# Government College of Engineering, Karad

## Department of Information Technology

### Minor-Degree Certification Course in Artificial Intelligence and Machine Learning (AI & ML)

# Pre-requisites

It is expected that a student willing to pursue a Minor course in Machine Learning & Artificial Intelligence will satisfy the following pre-requisites for the course selected for their minor program.

The minor program in AI & ML will require knowledge of math, statistics, and fundamental programming skills in languages like C, Python, R and Matlab, etc. which are pre-requisites for the minor courses.

Specifically, the following pre-requisite knowledge is required:

- Programming skill with C or Python
- Statistical analysis concepts & Descriptive statistics
- Probability and Bayes theorem, Probability distributions
- Hypothesis testing & scores

DEPARTMENT OF INFO. TECH.
Board of Studies
Year 2021-22
GCE KARAD

# Government College of Engineering, Karad

## SCHEME OF INSTRUCTION & SYLLABI

Programme: MINOR/Honors in Artificial Intelligence & Machine learning

Minor: Semester – I (Major: Semester – V)

| Sr. No. | Course Code | Course Title | L | P | Contact Hrs/Wk | Course Credits | EXAM SCHEME | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | FA-I | FA-II | SA | TOTAL |
| 1 | ITm-3501 | Fundamentals of Data Science | 03 | -- | 03 | 03 | 10 | 10 | 30 | 50 |
| 2 | ITm- 3502 | Competency Lab-I | -- | 02 | 02 | 01 | -- | -- | 50 | 50 |
| 3 | ITm-3503 | Professional Training & Mini- Project-I | -- | 02 | 02 | 01 | -- | -- | 50 | 50 |
| | | **Total** | **03** | **04** | **07** | **05** | **10** | **10** | **130** | **150** |

L- Lecture P-Practical

FA-I- Formative Assessment-I

FA-II- Formative Assessment-II SA - Summative Assessment (For Laboratory End Semester performance)

**TOTAL CREDITS: 05**

# Government College of Engineering, Karad

## SCHEME OF INSTRUCTION & SYLLABI

Programme: MINOR in Artificial Intelligence & Machine learning

Minor: Semester – II (Major: Semester – VI)

| Sr. No. | Course Code | Course Title | L | P | Contact Hrs/Wk | Course Credits | EXAM SCHEME | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | FA-I | FA-II | SA | TOTAL |
| 1 | ITm-3601 | Artificial Intelligence & Machine Learning | 03 | -- | 03 | 03 | 10 | 10 | 30 | 50 |
| 2 | ITm -3602 | Competency Lab-II | -- | 02 | 02 | 01 | -- | -- | 50 | 50 |
| 3 | ITm-3603 | Professional Training & Mini- Project-II | -- | 02 | 02 | 01 | -- | -- | 50 | 50 |
| | | **Total** | **03** | **04** | **07** | **05** | **10** | **10** | **130** | **150** |

L- Lecture P-Practical

FA-I- Formative Assessment-I

FA-II- Formative Assessment-II SA - Summative Assessment (For Laboratory End Semester performance)

**PROGRESSIVE TOTAL CREDITS: 05+05=10**

# Government College of Engineering, Karad

## SCHEME OF INSTRUCTION & SYLLABI

Programme: MINOR in Artificial Intelligence & Machine learning

Minor: Semester – III (Major: Semester – VII)

| Sr. No. | Course Code | Course Title | L | P | Contact Hrs/Wk | Course Credits | EXAM SCHEME | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | FA-I | FA-II | SA | Total |
| 1 | ITm -4701 | Deep Learning Techniques and Tools | 03 | -- | 03 | 03 | 10 | 10 | 30 | 50 |
| 2 | ITm -4702 | Competency Lab-III | -- | 02 | 02 | 01 | -- | -- | 50 | 50 |
| 3 | ITm -4703 | Professional Training & Mini- Project-III | -- | 02 | 02 | 01 | -- | -- | 50 | 50 |
| | | **Total** | **03** | **04** | **07** | **05** | **10** | **10** | **130** | **150** |

L- Lecture P-Practical

FA-I- Formative Assessment-I

FA-II- Formative Assessment-II SA - Summative Assessment (For Laboratory End Semester Performance)

**TOTAL CREDITS: 10+05=15**

# Government College of Engineering, Karad

## SCHEME OF INSTRUCTION & SYLLABI

Programme: MINOR in Artificial Intelligence & Machine learning

Minor: Semester – IV (Major: Semester – VIII)

| Sr. No. | Course Code | Course Title | L | P | Contact Hrs/Wk | Course Credits | EXAM SCHEME | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | PBE-I | PBE-II | TOTAL |
| 1 | ITm -4801 | Major Capstone Project ( Design & Development) | -- | 10 | 10 | 05 | 75 | 75 | 150 |
| | | **Total** | **--** | **10** | **10** | **05** | **75** | **75** | **150** |

L- Lecture P-Practical

FA-I- Formative Assessment-I

FA-II- Formative Assessment-II SA - Summative Assessment (For Laboratory End Semester performance)

