Walchand College of Engineering

(Government aided autonomous institute)

Vishrambag, Sangli. 416415

Credit System for Minor Certification

in

Artificial Intelligence and Machine Learning

(2019-2022)

Offered by

Department of Information Technology

Credit System for Minor Certification in Artificial Intelligence and Machine Learning

offered by Department of Information Technology (AY 2019-22)

Sr.No.	Year	Sem	Course Code	Course Name	L	T	P	Hrs	Credits	ISE-1/ T1/ LA1	MSE	ISE-2/ T2/ LA2	ESE
1	SY B.Tech	I	1ITM01	Fundamentals of Artificial Intelligence	3	-	-	2+1*	3	10	30	10	50
2		II	1ITM02	Introduction to Machine Learning	3	-	-	2+1*	3	10	30	10	50
3	TY B.Tech	I	1ITM03	Data Science for Engineers	3	-	-	2+1*	3	10	30	10	50
4		II	1ITM04	Machine Learning in Practice	3	-	-	2+1*	3	10	30	10	50
5	Final Year B.Tech	I	1VA0017	Fundamentals of Deep Learning	2	-	-	2	2	20	-	20	60
6		I	1VA0023	Advanced Deep Learning	2	-		2	2	20	-	20	60
7		II	1VA0024	Project on AIML Phase I	-	-	4	4	2	30	-	30	40
8		II	1VA0025	Project on AIML Phase II	-	-	4	4	2	30	-	30	40
Total					16	-	8	24	20				

(**Note:** '*' indicates Flipped classroom)

HoD

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Credit System for Minor Certification in Artificial Intelligence and Machine Learning

offered by Department of Information Technology (AY 2019-22)

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*						
2019-22						
Course Information						
Programme	Minor Certification in AIML					
Class, Semester	Second Year B. Tech., Sem I					
Course Code	1ITM01					
Course Name	Fundamentals of Artificial Intelligence					
Desired Requisites:	Foundation in Mathematics					
Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	2+1 (Flipped) Hrs/week	**ISE1**	**MSE**	**ISE2**	**ESE**	**Total**
Tutorial	-	10	30	10	50	100
Practical	-					
Interaction	-	**Credits: 3**				

Course Objectives	
1	To get acquaint with concepts in Artificial Intelligence (AI)
2	To apprehend the recent trends in AI
3	To recognize applications of AI

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	To recognize the problem-solving techniques in Artificial Intelligence	Understand
CO2	To apprehend the recent trends in AI	Apply
CO3	To recognize applications of AI	Evaluate

Module	Module Contents	Hours
I	**Introduction and Searching in AI** AI: History, Trends and Future, Turing Machine Test, Application of AI, Characteristics of AI problems	4
II	**Uninformed search techniques** Problem Solving techniques, state space representation, Uninformed search techniques, DFS, BFS, Iterative deepening search, bi-directional search techniques	4
III	**Informed Search Technique** Heuristic search techniques, Hill climbing techniques, Best First search, A* algorithm, constraints satisfaction, Means-Ends analysis	5
IV	**Knowledge Representation** Propositional and predicate knowledge, Unification algorithm, Resolution in predicate logic, forward and backward chaining and conflict resolution	4
V	**Structured Knowledge Representation** Semantic nets, frames, conceptual dependency, scripts, probabilistic and uncertainty knowledge, representations, certainty factors	4
VI	**Planning** Introduction, planning as problem-solving, STRIPS, forward and backward planning, non-linear planning	5

	Text Books
1	S. Janakiraman, K Sarukesi, P Gopalakrishnan, "Foundations of Artificial Intelligence and Expert Systems Approach", 3rd Edition, Prentice Hall
2	Saroj Kaushik, "Artificial Intelligence"

	References
1	Prof. Shyamanta, M Hazarika, IIT Guwahati, "Fundamentals of Artificial Intelligence" course on NPTEL/ SWAYAM (for flipped classroom)

	Useful Links
1	https://www.coursera.org/learn/ai-for-everyone
2	https://www.udemy.com/topic/artificial-intelligence/
3	https://ai.google/education/social-good-guide/

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Course Information

Programme	Minor Certification in AIML
Class, Semester	Second Year B. Tech., Sem II
Course Code	1ITM02
Course Name	Introduction to Machine Learning
Desired Requisites:	Foundation in Mathematics and Statistics

Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	2+1 (Flipped) Hrs/week	**ISE1**	**MSE**	**ISE2**	**ESE**	**Total**
Tutorial	-	10	30	10	50	100
Practical	-					
Interaction	-	**Credits: 3**				

Course Objectives

1	To get acquaint with concepts in Machine Learning
2	To apprehend the recent trends in Machine Learning
3	To make able to understand applications of Machine Learning

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	To realize the problem-solving techniques in Machine Learning	Understand
CO2	To apply the recent trends in Machine Learning	Apply
CO3	To make able to understand applications of Machine Learning	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction and Regression Analysis:** Machine Learning concepts, Supervised learning, Unsupervised learning, linear regression in one variable, cost function, gradient descent, linear regression with multiple variables: gradient descent	4

II	**Logistic Regression:** Classification, hypothesis representation, decision boundary, cost function, simplified cost function and gradient descent, optimization, one v/s all	4
III	**Neural Networks:** MP Neuron, Simple perceptron, non-linear hypothesis, representation, multi-class classification, one v/s all **Neural Networks Learning:** Back propagation, multilayer feed forward neural network	5
IV	**Support Vector Machines:** Optimization objective, mathematics behind large margin classification, kernels using as SVM	4
V	**Learning Theory:** Regularization, bias/ Variance trade-off, error analysis, ensemble methods, practical advice on how to use learning algorithms, precision/recall trade-off	4
VI	**Unsupervised Learning:** Clustering, k-means, EM, principal component analysis, outliers detection	5

Text Books	
1	Tom Mitchell, "Machine Learning", McGrawHill, 1997
2	Aurelien Gern, "Hands-on Machine Learning with Scikit Learn & Tensorflow", O'Reilly

References	
1	Andrew N G, "Coursera: Machine Learning"
2	http://www.stanford.edu/class/cs229/materials.html

Useful Links	
1	https://www.coursera.org/learn/machine-learning
2	https://www.udemy.com/topic/machine-learning/
3	https://developers.google.com/machine-learning/guides

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Course Information

Programme	Minor Certification in AIML
Class, Semester	Third Year B. Tech., Sem I
Course Code	1ITM03
Course Name	Data Science for Engineers
Desired Requisites:	Foundation in Mathematics, Introduction to Machine Learning

Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	2+1 (Flipped) Hrs/week	**ISE1**	**MSE**	**ISE2**	**ESE**	**Total**
Tutorial	-	10	30	10	50	100
Practical	-					
Interaction	-	**Credits: 3**				

Course Objectives

1	To get acquaint with concepts in Machine Learning (ML)
2	To apprehend the recent trends in Data Science
3	To make able to understand the applications in Data Science

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

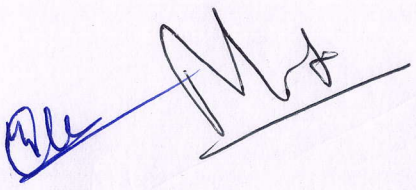
CO1	To understand the mathematical foundations required for data science	Understand
CO2	To apply the first level data science algorithms	Apply
CO3	To evaluate data science problem solving algorithms and frameworks with a practical case study	Evaluate

Module	Module Contents	Hours
I	**Basics of Python** Tools required for Data Science, Introduction to Spyder, setting working directory, creating and saving a script file, file execution, clearing console, removing variables from environment, clearing environment, commenting script files, variable creation, arithmetic and logical operations, data types	4
II	**Data types, Control structures and Libraries** Strings, lists, arrays, tuples, dictionary, sets, range, Reading files, exploratory data analysis, data preparation and preprocessing, If-else family, for loop, for loop with if break, while loop and functions, Numpy, Pandas	4
III	**Data Visualization using Matplotlib and Seaborn libraries** Scatter plot, line plot, bar plot, histogram, box plot, pie chart, pair plot	5
IV	**Unsupervised Learning** Why data reduction?, key idea behind PCA, linear algebra behind PCA, PCA in practice, clustering algorithm in practice, case study of k-means algorithm	4
V	**Interactive Python dashboards with Plotly and Dash** Plotly Basic – scatter plot, bar plot, bubble plot, box plot, histograms, heat maps, dashboard components, interactive components in dashboard	4
VI	**Case Study** Regression and Classification (Use of any case study using a dataset) Regression Datasets - Crime_in_India, Salary_Classification, Income_Data, Classification Datasets - Shopping_Mall, Social_Network_Ads	5

