

# TEACHING PLAN (TP)

Academic Year: 2025-2026 (EVEN)

Date: 15/12/2025

Institute Code & Name: 0078 - K. K. Wagh Polytechnic, Nashik

Semester: Four

Programme & Code: Artificial Intelligence & Machine Learning (AN)

Course Index: 404

Course and code: Mathematics For Machine Learning (MML)

Course Code : 314320

Scheme: K

Allocated Hrs: 45

Class: SYAN

Name of Faculty: Mr.V.N.Bachhav

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## COURSE LEVEL LEARNING OUTCOMES (COS)

- CO1 - Use partial differentiation concept to obtain optimal solution.
- CO2 - Implement matrix concept to solve real life problems.
- CO3 - Build programs to implement basic operations based on vectors and tensors.
- CO4 - Evaluate numerical differentiation and integration functions.
- CO5 - Apply the linear programming problem concept to obtain optimal solution.

## TEACHING-LEARNING & ASSESSMENT SCHEME

| Course Code | Course Title                     | Abbr | Course Category | Learning Scheme         |    |    |       |     |     | Credits | Paper Duration | Assessment Scheme |       |     |       |                             |       |     |     |             |     | Total Marks |
|-------------|----------------------------------|------|-----------------|-------------------------|----|----|-------|-----|-----|---------|----------------|-------------------|-------|-----|-------|-----------------------------|-------|-----|-----|-------------|-----|-------------|
|             |                                  |      |                 | Actual Contact Hrs/Week |    |    |       | SLH | NLH |         |                | Theory            |       |     |       | Based on LL & TSL Practical |       |     |     | Based on SL |     |             |
|             |                                  |      |                 | CL                      | TL | LL | FA-TH |     |     |         |                | SA-TH             | Total |     | FA-PR |                             | SA-PR |     | SLA |             |     |             |
|             |                                  |      |                 |                         |    |    |       |     |     |         |                |                   | Max   | Min | Max   | Min                         | Max   | Min | Max | Min         |     |             |
| 314320      | MATHEMATICS FOR MACHINE LEARNING | MML  | AEC             | 4                       | -  | 2  | -     | 6   | 3   | 3       | 30             | 70                | 100   | 40  | 25    | 10                          | 25@   | 10  | -   | -           | 150 |             |

Total IKS Hrs for Sem.: 0 Hrs

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment Legends: @ Internal Assessment, # External Assessment, \*# Online Examination, @\$ Internal Online Examination

## SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs)                     |                       |                                       |                        |  |                         |                         | Programme Specific Outcomes (PSOs) |        |
|-----------------------|--|-----------------------|---------------------------------------|------------------------|--|-------------------------|-------------------------|------------------------------------|--------|
|                       | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1                             | PSO- 2 |
| CO1                   | 2  | 2                     | 2                                     | 1                      | 1  | -                       | 1                       |                                    |        |
| CO2                   | 2  | 2                     | 2                                     | 1                      | 1  | -                       | 1                       |                                    |        |
| CO3                   | 2  | 2                     | 2                                     | 1                      | 1  | -                       | 2                       |                                    |        |
| CO4                   | 2  | 2                     | 2                                     | 1                      | 1  | -                       | 1                       |                                    |        |
| CO5                   | 2  | 3                     | 3                                     | 1                      | 1  | -                       | 1                       |                                    |        |

Legends:- High:03, Medium:02,Low:01, No Mapping: -

PSO 1: Apply fundamental concepts of Computer Engineering and Artificial Intelligence and machine learning to solve technical problems.

PSO2: Implement the domain knowledge to achieve successful career as an engineering professional.

## Course Outcomes (COs) and Theory Learning Outcomes (TLOs)

By learning course Mathematics For Machine Learning (MML), Second Year students will be able to:

| CO No.         | TLO No. | Course Outcomes (COs) and Theory Learning Outcomes (TLOs)  |
|----------------|---------|--|
| <b>CO404.1</b> |         | Use partial differentiation concept to obtain optimal solution.  |
|                | 1.1     | Calculate partial derivative of first order, second order and mixed order.   |
|                | 1.2     | Verify Euler's theorem for the homogeneous function.   |
|                | 1.3     | Calculate maximum and minimum value of the function.   |
|                | 1.4     | Find maximum and minimum value of the function subject to the given condition using Lagrange's undetermined multipliers. |
| <b>CO404.2</b> |         | <b>Implement matrix concept to solve real life problems.</b>   |
|                | 2.1     | Reduce the matrix to echelon form and normal form.   |
|                | 2.2     | Find the inverse of matrix by elementary transformation.   |
|                | 2.3     | Calculate the rank of matrix using determinant of order 2 and 3.   |
|                | 2.4     | Calculate the rank of matrix by reducing matrix to echelon form of order 2 and 3.  |
|                | 2.5     | Calculate the rank of matrix by reducing matrix to normal form of order 2 and 3.   |
|                | 2.6     | Check the consistency of non-homogenous system of linear equation using rank of matrix.                                  |
|                | 2.7     | Check the consistency of homogenous system of linear equation using rank of matrix.                                      |
|                | 2.8     | Find solution of non- homogeneous system of linear equations.  |
|                | 2.9     | Find solution of homogenous system of linear equations.  |
|                | 2.10    | Find eigen-values and eigen-vectors for the given matrix of order 2.   |
| <b>CO404.3</b> |         | <b>Build programs to implement basic operations based on vectors and tensors.</b>  |
|                | 3.1     | Calculate the magnitude of given vector and unit vector perpendicular to given vector.                                   |
|                | 3.2     | Calculate direction ratio and direction cosines of a vector.   |
|                | 3.3     | Find scalar(dot) product of two vectors.   |
|                | 3.4     | Find angle between two vectors using scalar(dot) product.  |
|                | 3.5     | Find projection of one vector on another vector.   |
|                | 3.6     | Find vector(cross) product of two vectors.   |
|                | 3.7     | Find angle between two vectors using vector(cross) product.  |
|                | 3.8     | Find scalar triple product of the vectors.   |
|                | 3.9     | Define different types of tensors.   |
| <b>CO404.4</b> |         | <b>Evaluate numerical differentiation and integration functions.</b>   |
|                | 4.1     | Find first order derivative using forward and backward interpolation.  |
|                | 4.2     | Evaluate numerical integration using Trapezoidal rule.   |
|                | 4.3     | Evaluate numerical integration using Simpson's one third rule.   |
|                | 4.4     | Evaluate numerical integration using Simpson's three eight rule.   |
| <b>CO404.5</b> |         | <b>Apply the linear programming problem concept to obtain optimal solution.</b>  |
|                | 5.1     | Formulate given problem in Linear Programming Problems.  |
|                | 5.2     | Find optimal solution of Linear Programming Problems using graphical (corner point) method.                              |
|                | 5.3     | Find optimal solution of Linear Programming Problems using simplex method.   |

# Maharashtra State Board of Technical Education, Mumbai

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**Program:** Artificial Intelligence & Machine Learning (AN)