PBE-I– Project-based Examination (For Laboratory Mid Semester Performance)

PBE- II Project-based Examination (For Laboratory End Semester Performance)

**PROGRESSIVE TOTAL CREDITS: 15+05=20**

**IMPORTANT**

**To be offered as Honors for Major Disciplines as–**

- **Computer Engineering**
- **Electronics and Telecommunication Engineering**
- **Electronics Engineering**

**For any other Major Disciplines which is not mentioned above, it may be offered as Minor Degree.**

**Reference: https://www.aicte-india.org/sites/default/files/APH%202020_21.pdf / page 99-100**

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| Minor degree course (Artificial Intelligence and Machine Learning) | | | | |
| ITm-3501: Fundamentals of Data Science | | | | |
| **Teaching Scheme** | | **Examination Scheme** | | |
| **Lectures** | 3Hrs/week | **Exam** | **Dur.** | **Marks** |
| **Tutorial** | -- | **FA-I** | **30 min** | 10 |
| **Total Credits** | **3** | **FA-II** | **30 min** | 10 |
| **Subject Code** | ITm-3501 | **SA** | **60 min** | 30 |
| | | | | |

| **Course Outcome (CO):** | |
|---|---|
| 1 | Define and Select Apply data preprocessing methods on open access data and generate quality data for analysis |
| 2 | Implement analytical methods using Python/R |
| 3 | Apply different data visualisation techniques to understand the data. |
| 4 | Analyse the data using suitable method; visualise using the open-source tool. |

| **Course Contents** | | |
|---|---|---|
| **Units** | | **Teaching Hours** |
| Unit I | **Introduction:** Need of Data Science, What is Data Science, The Data Science Process, Business Intelligence and Data Science, Prerequisite for Data Science, Components of Data Science, Tools and Skills Need, Applications of Data Science | 7 |
| Unit II | Data Science Methodology: Analytics for Data Science, Data Analytics Examples, Data Analytics Life Cycle, Data Discovery, Data preparation, Model Planning, Model Building, Communicate Results, Operationalise, Overview of Big Data, Big Data Analysis, Big data and data science, terminologies used in Big Data environment, Open-source analysis tools. | 9 |
| Unit III | SQL for Data Science: Basic Statistics with SQL, Data Munging with SQL, Filtering, Joins, and Aggregation, Window Functions and Ordered Data, Preparing Data for Analytics Tools. NoSQL for Data Science: Why NoSQL, Perform Common Data Science tasks with NoSQL, MongoDB, Connectivity with nonrelational database, Documents databases for Data Science, Wide-Column Databases for | 9 |

DEPARTMENT OF INFO. TECH.
Board of Studies
Year 2021-22
GCE KARAD

| | | |
|---|---|---|
| | Data Science, Graph Databases for Data Science. | |
| Unit IV | Data Science tool: Python Basics Of Python, Python libraries: Data Frame Manipulation With Pandas, Numpy, Data Analysis Exploration using Matplotlib, Keras, TensorFlow, Pytorch etc.. | 9 |

| **Text Books:** | |
|---|---|
| 1 | Fundamentals of Data Science, 1st Edition (2021) CRC Press |
| 2 | Data Mining: Concepts and Techniques, 3rd Edition. Jiawei Han, Micheline Kamber, Jian Pei. |
| 3. | Big Data and Analytics by Seema Acharya and Subhashini Chellappan, Wiley |
| **References:** | |
| 1 | Big data black book, Dream tech publication. |
| 2 | Data science from scratch, Joel Grus, Oreille publication |
| 3 | Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Vovost Foster, Fawcett Tom. |
| **Useful Links:** | |
| 1 | handbook for visualising: a handbook for data driven design by Andy krik http://book.visualisingdata.com/ |
| 2 | https://www.programmer-books.com/introducing-data-science-pdf/ |
| 3 | An Introduction to Statistical Learning with Applications in R http://faculty.marshall.usc.edu/gareth-james/ISL/ |

**MOOC/ Video Lectures available at:**

- *https://nptel.ac.in/courses/106/106/106106179/*
- *https://nptel.ac.in/courses/106/106/106106212/*
- *https://nptel.ac.in/courses/106/105/106105174/*

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | - |
| CO 2 | 1 | - | 1 | 2 | 3 | - | - | - | - | - | - | 1 | 1 | - |
| CO 3 | 1 | 3 | 2 | 2 | - | - | - | - | - | - | - | 1 | 2 | 2 |
| CO 4 | 2 | 1 | 2 | 3 | 2 | - | - | - | - | - | - | 1 | 2 | 2 |

DEPARTMENT OF INFO. TECH. Board of Studies Year 2021-22 GCE KARAD

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | FA 1 | FA 2 | SA |
|---|---|---|---|
| Remember | 2 | 2 | 6 |
| Understand | 2 | 2 | 6 |
| Apply | 2 | 2 | 6 |
| Analyse | 2 | 2 | 6 |
| Evaluate | 2 | 2 | 6 |
| Create | - | - | - |
| TOTAL | 10 | 10 | 30 |