	Text Books
1	Introduction to linear algebra - by Gilbert Strang
2	Applied statistics and probability for engineers – by Douglas Montgomery
3	Mastering Python for data science, Samir Madhavan

	References
1	Scikit-Learn User Guide, Release 0.23.1, scikit-learn developers, May 19, 2020
2	Python 3.x Documentation

	Useful Links
1	https://docs.python.org/3/tutorial/introduction.htm



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Course Information

Programme	Minor Certification in AIML
Class, Semester	Third Year B. Tech., Sem II
Course Code	1ITM04
Course Name	Machine Learning in Practise
Desired Requisites:	Introduction to Machine Learning, Data Science for Engineers

Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	2+1 (Flipped) Hrs/week	**ISE1**	**MSE**	**ISE2**	**ESE**	**Total**
Tutorial	-	10	30	10	50	100
Practical	-					
Interaction	-	**Credits: 3**				

Course Objectives

1	To inculcate the paradigm shift technique, Machine Learning into students
2	To discuss the applications of different Machine Learning technology
3	To present the research scope of Machine Learning

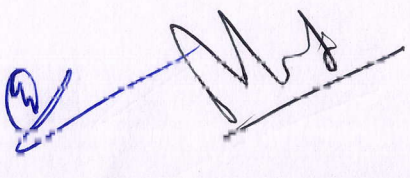
Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Comprehend the usage of Scikit-Learn and Tensorflow towards Machine Learning projects	Understand
CO2	Apply the conceptual understanding of Machine Learning algorithm on real world problems	Apply
CO3	Evaluate the performance of Scikit-Learn and Tensorflow for Machine Learning algorithms	Evaluate

Module	Module Contents	Hours
I	**Introduction and Scikit-Learn** Introduction to Scikit-Learn, statistical learning for scientific data processing, working with Text Data, choosing the right estimator, Estimator basics: fitting and predicting, model evaluation, Scikit-Learn API reference	4
II	**How to use Tensorflow** Why to use Tensorflow?, Introduction to Tensorflow, installing tensorflow, overview of Tensorflow, using libraries in Tensorflow	4
III	**Regression using Scikit-Learn** Using Scikit-Learn for regression problems, using scikit-learn for logistic regression, applying regularization concepts using Scikit-Learn on real-world data	5
IV	**KNN, Decision Trees, Random Forest using Scikit-Learn** Applying KNN, Decision Trees, Random Forest algorithm on real world dataset using Scikit-Learn API	4
V	**Support Vector Machine, Clustering (Unsupervised Learning) using Scikit-Learn** Testing Support Vector Machine, k-means algorithm on real world dataset, using Scikit-Learn	4
VI	**Neural Network using Tensorflow** Exploring the Tensorflow for Artificial Neural Networks on real world dataset	5

	Text Books
1	Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and Tensorflow concepts, Tools and Techniques to build intelligent systems", O'Reilly, First Edition, 2017
2	Guillerno Moncecchi, Raul Garreta, "Learning Scikit-Learn: Machine Learning in Python", Packt Publishing Ltd. First Edition, 2013
3	Bharath Ramsundar, Reza Bosagh Zadeh, "Tensorflow for Deep Learning: From Linear Regression to Reinforcement Learning", O'Reilly, First Edition, 2018
	References
1	Scikit-Learn User Guide, Release 0.23.1, scikit-learn developers, 2020
2	https://www.tensorflow.org/guide
	Useful Links
1	https://developers.google.com/machine-learning/crash-course
2	https://www.tensorflow.org/resources/learn-ml
3	https://www.coursera.org/projects/getting-started-tensorflow-2



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Course Information

Programme	Minor Certification in AIML
Class, Semester	Final Year B. Tech., Sem I
Course Code	1VA0017
Course Name	Fundamentals of Deep Learning
Desired Requisites:	Familiarity with basic knowledge of mathematics. **(It would be beneficial if the participants have done a course on Introduction to Machine Learning)**

Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	2	**T1**	**MSE**	**T2**	**ESE**	**Total**
Tutorial	-	20	–	20	60	100
Practical	-					
Interaction	-	**Credits: 2**				