**Course:** Mathematics For Machine Learning (MML)

**Class:** SYAN

**Institute Code:** 0078

**Course Code:** 314320

**Semester:** Four [AN-4K]

**Name of Faculty:** Mr.V.N.Bachhav

| Chap No.<br>(Alloted Hrs.) | CO          | TLO       | Unit Name and Learning Content Title/ Details  | No. of Lecture | Plan (From-To)                   | Actual Execution (From-To) | Teaching method/ Media                            | Remark |
|----------------------------|-------------|-----------|--|----------------|----------------------------------|----------------------------|---|--------|
| <b>01<br/>(10)</b>         | <b>CO-1</b> | <b>I</b>  | <b>Partial Differentiation</b>   | <b>10</b>      |                                  |                            |   |        |
|                            |             | TLO-1.1   | 1.1 Introduction to Derivative   | 01             | 18/12/25 To                      |                            | <b>Chalk &amp; Black Board, ppt., Video, LMS.</b> | Ex.    |
|                            |             | TLO-1.1   | 1.2 Partial derivative (Two variables): Introduction, Partial derivative of first order, second order and mixed order  | 04             | 18/12/25 To 19/12/25             |                            |   |        |
|                            |             | TLO-1.2   | 1.3 Homogeneous Function   | 01             | 27/12/25 To 01/01/26             |                            |   |        |
|                            |             | TLO-1.2   | 1.4 Euler's theorem on homogeneous function (Two variables)  | 01             | 01/01/26 To 02/01/26             |                            |   |        |
|                            |             | TLO-1.3   | 1.5 Maxima and minima of function (Two variables)  | 01             | To 02/01/26                      |                            |   |        |
|                            |             | TLO-1.4   | 1.6 Lagrange's method of undetermined multipliers with one constraint (Two variables)  | 02             | 02/01/26 To 03/01/26 To 08/01/26 |                            |   |        |
| <b>02<br/>(18)</b>         | <b>CO-2</b> | <b>II</b> | <b>Matrices</b>  | <b>18</b>      |                                  |                            |   |        |
|                            |             | TLO-2.1   | 2.1 Review of types of matrices and algebra of matrices  | 01             | 09/01/26 To                      |                            | <b>Chalk &amp; Black Board, ppt., Video, LMS.</b> | Ex.    |
|                            |             | TLO-2.1   | 2.2 Elementary row and column transformation of matrices   | 01             | 09/01/26 To 10/01/26             |                            |   |        |
|                            |             | TLO-2.1   | 2.3 Conversion of matrix to echelon and normal form  | 01             | To 10/01/26                      |                            |   |        |
|                            |             | TLO-2.2   | 2.4 Inverse of matrix using elementary transformation  | 01             | 15/01/26 To                      |                            |   |        |
|                            |             | TLO-2.3   | 2.5 Rank of matrix using determinant of order two & three, Rank of matrix by reducing matrix to echelon and normal form  | 04             | 15/01/26 To 16/01/26             |                            |   |        |
|                            |             | TLO-2.6   | 2.6 Non-Homogeneous and Homogeneous system of linear equations   | 02             | 16/01/26 To 22/01/26             |                            |   |        |
|                            |             | TLO-2.7   | 2.7 Consistency of system of linear equations using rank of matrices   | 01             | To 23/01/26                      |                            |   |        |
|                            |             | TLO-2.8   | 2.8 Non-Homogeneous system of linear equation: Unique solution, Infinite number of solutions   | 02             | 24/01/26 To 24/01/26             |                            |   |        |
|                            |             | TLO-2.9   | Homogeneous system of linear equation: Unique or trivial solution, Infinite number of non-trivial solutions  | 02             | 29/01/26 To 30/01/26             |                            |   |        |
|                            |             | TLO-2.10  | 2.10 Eigen values and Eigen-vector: Basic Definition, Characteristic Polynomial, Characteristic Equation, Eigen-value and Eigen- vector of a matrix of order 2 | 03             | 31/01/26 To 06/02/26             |                            |   |        |

|                    |             |                       |   |              |  |  |   |     |
|--------------------|-------------|-----------------------|---|--------------|--|--|---|-----|
|                    |             | <b>III</b>            | <b>Vectors and Tensors</b>  | <b>14</b>    |  |  |   |     |
| <b>03<br/>(14)</b> | <b>CO-3</b> | TLO-3.1               | 3.1 Introduction, Definition of scalar and vector quantity, Representation of vector, Magnitude of vector, Component of vector, Direction ratio, Direction cosines                                  | 02           | 07/02/26<br>To<br>12/02/26             |  | <b>Chalk &amp; Black Board, ppt., Video, LMS.</b> | Ex. |
|                    |             | TLO-3.1               | 3.2 Types of vectors: Zero vector, Unit vector, Position vector, Equal vector, Negative vector. Parallel vector, Co-initial vector, Collinear vector  | 02           | 13/02/26<br>To<br>14/02/26<br>20/02/26 |  |   |     |
|                    |             | TLO-3.2               | 3.3 Algebra of vectors: Addition of vectors, Triangle law of vectors addition, Parallelogram law of vectors addition, Subtraction of vectors, Multiplication of vectors by scalar                   | 02           | 21/02/26<br>To<br>26/02/26             |  |   |     |
|                    |             | TLO-3.3<br>3.4<br>3.5 | 3.4 Product of two vectors: Scalar (dot) product of two vectors, Projection of one vector on another vector, Angle between two vectors using scalar(dot) product, Properties of scalar(dot) product | 03           | 28/02/26<br>To<br>05/03/26             |  |   |     |
|                    |             | TLO-3.6<br>3.7        | 3.5 Vector (cross) product of two vectors, Angle between two vectors using vector (cross) product, Properties of vector (cross) product   | 02           | 06/03/26<br>07/03/26<br>To<br>12/03/26 |  |   |     |
|                    |             | TLO-3.8               | 3.6 Scalar triple product of vectors  | 02           | 13/03/26<br>To<br>13/03/26             |  |   |     |
|                    |             | TLO-3.9               | 3.7 Tensor: Definition of tensors, Types of tensors, Rank of tensors, Algebra of tensors  | 01           |  |  |   |     |
| <b>04<br/>(10)</b> | <b>CO-4</b> | <b>IV</b>             | <b>Numerical Differentiation and Integration</b>  | <b>10</b>    |  |  | <b>Chalk &amp; Black Board, ppt., Video, LMS.</b> | Ex. |
|                    |             | TLO-4.1               | 4.1 Introduction to numerical differentiation and integration   | 02           | 14/03/26<br>To<br>17/03/26             |  |   |     |
|                    |             | TLO-4.2               | 4.2 Derivative using forward and backward interpolation   | 02           | 18/03/26<br>To<br>19/03/26             |  |   |     |
|                    |             | TLO-4.3               | 4.3 Numerical integration using Trapezoidal rule  | 02           | 20/03/26<br>To<br>21/03/26             |  |   |     |
|                    |             | TLO-4.3               | 4.4 Numerical integration using Simpson's one third rule  | 02           | 25/03/26<br>To<br>25/03/26             |  |   |     |
|                    |             | TLO-4.4               | 4.5 Numerical integration using Simpson's three eight rule  | 01           |  |  |   |     |
|                    |             | <b>V</b>              | <b>Linear Programming Problems</b>  | <b>08</b>    |  |  |   |     |
| <b>05<br/>(08)</b> | <b>CO-5</b> | TLO-5.1               | 5.1 Introduction, Basic terms in Linear Programming Problems  | 01<br><br>03 | 26/03/26<br>To<br>26/03/26<br>27/03/26 |  | <b>Chalk &amp; Black Board, ppt., Video, LMS.</b> | Ex. |
|                    |             | TLO-5.2               | 5.2 Mathematical formulation of Linear Programming Problems   | 04           | To<br>28/03/26                         |  |   |     |
|                    |             | TLO-5.3               | 5.3 Method of solving Linear Programming Problems (Two equations in two variables): Graphical (corner point) method, Simplex method   |              | 01/04/26<br>To<br>04/04/26             |  |   |     |