DEPARTMENT OF INFO. TECH.
Board of Studies
Year 2021-22
GCE KARAD

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| Minor degree course (Artificial Intelligence and Machine Learning) | | | | |
| ITm-3502: Competency Lab-I | | | | |
| **Laboratory Scheme:** | | | **Examination Scheme:** | |
| **Practical** | 2 Hrs/week | | **SA** | **50** |
| **Total Credits** | 1 | | | |
| | | | | |

| **Course Outcomes:** | |
|---|---|
| **Students will be able to:** | |
| 1 | Apply various libraries for data visualization. |
| 2 | Interpret preprocessing, and text mining approaches. |
| 3 | Implement various Heuristic Search Techniques |
| 4 | Identify the appropriate data structure for the given problem |

| **Course Contents** | |
|---|---|
| **Experiment 1** | Explore SPSS tool. |
| **Experiment 2** | For a given data, determine to Mean, Median, Mode, Standard Deviation, Harmonic Mean. |
| **Experiment 3** | Problem-solving approach for given data using $chi^2$ square method. |
| **Experiment 4** | Explore Weka Tool by using various data sets and apply any classification algorithm. |
| **Experiment 5** | Design & Implement a program to connect a variety of data sources using Python. |
| **Experiment 6** | Design & Implement a program for Basics Statistics and data visualisation using Python. |
| **Experiment 7** | Design & Implement a program that shows Data Manipulation using Python. |
| **Experiment 8** | Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets |
| **Experiment 9** | Build training and testing dataset of assignment 1 to predict the probability of survival of a person based on gender, age and passenger-class |
| **Experiment 10** | Implement a program that shows Data Manipulation for **traffic engineering** using Python. |
| **Experiment 11** | Implement a program to derive a Critical path from a given set of example. |
| **Experiment 12** | Implement a program to develop connectivity between **seasonal change and cost variation in the construction of industry** using Python. |
| **Experiment 13** | Implementation of Statistical time-domain features extraction (Such as RMS, Variance, Skewness) applied in condition monitoring (Vibration signatures) of typical rolling element bearings using python. |
| **Experiment 14** | Implementation of Statistical time-domain features extraction (Such as Kurtosis, shape factor, crest factor and entropy) applied in condition monitoring (Vibration signatures) of typical rolling element bearings using python. |

**List of Submission:**

| | |
|---|---|
| 1. | Total number of Experiments : 10 |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 1 | 2 | 3 | - | - | - | - | - | - | 1 | 2 | 1 |
| CO 2 | 2 | 3 | 1 | 3 | 2 | - | - | - | - | - | - | 1 | 1 | 2 |
| CO 3 | 1 | 2 | 2 | 2 | 3 | - | - | - | - | - | - | 1 | 2 | 2 |
| CO 4 | 2 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | 1 | 2 | 2 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | SA |
|---|---|
| Remember | 5 |
| Understand | 5 |
| Apply | 10 |
| Analyse | 10 |
| Evaluate | 10 |
| Create | 10 |
| TOTAL | 50 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| **Minor degree course (Artificial Intelligence and Machine Learning)** | | | | |
| **ITm-3503: Professional Training & Mini- Project-I** | | | | |
| **Laboratory Scheme:** | | | **Examination Scheme:** | |
| Practical | 2 Hrs/week | | SA | 50 |
| Total Credits | **01** | | | |
| | | | | |

**Course Outcomes:**

**Students will be able to:**

| | |
|---|---|
| **1** | Define community needs. |
| **2** | Implement an idea into a product. |
| **3** | Design, develop and implement a project. |
| **4** | Communicate effectively with customers. |

**Course Contents**

The specific objectives of the course could depend on the problem definition for the project, but the overall performance must be measured on the following criteria. As per the recommendation of industry experts opinion and industry trends, professional training for tools and technology should be delivered, assessed and evaluated as per the examination scheme in the curriculum structure.

1. Literature survey and Problem statement- Student should be able to define the problem statement with clearly specified inputs and outputs. Goals for complex problems could evolve, but it is necessary to have one in the beginning. A brief survey of the available literature and an initial draft of possible directions should be adequate.

2. Modeling or Theoretical results- An appropriate model should be chosen for the problem. They should be able to reason the pros and cons of various models and choose a suitable one. They must be in a position to defend their choices. The model should also involve the criteria by which they will quantify and test its performance. In theoretical work, one should describe the underlying mathematical basis of such problems in the literature.

3. Engineering or Mathematical tools- Numerous available methods could be used to implement and test the described model. They should demonstrate the ability to learn and put various methods to use.

4. Demonstration and Presentation- A model designed and implemented (or results derived or proved in case of theory) should be convincingly presented to showcase its Strengths and weakness aspects. A demonstration to this end where applicable or a presentation in case of theoretical contributions should clearly describe the work. The purpose is to measure the techniques and methods used and appreciate the results in the larger context of their applicability in science and engineering.

Each student carries out the mini-project separately. Evaluation will be done based on seminars, period presentations in the panel, written reports, and a developed system.

