to predict the 7 <sup>th</sup> week sales<br>Table : Sample data <table><tr><th>X</th><th>Y</th></tr><tr><th>(week)</th><th>(Sales in Thousands)</th></tr><tr><td>1</td><td>1.2</td></tr><tr><td>2</td><td>1.8</td></tr><tr><td>3</td><td>2.6</td></tr><tr><td>4</td><td>3.2</td></tr><tr><td>5</td><td>3.8</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                              | X               | Y                | (week)    | (Sales in Thousands) | 1   | 1.2 | 2   | 1.8  | 3   | 2.6 | 4   | 3.2  | 5   | 3.8 | 10  | L3   | CO3 |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| X               | Y                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| (week)          | (Sales in Thousands) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 1               | 1.2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 2               | 1.8                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 3               | 2.6                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 4               | 3.2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| 5               | 3.8                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
|                 | b.                   | Explain ID3 algorithm and solve the following problem : <table><tr><th>Age</th><th>Competition</th><th>Type</th><th>Profit</th></tr><tr><td>Old</td><td>Yes</td><td>S/W</td><td>Down</td></tr><tr><td>Old</td><td>No</td><td>S/W</td><td>Down</td></tr><tr><td>Old</td><td>No</td><td>H/W</td><td>Down</td></tr><tr><td>Mid</td><td>Yes</td><td>S/W</td><td>Down</td></tr><tr><td>Mid</td><td>Yes</td><td>H/W</td><td>Down</td></tr><tr><td>Mid</td><td>No</td><td>H/W</td><td>Up</td></tr><tr><td>Mid</td><td>No</td><td>S/W</td><td>Up</td></tr><tr><td>New</td><td>Yes</td><td>S/W</td><td>Up</td></tr><tr><td>New</td><td>No</td><td>H/W</td><td>Up</td></tr><tr><td>New</td><td>No</td><td>S/W</td><td>Up</td></tr></table>                                                                                                                                                                            | Age             | Competition      | Type      | Profit               | Old | Yes | S/W | Down | Old | No  | S/W | Down | Old | No  | H/W | Down | Mid | Yes | S/W | Down | Mid | Yes | H/W | Down | Mid | No | H/W | Up | Mid | No | S/W | Up | New | Yes | S/W | Up | New | No | H/W | Up | New | No | S/W | Up | 10 | L3 | CO3 |
| Age             | Competition          | Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Profit          |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Old             | Yes                  | S/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Down            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Old             | No                   | S/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Down            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Old             | No                   | H/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Down            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Mid             | Yes                  | S/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Down            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Mid             | Yes                  | H/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Down            |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Mid             | No                   | H/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Up              |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| Mid             | No                   | S/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Up              |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| New             | Yes                  | S/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Up              |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| New             | No                   | H/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Up              |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |
| New             | No                   | S/W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Up              |                  |           |                      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |    |     |    |     |    |     |    |     |     |     |    |     |    |     |    |     |    |     |    |    |    |     |

| Module – 4 |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
|------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|-------|------|--------|-----|-----|-----|--------|-----|-----|-----|--------|----|-----|----|-----|----|-----|-----|---|---|-----|-----|----|----|-----|
| Q.7        | a.     | Explain Baye's Theorem and Bayes' optimal classifier.                                                                                                                                                                                                                                                                                                                                                                                                            | 8     | L2     | CO4   |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
|            | b.     | Explain the Naïve Bayes algorithm and solve the problem using the Naïve Bayes classifier. Classify using Naïve Bayes' for the new sample : (fruit = {yellow, sweet, long})<br>Data : <table><tr><td>Fruit</td><td>Yellow</td><td>Sweet</td><td>Long</td></tr><tr><td>Orange</td><td>350</td><td>450</td><td>0</td></tr><tr><td>Banana</td><td>400</td><td>300</td><td>350</td></tr><tr><td>Others</td><td>50</td><td>100</td><td>50</td></tr></table>            | Fruit | Yellow | Sweet | Long | Orange | 350 | 450 | 0   | Banana | 400 | 300 | 350 | Others | 50 | 100 | 50 | 12  | L3 | CO4 |     |   |   |     |     |    |    |     |
| Fruit      | Yellow | Sweet                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Long  |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| Orange     | 350    | 450                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0     |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| Banana     | 400    | 300                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 350   |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| Others     | 50     | 100                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 50    |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| OR         |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| Q.8        | a.     | Write a note on :<br>i) Perceptron<br>ii) Different types of Artificial Neural Network with a suitable diagram.                                                                                                                                                                                                                                                                                                                                                  | 8     | L2     | CO4   |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
|            | b.     | Explain the ANN Node structure and all its associated activation function with suitable mathematical notations.                                                                                                                                                                                                                                                                                                                                                  | 12    | L2     | CO4   |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| Module – 5 |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| Q.9        | a.     | Write a short note on Clustering and classification along with advantages and disadvantages of the clustering algorithm.                                                                                                                                                                                                                                                                                                                                         | 6     | L2     | CO5   |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
|            | b.     | Explain the proximity measures.                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6     | L2     | CO5   |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
|            | c.     | Explain the Mean Shift Clustering Algorithm and solve the following problem. Start with point P1(1, 1)<br>P1 = (1, 1)<br>P2 = (2, 1)<br>P3 = (2, 2)<br>P4 = (8, 8)<br>P5 = (9, 8)<br>P6 = (8, 9)<br>Mean shift clustering using a bandwidth (radius) of 4 units.<br>Stopping threshold : Stop when the new center moves less than 0.01                                                                                                                           | 8     | L3     | CO5   |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| OR         |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| Q.10       | a.     | Explain the K-Mean clustering algorithm and solve the following problem. <table><tr><td>Point</td><td>X</td><td>Y</td></tr><tr><td>A</td><td>1</td><td>1</td></tr><tr><td>B</td><td>1.5</td><td>2</td></tr><tr><td>C</td><td>3</td><td>4</td></tr><tr><td>D</td><td>5</td><td>7</td></tr><tr><td>E</td><td>3.5</td><td>5</td></tr><tr><td>F</td><td>4.5</td><td>5</td></tr><tr><td>G</td><td>3.5</td><td>4.5</td></tr></table><br>Let's apply K-Means with K = 2 | Point | X      | Y     | A    | 1      | 1   | B   | 1.5 | 2      | C   | 3   | 4   | D      | 5  | 7   | E  | 3.5 | 5  | F   | 4.5 | 5 | G | 3.5 | 4.5 | 12 | L3 | CO5 |
| Point      | X      | Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| A          | 1      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| B          | 1.5    | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| C          | 3      | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| D          | 5      | 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| E          | 3.5    | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| F          | 4.5    | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
| G          | 3.5    | 4.5                                                                                                                                                                                                                                                                                                                                                                                                                                                              |       |        |       |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |
|            | b.     | Short note on : Monte Carlo method, temporal difference learning, Q-learning and SARSA learning.                                                                                                                                                                                                                                                                                                                                                                 | 8     | L2     | CO5   |      |        |     |     |     |        |     |     |     |        |    |     |    |     |    |     |     |   |   |     |     |    |    |     |

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