**ASSESSMENT METHODOLOGIES/TOOLS****A. Formative assessment (Assessment for Learning) (FA-TH)**

- Tests

**B. Summative Assessment (Assessment of Learning) (SA-TH)**

- End Term Exam

**SUGGESTED LEARNING MATERIALS / BOOKS**

| Sr. no | Author                                  | Title                          | Publisher with ISBN Number                                     |
|--------|---|--------------------------------|--|
| 01     | H. K. Dass,<br>Er.Rajnish Verma         | Higher Engineering Mathematics | S. Chand Technical, ISBN: 9788121938907                        |
| 02     | K.Nageswara Rao,<br>Shaikh Akbar        | Python Programming             | Scitech Publication(India) Pvt. Ltd.<br>ISBN:9789385983450     |
| 03     | Grewal B. S.                            | Higher Engineering Mathematics | Tata McGraw Hill Education, New Delhi,<br>ISBN : 9789386173522 |
| 04     | A. C. Shrivastava,<br>P. K. Shrivastava | Engineering Mathematics        | PHI Learning, New Delhi,<br>ISBN:9788120342934                 |
| 05     | Mark Lutz                               | Learning Python                | O'Reilly Publication ISBN-13:<br>9780672329784                 |

**LEARNING WEBSITES & PORTALS**

| Sr.No | Link / Portal   | Description  |
|-------|---|--|
| 1     | <a href="https://atozmath.com/default.aspx">https://atozmath.com/default.aspx</a>   | Online Learning Initiative for Mathematics Problems with Solutions |
| 2     | <a href="https://www.w3schools.com/ai/ai_mathematics.asp">https://www.w3schools.com/ai/ai_mathematics.asp</a>                         | Machine Learning Mathematics                                       |
| 3     | <a href="https://docs.python.org/3/tutorial/index.html">https://docs.python.org/3/tutorial/index.html</a>                             | The Python Tutorial  |
| 4     | <a href="https://www.geeksforgeeks.org/machine-learning-mathematics/">https://www.geeksforgeeks.org/machine-learning-mathematics/</a> | Machine Learning Mathematics                                       |
| 5     | <a href="https://onlinecourses.nptel.ac.in/noc21_ma38/prview">https://onlinecourses.nptel.ac.in/noc21_ma38/prview</a>                 | NPTEL Course   |
| 6     | <a href="https://www.purplemath.com/index.htm">https://www.purplemath.com/index.htm</a>   | Foundational Mathematics to improve learning                       |
| 7     | <a href="https://mathworld.wolfram.com/">https://mathworld.wolfram.com/</a>   | Extensive mathematical resource with detailed explanations         |
| 8     | <a href="https://www.khanacademy.org/math">https://www.khanacademy.org/math</a>   | Mathematical concepts through video lectures                       |

Mr.V.N.Bachhav  
(Name & Signature of staff)

Prof.A.D.Watpade  
(Name & Signature of HOD)

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