DEPARTMENT OF INFO. TECH. Board of Studies Year 2021-22 GCE KARAD

| The mini-project should be executed/deployed in the Google Co-Lab environment | |
|---|---|
| **List of Submission:** | |
| **1.** | Working model of the software project |
| **2.** | Project Report |
| **3.** | Presentation and demonstration of the project |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 1 |
| CO 2 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 |
| CO 3 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2 |
| CO 4 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | SA |
|---|---|
| Remember | 5 |
| Understand | 5 |
| Apply | 10 |
| Analyse | 10 |
| Evaluate | 10 |
| Create | 10 |
| TOTAL | 50 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| **Minor degree course (Artificial Intelligence and Machine Learning)** | | | | |
| **ITm-3601: Artificial Intelligence & Machine Learning** | | | | |
| **Teaching Scheme** | | **Examination Scheme** | | |
| **Lectures** | 3Hrs/week | **Exam** | **Dur.** | **Marks** |
| **Tutorial** | -- | **FA-I** | **30 min** | 10 |
| **Total Credits** | **3** | **FA-II** | **30 min** | 10 |
| **Subject Code** | ITm-3602 | **SA** | **60 min** | 30 |

**Course Outcome (CO):** On completion of the course, the learner will be able to –

| | |
|---|---|
| CO1 | Interpret the fundamental issues and challenges of machine learning regarding data, model selection, model complexity etc. |
| CO2 | Analyse real-world problems in Data Mining and Big Data Analytics, Information Retrieval, Computer vision, Linguistics and Bioinformatics. |
| CO3 | Apply AI concepts to solve real-world problems. |
| CO4 | Estimate the learning model. |

**Course Contents**

| **Units** | | **Teaching Hours** |
|---|---|---|
| Unit I | **Introduction to Artificial Intelligence:** Introduction to AI, Intelligent agents, Concepts of Searching Strategies: uninformed search, Heuristic Search, Adversarial search. AIML language for programming AI, Application of searching in Gaming, Logical Agent, propositional logic and first order logic AI Applications in Machine learning. | 8 |
| Unit II | **Overview of Machine Learning and Classification Techniques:** What is Machine Learning, Examples of Machine Learning applications, Training versus Testing, Positive and Negative Class, Cross-validation. Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning, reinforcement learning. Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis. Binary and Multiclass Classification: ensemble methods, Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest Linear Models: Perceptron, Support Vector Machines (SVM), Soft Margin | 9 |

DEPARTMENT OF INFO. TECH. Board of Studies Year 2021-22 GCE KARAD

| | | |
|---|---|---|
| | SVM, Kernel methods for non-linearity, Random forest. | |
| Unit III | **Regression and Generalisation:** Regression: Assessing performance of Regression – Error measures, Overfitting and Underfitting, Catalysts for Overfitting, VC Dimensions Linear Models: Least Square method, Univariate Regression, Multivariate Linear Regression, Regularized Regression - Ridge Regression and Lasso Theory of Generalization: Bias and Variance Dilemma, Training and Testing Curves Case Study of Polynomial Curve Fitting | 8 |
| Unit IV | **Logic Based & Algebraic Models:** Distance Based Models: Neighbors and Examples, Nearest Neighbor Classification, Distance based clustering algorithms - K-means and K-medoids, Hierarchical clustering. Rule Based Models: Rule learning for subgroup discovery, Association rules mining – Apriori Algorithm, Confidence and Support parameters. Tree Based Models: Decision Trees, Minority Class, Impurity Measures – Gini Index and Entropy, Best Split. | 9 |

| **Textbooks:** | |
|---|---|
| 1 | Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall. |
| 2 | Ethem Alpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013. 2 |
| 3 | Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012. |
| 4 | Data Mining: Concepts and Techniques, 3rd Edition. Jiawei Han, Micheline Kamber, Jian Pei. |
| **References:** | |
| 1 | Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010 2. S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011 |
| 2 | Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill. |
| 3 | C. M. Bishop: Pattern Recognition and Machine Learning, Springer 1st Edition-2013. 2.. |
| 4 | Ian H Witten, Eibe Frank, Mark A Hall: Data Mining, Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition |

DEPARTMENT OF INFO. TECH.
Board of Studies
Year 2021-22
GCE KARAD

| | |
|---|---|
| 5 | Nikhil Buduma: Fundamentals of Deep Learning, O'Reilly Media, June 2017. |
| 6 | Kevin P Murphy: Machine Learning – A Probabilistic Perspective, MIT Press, August 2012 |
| **Useful Links:** | |
| 1 | **e-Books:**<br>• https://web.stanford.edu/~hastie/ElemStatLearn/<br>• http://www.springer.com/in/book/9780387310732<br>• http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/<br>• https://www.cs.cornell.edu/jeh/book.pdf |
| **MOOC/ Video Lectures available at:**<br>• https://nptel.ac.in/courses/106/106/106106139/<br>• https://nptel.ac.in/courses/106/106/106106202/<br>• https://nptel.ac.in/courses/106/106/106106198/<br>• https://nptel.ac.in/courses/106/105/106105152/<br>• https://nptel.ac.in/courses/106/106/106106213/<br>• https://www.coursera.org/learn/machine-learning | |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 2 |
| CO 2 | 3 | 2 | 3 | 3 | 1 | - | - | - | - | - | - | 2 | 1 | 3 |
| CO 3 | 2 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 2 |
| CO 4 | 1 | 2 | 2 | 2 | 3 | - | - | - | - | - | - | 2 | 2 | 2 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | FA 1 | FA 2 | SA |
|---|---|---|---|
| Remember | 2 | 2 | 6 |
| Understand | 2 | 2 | 6 |
| Apply | 2 | 2 | 6 |
| Analyse | 2 | 2 | 6 |
| Evaluate | 2 | 2 | 6 |
| Create | - | - | - |
| TOTAL | 10 | 10 | 30 |