Course Objectives

1	To introduce the paradigm shift technique, deep learning to the students.
2	To elaborate the deep learning methods in real world applications
3	To explain deep learning concepts

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Understand the basics of Deep Learning and optimization techniques in deep learning.	Understand
CO2	Apply the regularization techniques in deep learning and Measure strengths and weaknesses of various deep learning approaches.	Apply
CO3	Evaluate Principal Component Analysis(PCA) and its interpretations, Singular Value Decomposition, Auto encoders and relation to PCA.	Evaluate

Module	Module Contents	Hours
I	**Fundamentals of Neural Networks:** McCulloch Pitts Neuron, Thresholding, Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks. Backpropagation algorithm.	5
II	**Optimizations in Gradient Descent:** Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Bias correction in Adam	4
III	**Regularization:** Regularization: Bias Variance Trade off, L2 regularization, Early stopping, Data-set augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.	4
IV	**Principal Component Analysis:** Eigenvalues and eigenvectors, Basis, Principal Component Analysis and its interpretations, Singular Value Decomposition,	4
V	**Autoencoders and relation to PCA:** Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders	4
VI	**Greedy Layer Wise Pre-training:** Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.	5

	Text Books
1	Ian GoodFellow, Yoshua Bengio and Aaron Courville ``Deep Learning". The MIT Press Cambridge, Massachusetts London, England, 2017
2	Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and tensorflow", O'Reilly, Dec 2017

	References
1	Prof. Mitesh M. Khapra, "Deep Learning", course on NPTEL, July 2018
2	Andrew N G, "Deep Learning Specialization", Coursera online course

	Useful Links
1	https://www.coursera.org/specializations/deep-learning
2	https://www.udemy.com/topic/deep-learning/
3	https://online.stanford.edu/courses/cs230-deep-learning

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Course Information

Programme	Minor Certification in AIML
Class, Semester	Final Year B. Tech., Sem I
Course Code	1VA0023
Course Name	Advanced Deep Learning
Desired Requisites:	Course on Fundamentals of Deep Learning

Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	2	**T1**	**MSE**	**T2**	**ESE**	**Total**
Tutorial	-	20	–	20	60	100
Practical	-					
Interaction	-	**Credits: 2**				

Course Objectives

1	To introduce the advanced concepts in deep learning to the students.
2	To elaborate the deep learning methods in real world applications in Computer Vision & Natural Language Processing.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Understand the advanced concepts of Deep Learning and the advanced techniques in deep learning for real models.	Understand
CO2	Apply the techniques in deep learning with respect to CV & NLP and Measure strengths of advanced deep learning approaches.	Apply
CO3	Evaluate the Encoder-Decoder Models and get the basic understanding of Generative Adversarial Networks (GANs)	Evaluate

Module	Module Contents	Hours
I	**Convolutional Neural Networks:** Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, c, Deep Dream, Deep Art, Fooling Convolutional Neural Networks	5
II	**Recurrent Neural Networks:** Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs	4
III	**Deep Learning for Computer Vision:** Object Localization, Object Detection using Convolutional Implementation of Sliding Windows, Bounding Box Predictions, Intersection Over Union, Non-max Suppression, Anchor Boxes, YOLO Algorithm, and Region Proposal Networks.	4
IV	**Deep Learning for Natural Language Processing:** Vectorial Representation of words, Continues bag of word model, Skip gram model, BERT model, GPT models.	4
V	**Encoder Decoder Models:** Attention Mechanism, Attention over images. Study of Image Captioning Encoder Decoder Model, Study of Chat Bots etc.	4
VI	**Generative Adversarial Networks (GANs):** Generative Adversarial Networks (GANs)- Intuition, Architectures, Mathematics behind GANs, Some applications of GANs.	5

Text Books

1	Ian GoodFellow, Yoshua Bengio and Aaron Courville ``Deep Learning". The MIT Press Cambridge, Massachusetts London, England, 2017
2	Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and tensorflow", O'Reilly, Dec 2017

References

1	Prof. Mitesh M. Khapra, "Deep Learning", course on NPTEL, July 2018
2	Andrew N G, "Deep Learning Specialization", Coursera online course

Useful Links

1	https://www.coursera.org/specializations/deep-learning
2	https://www.udemy.com/topic/deep-learning/
3	https://online.stanford.edu/courses/cs230-deep-learning