DEPARTMENT OF INFO. TECH. Board of Studies Year 2021-22 GCE KARAD

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| Minor degree course (Artificial Intelligence and Machine Learning) | | | | |
| ITm-3602: Competency Lab-II | | | | |
| **Laboratory Scheme:** | | | **Examination Scheme:** | |
| **Practical** | 2 Hrs/week | | **SA** | **50** |
| **Total Credits** | 1 | | | |
| | | | | |

| **Course Outcomes:** | |
|---|---|
| **Students will be able to:** | |
| 1 | Apply knowledge of science and engineering in Machine Learning practice. |
| 2 | Identify, analyse, formulate, and solve critical problems with proper knowledge in the area of specialisation. |
| 3 | Implement the AI & Machine learning by research and innovation to solve real problems. |
| 4 | Construct advised experiments, interpret data, and provide well-informed conclusions. |

| **Course Contents** | |
|---|---|
| **Experiment 1** | Design & Implement a program for Breadth-First Search Traversal & Depth First Traversal |
| **Experiment 2** | Design & Implement a program for Simple Chatbot. |
| **Experiment 3** | Design & Implement a program to derive meaningful information from natural language text. |
| **Experiment 4** | Design & Implement a program for a-priori algorithm for a given dataset |
| **Experiment 5** | Design & Implement a program for Decision Tree Classifier: Implement a program for Decision Tree Classifier: **To predict the cost of the construction project (Civil)** |
| **Experiment 6** | Design & Implement a program for Linear Regression for the given input. |
| **Experiment 7** | Design & Implement a program to derive meaningful information from natural language text. |
| **Experiment 8** | Design & Implement a program for k-NN Classification: Implement a program for k-NN Classification: **Classification of construction material whether is sustainable or conventional (Civil)** |
| **Experiment 9** | Design & Implement a program for K-Means Clustering: **Applying cluster analysis to construction contractor classification (Civil)** |
| **Experiment 10** | Develop Applications in Python for Bigmart Sales Analysis |
| **Experiment 11** | Develop Applications in Python Twitter Data Analysis |
| **Experiment 12** | Design & Implement Road Trip analysis using Machine Learning with the help of Python |
| **Experiment 13** | Implement Response Surface Method (Regression Analysis) for prediction of the MRR (Material Removal Rate), Surface Roughness of machined component using Electric Discharge Machining. Use python of MATLAB toolbox for analysis |

| | |
|---|---|
| **Experiment 14** | Implement ANN for prediction of the MRR (Material Removal Rate), Surface Roughness of machined component using Electric-Discharge Machining. Use python of MATLAB toolbox for analysis |
| **Experiment 15** | PID control techniques to solve the temperature control problem and to demonstrate the problem that PID controllers have with large disturbances using a neural network control strategy. |
| | |
| **List of Submission:** | |
| 1. | Total number of Experiments : 10 |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | 2 |
| CO 2 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | 1 | 3 | 2 |
| CO 3 | 1 | 2 | 3 | 3 | 2 | - | - | - | - | - | - | 1 | 1 | 2 |
| CO 4 | 2 | 1 | 3 | 3 | 2 | - | - | - | - | - | - | 1 | 3 | 2 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | SA |
|---|---|
| Remember | 5 |
| Understand | 5 |
| Apply | 10 |
| Analyse | 10 |
| Evaluate | 10 |
| Create | 10 |
| TOTAL | 50 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| **Minor degree course (Artificial Intelligence and Machine Learning)** | | | | |
| **ITm-3603: Professional Training & Mini- Project-II** | | | | |
| **Laboratory Scheme:** | | | **Examination Scheme:** | |
| Practical | 2Hrs/week | | SA | 50 |
| Total Credits | **01** | | | |
| | | | | |

| **Course Outcomes:** | |
|---|---|
| **Students will be able to:** | |
| **1** | Demonstrate a sound technical knowledge of their selected project topic. |
| **2** | Undertake problem identification, formulation and solution. |
| **3** | Demonstrate the knowledge, skills and attitudes of a professional engineer. |
| **4** | Communicate with engineers and the community at large in written an oral forms. |

**Course Contents**

The specific objectives of the course could depend on the problem definition for the project, but the overall performance must be measured on the following criteria. As per the recommendation of industry experts opinion and industry trends, professional training for tools and technology should be delivered, assessed and evaluated as per examination scheme in the curriculum structure.

1. Literature survey and Problem statement- Student should be able to define the problem statement with clearly specified inputs and outputs. Goals for complex problems could evolve over time but it is necessary to have one in the beginning. A brief survey of the available literature and an initial draft of possible directions should be adequate.

2. Modeling or Theoretical results- An appropriate model should be chosen for the problem. They should be able to reason the pros and cons of various models and choose a suitable one. It is important that they be in a position to defend their choices. The model should also involve the criteria by which they will quantify and test its performance. In case of theoretical work, one should be able to describe the underlying mathematical basis of such problems in the literature.

3. Engineering or Mathematical tools- Numerous available methods could be put to use in implementing and testing the described model. They should demonstrate the ability to learn and put various methods to use.

4. Demonstration and Presentation- A model designed and implemented (or results derived or proved in case of theory) should be convincingly presented to showcase its Strengths and weakness aspects. A demonstration to this end where applicable or a presentation in case of theoretical contributions should clearly describe the work. The purpose is to measure understanding of the techniques and methods used and to appreciate the results in the larger context of their applicability in science and engineering.

Each student carry out the mini project separately. Evaluation will be done based on seminars, period presentations in presence of panel, written reports and developed system.

DEPARTMENT OF INFO. TECH. Board of Studies Year 2021-22 GCE KARAD

| The mini-project should be executed / deployed in Google Co-Lab environment | |
|---|---|
| **List of Submission:** | |
| **1.** | Working model of the software project |
| **2.** | Project Report |
| **3.** | Presentation and demonstration of project |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 1 |
| CO 2 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 |
| CO 3 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2 |
| CO 4 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | SA |
|---|---|
| Remember | 5 |
| Understand | 5 |
| Apply | 10 |
| Analyse | 10 |
| Evaluate | 10 |
| Create | 10 |
| TOTAL | 50 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| Minor degree course (Artificial Intelligence and Machine Learning) | | | | |
| ITm-4701: Deep Learning Techniques and Tools | | | | |
| **Teaching Scheme** | | **Examination Scheme** | | |
| **Lectures** | 3Hrs/week | **Exam** | **Dur.** | **Marks** |
| **Tutorial** | -- | **FA-I** | **30 min** | 10 |
| **Total Credits** | **3** | **FA-II** | **30 min** | 10 |
| **Subject Code** | ITm-4701 | **SA** | **60 min** | 30 |
| | | | | |

**Course Outcome (CO):** On completion of the course, learner will be able to –

| | |
|---|---|
| 1 | Interpret the principal techniques in deep learning and the main research in this field. |
| 2 | Relate the principal techniques in deep learning for NLP applications. |
| 3 | Design and implement deep neural network systems. |
| 4 | Identify new application requirements in the field of computer vision. |

**Course Contents:**

| **Units** | | **Teaching Hours** |
|---|---|---|
| Unit I | **Introduction:** Building intelligent machines, Feedforward Neural networks, Gradient descent and the backpropagation algorithm, Unit saturation, aka the vanishing radiant problem, and ways to mitigate it, ReLU Heuristics for avoiding bad local minima, Heuristics for faster training, Nesters accelerated gradient descent, Regularisation, Dropout. | 8 |
| Unit II | **Deep Learning Methods:** Convolution and pooling layers, Deep Learning Architectures VGG net, DenseNet, Xception net, ResNet, LeNet, GoogLeNet, Inception net, LSTM, GRU, Encoder Decoder architectures, Autoencoders (standard, sparse, denoising, contractive, etc.), Variational Autoencoders, Adversarial Generative Networks, Autoencoder and DBM. | 9 |
| Unit III | **Applications of Deep Learning:** Computer Vision: ANN, Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models. Attention models for computer vision tasks. facial recognition software, image classification, speech recognition | 9 |

DEPARTMENT OF INFO. TECH.
Board of Studies
Year 2021-22
GCE KARAD

| | | |
|---|---|---|
| | programs using CNN, Prediction problems Language, Call Center Analysis, Face detection, OCR Applications as Image Recognition using RNN | |
| Unit IV | **Applications of Deep Learning to NLP:** Parsing and Sentiment Analysis using Recursive Neural Networks, Sentence Classification using Convolutional Neural Networks, Modelling and Generating Text, Text Summarisation using RNN, Dialogue Generation with LSTMs, Applications of Dynamic Memory Networks in NLP. | 8 |

**Textbooks:**


| | |
|---|---|
| 1 | Nicholas Locascio and Nikhil Buduma. "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly. 2017 |
| 2 | François Chollet. "Deep Learning with Python", Manning Publication. 2017. |
| 3 | Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1 (2009): 1127. |
| 4 | Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015). |