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Course Information					
Programme	Minor Certification in AIML				
Class, Semester	Final Year B. Tech., Sem II				
Course Code	1VA0024				
Course Name	Project on AIML Phase I				
Desired Requisites:	Knowledge of AIML tools and techniques.				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	4 Hrs/Week				
Interaction	-	**Credits: 2**			
Course Objectives					
1	To introduce the concept of literature survey in AIML to the students.				
2	To elaborate the tools, techniques and methods in real world application of AIML				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	Understand the advances in the field of AIML	Understand			
CO2	Evaluate the advanced techniques in the field of AIML	Evaluate			
CO3	Evaluate the strength of advanced AIML approaches	Evaluate			
List of Experiments / Lab Activities					

List of Experiments:

Project is to be carried out in a group of maximum 4 to 5 students.
Each group will carry out a project by developing any application software based on the following areas.

1. Application can be based on any trending new technology.
2. Application can be extended to previous projects.
3. Project group should achieve all the proposed objectives of the problem statement.
4. The work should be completed in all aspects of design, implementation and testing and follow software engineering practices.
5. Project reports should be prepared and submitted in soft and hard form along with the code and other dependency documents. Preferable use online code repositories (github/bitbucket)
6. Project will be evaluated continuously by the guide/panel as per assessment plan.
7. Presentation and report should use standard templates provided by the department.

Project report (pre-defined template) should be prepared using Latex/Word and submitted along
with soft copy on CD/DVD (with code, PPT, PDF, Text report document & reference material) or
on an online repository.
Students should maintain a project log book containing weekly progress of the project.

Text Books	
1	Rajendra Kumbhar , "*How to Write Project Reports, Ph. D. Thesis and Research Articles*", Universal Prakashan, 2015
2	Marilyn Deegan, " *Academic Book of the Future Project Report*", A Report to the AHRC & the British Library, 2017
References	
1	https://www.youtube.com/watch?v=0oSDa2kf5I8 (report writing)
2	
Useful Links	
1	https://pats.cs.cf.ac.uk/wiki/lib/exe/fetch.php?media=project-report.pdf
2	http://users.iems.northwestern.edu/~hazen/Writing%20Project%20Reports%202004a.pdf
3	https://www.upgrad.com/blog/java-project-ideas-topics-for-beginners/
4	https://www.geeksforgeeks.org/computer-science-projects/

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
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Course Information					
Programme	Minor Certification in AIML				
Class, Semester	Final Year B. Tech., Sem II				
Course Code	1VA0025				
Course Name	Project on AIML Phase II				
Desired Requisites:	Knowledge of AIML tools and techniques				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	4 Hrs/Week				
Interaction	-	**Credits: 2**			
Course Objectives					
1	To introduce the standard practices for AIML projects to the students				
2	To elaborate the tools, techniques and methods in real world application of AIML				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	Deliver the complete project on AIML				Apply
CO2	Students will submit the report on the project done				Create
List of Experiments / Lab Activities					

List of Experiments:

Project is to be carried out in a group of maximum 4 to 5 students.
Each group will carry out a project by developing any application software based on the following areas.

1. Application can be based on any trending new technology.
2. Application can be extended to previous projects.
3. Project group should achieve all the proposed objectives of the problem statement.
4. The work should be completed in all aspects of design, implementation and testing and follow software engineering practices.
5. Project reports should be prepared and submitted in soft and hard form along with the code and other dependency documents. Preferable use online code repositories (github/bitbucket)
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Text Books	
1	Rajendra Kumbhar , "*How to Write Project Reports, Ph. D. Thesis and Research Articles*", Universal Prakashan, 2015
2	Marilyn Deegan, " *Academic Book of the Future Project Report*", A Report to the AHRC & the British Library, 2017
References	
1	https://www.youtube.com/watch?v=0oSDa2kf5I8 (report writing)
Useful Links	
1	https://pats.cs.cf.ac.uk/wiki/lib/exe/fetch.php?media=project-report.pdf
2	http://users.iems.northwestern.edu/~hazen/Writing%20Project%20Reports%202004a.pdf
3	https://www.upgrad.com/blog/java-project-ideas-topics-for-beginners/
4	https://www.geeksforgeeks.org/computer-science-projects/