**References:**


| | |
|---|---|
| 1 | Hochreiter, Sepp, and Jargen Schmidhuber. "Long short-term memory." Neural computation 9.8 (1997): 17351780. |
| 2 | Cole Howard, Hannes Hapke, and Hobson Lane. "Natural Language Processing in Action", Manning publication. 2019. |
| 3 | Edward Loper, Ewan Klein, and Steven Bird. "Natural Language Processing with Python", O'Reilly. 2009. |
| 4 | Collobert, Ronan, et al. "Natural language processing (almost) from scratch." Journal of Machine Learning Research 12.Aug (2011): 2493-2537. |
| 5 | Kim, Yoon. "Convolutional neural networks for sentence classification." EMNLP (2014). |
| 6 | Kumar, Ankit, et al. "Ask me anything: Dynamic memory networks for natural language processing." arXiv preprint arXiv: 1506.07285 (2015). |
| 7 | Socher, Richard, et al. "Parsing with Compositional Vector Grammars." ACL. 2013. |
| 8 | Abadi, Martın, et al. "Tensorflow: Large-scale machine learning on heterogeneous distributed systems." arXiv preprint arXiv: 1603.04467 (2016). |



DEPARTMENT OF INFO. TECH. Board of Studies Year 2021-22 GCE KARAD

| Useful Links: | |
|---|---|
| 1 | NPTEL :: Computer Science and Engineering - NOC:Deep Learning- Part 1 |
| 2 | NOC \| Deep Learning for Computer Vision (nptel.ac.in) |
| 3 | Deep Learning - Course (nptel.ac.in) |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 2 | 3 | 1 | - | - | - | - | - | - | 1 | 2 | 3 |
| CO 2 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 2 |
| CO 3 | 2 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | 1 | 2 | 2 |
| CO 4 | 2 | 2 | 2 | 1 | 3 | - | - | - | - | - | - | 1 | 2 | 2 |

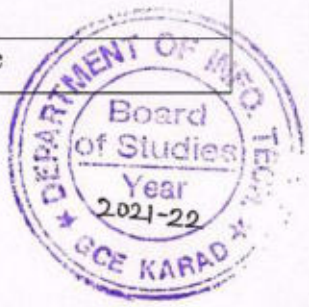
**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | FA 1 | FA 2 | SA |
|---|---|---|---|
| Remember | 2 | 2 | 6 |
| Understand | 2 | 2 | 6 |
| Apply | 2 | 2 | 6 |
| Analyse | 2 | 2 | 6 |
| Evaluate | 2 | 2 | 6 |
| Create | - | - | - |
| TOTAL | 10 | 10 | 30 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| Minor degree course (Artificial Intelligence and Machine Learning) | | | | |
| ITm-4702: Competency Lab-III | | | | |
| **Laboratory Scheme:** | | | **Examination Scheme:** | |
| **Practical** | 2 Hrs/week | | **SA** | **50** |
| **Total Credits** | 1 | | | |
| | | | | |

| **Course Outcomes:** | |
|---|---|
| **Students will be able to:** | |
| 1 | Classify various libraries required in Deep Learning |
| 2 | Implement unsupervised learning methods for Deep Learning Applications. |
| 3 | Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains. |
| 4 | Apply various CNN Models for real time applications. |

| **Course Contents** | |
|---|---|
| **Experiment 1** | Basics of any one tool for deep learning (Eg. Tensorflow, Keras, Pytorch etc.,) |
| **Experiment 2** | Implementation of 3-to-4 layer neural network. |
| **Experiment 3** | Design and implement deep learning for image classification. |
| **Experiment 4** | Design and implement deep learning for object localisation. |
| **Experiment 5** | Design and implement deep learning for Face recognition. |
| **Experiment 6** | Design and implement transfer learning using any one pre trained deep learning model for classification. |
| **Experiment 7** | Design and implement deep learning for language modeling. |
| **Experiment 8** | Design and implement deep learning for document classification |
| **Experiment 9** | Create a perceptron with appropriate no. of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights. |
| **Experiment 10** | To predict the ultimate shear strength of reinforced concrete deep beam using ANN. |
| **Experiment 11** | To predict the compressive strength and corresponding strain of circular concrete columns |
| **Experiment 12** | To predict settlement of shallow foundations on cohesion-less soils |
| **Experiment 13** | To evaluate the effective design parameters and earthquake performance of the RC buildings using neural networks. |
| **Experiment 14** | To Apply ANN for improved maintenance of transportation infrastructure |



| | |
|---|---|
| **Experiment 15** | To predict the safe work behaviour of construction employees |
| **Experiment 16** | Development of Automobile Fault Diagnosis (Battery failure, Low Fuel, Low Oil Condition etc.) system using python |
| **Experiment 17** | Implement ANN for prediction of failure of gear tooth and its profile using python coding |
| **List of Submission:** | |
| 1. | Total number of Experiments : 10 |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | - | 1 | 2 | 3 | - | - | - | - | - | - | 1 | 2 | 2 |
| CO 2 | - | 3 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | - | - | 1 | 3 | 2 |
| CO 3 | - | 2 | 2 | 2 | 3 | - | - | - | - | - | - | 1 | 2 | 2 |
| CO 4 | - | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | - | - | 1 | 2 | 2 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | SA |
|---|---|
| Remember | 5 |
| Understand | 5 |
| Apply | 10 |
| Analyse | 10 |
| Evaluate | 10 |
| Create | 10 |
| TOTAL | 50 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| **Minor degree course (Artificial Intelligence and Machine Learning)** | | | | |
| **ITm-4703: Professional Training & Mini- Project-III** | | | | |
| **Laboratory Scheme:** | | | **Examination Scheme:** | |
| Practical | 2 Hrs/week | | SA | 50 |
| Total Credits | **01** | | | |
| | | | | |

**Course Outcomes:**

**Students will be able to:**

| | |
|---|---|
| **1** | Extend a sound technical knowledge of their selected project topic. |
| **2** | Undertake problem identification, formulation and solution. |
| **3** | Demonstrate the knowledge, skills and attitudes of a professional engineer. |
| **4** | Communicate with engineers and the community at large in written an oral forms. |

**Course Contents**

The specific objectives of the course could depend on the problem definition for the project, but the overall performance must be measured on the following criteria. As per the recommendation of industry experts opinion and industry trends, professional training for tools and technology should be delivered, assessed and evaluated as per examination scheme in the curriculum structure.

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DEPARTMENT OF INFO. TECH. Board of Studies Year 2021-22 GCE KARAD

| The mini-project should be executed/ deployed in Google Co-Lab environment | |
|---|---|
| **List of Submission:** | |
| **1.** | Working model of the software project |
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**Mapping of COs and POs**

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 1 |
| CO 2 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 |
| CO 3 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2 |
| CO 4 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | SA |
|---|---|
| Remember | 5 |
| Understand | 5 |
| Apply | 10 |
| Analyse | 10 |
| Evaluate | 10 |
| Create | 10 |
| TOTAL | 50 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| **Minor degree course (Artificial Intelligence and Machine Learning)** | | | | |
| **ITm-4801: Major Capstone Project (Design & Development)** | | | | |
| **Laboratory Scheme:** | | | **Examination Scheme:** | |
| Practical | 10 Hrs/week | | PBE-I | 75 |
| Total Credits | **5** | | PBE-II | 75 |
| | | | | |

| **Course Outcomes:** | |
|---|---|
| **Students will be able to:** | |
| **1** | Define and analyse the problem. |
| **2** | Design, develop and implement a group project. |
| **3** | Apply presentation and communication skills. |
| **4** | Enhance the knowledge of writing a project report and technical paper. |

**Course Contents**

**Guidelines:**

• Select a Engineering topic or problem statement relevant to the AI and ML minor degree programme.

• For selection of topic refer Scopus/ SCI Index Journals from reputed publishers such as IEEE transaction, Springer, Elsevier, innovative ideas and societal use application.

• The project will be undertaken individually and implement the project. The individual will select a project with approval from a committee formed by the department of senior faculty to check the feasibility and approve the topic.

• The project work can be undertaken in own organisation/company/any reputed R&D Lab.

• Student must consult project guide in selection of topic.

• Projects should have preferably industrial exposure, societal use application and research oriented.

• Student should report weekly to the project guide and logbook of activities should be maintained for continuous assessment of the project work. The logbook should be used for PBE evaluation.

The Capstone-project should be executed / deployed in Google Co-Lab environment

**Project Report Format:**

Project report should be of 40 to 60 pages (typed on A4 size sheets). For standardisation of the project reports the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch

6. Para Text: Times New Roman 12 Point Font

7. Line Spacing: 1.5 Lines

8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman

9. Headings: Times New Roman, 14 Point Bold Face

10. Certificate: All students should attach standard format of certificate as described by the department. Certificate should be awarded to group and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/ Director.

11. Index of Report:

a. Title Sheet

b. certificate

c. Acknowledgement

d. Table of Contents

e. List of Figures

f. List of Tables

12. References: References should have the following format.

For Books: "Title of Book", Authors, Publisher, Edition

For Papers: "Title of Paper", Authors, Journal/Conference Details, Year

**II. Assessment Guideline:**

• Project work should be continually evaluated based on the contribution of the student, originality of the work, innovations brought in, research and developmental efforts, depth and applicability, convincing of the problem statement and so on would be considered.

• There shall be at least two reviews for PBE-I in semester by the review committee constituted at department level by the programme head which includes presentations and demonstration of the work carried out by the students.

• PBE-II examination should be conducted by the panel of internal examiner and external examiners from reputed institute or industry.

• The final certification and acceptance of work ensures the satisfactory performance on the above aspects.

**List of Submission:**

| | |
|---|---|
| **1.** | Working model of the software project |
| **2.** | Project Report |
| **3.** | Presentation and demonstration of project |

DEPARTMENT OF INFO. TECH.
Board of Studies
Year 2021-22
GCE KARAD

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 2 |
| CO 2 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 |
| CO 3 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 1 |
| CO 4 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | PBE 1 | PBE 2 |
|---|---|---|
| Remember | 10 | 10 |
| Understand | 15 | 15 |
| Apply | 15 | 15 |
| Analyse | 10 | 10 |
| Evaluate | 10 | 10 |
| Create | 15 | 15 |
| TOTAL | 75 | 75 |

**Chairman, Board Of Studies**

Minor-Degree Certification Course in AI & ML