WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(AN AUTONOMOUS INSTITUTE)

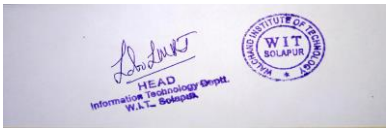
Affiliated to
Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Information Technology

CHOICE BASED CREDIT SYSTEM (CBCS)

Structure and Syllabus
for
Honors Degree in
Artificial Intelligence and Machine Learning

T.Y. B. Tech. Information Technology W.E.F. 2024-25



Information Technology Department

Department Vision

To be a frontier in Information Technology, to produce globally competent engineers with an aptitude for leadership and research, who will be instrumental in continuous socio-economic development.

Department Mission

M1: To impart quality education in Information Technology in accordance with the needs of the society through blended mode.

M2: To inculcate critical thinking and creativity for identifying various issues and to provide sustainable solutions by becoming a lifelong learner.

M3: To enhance career opportunities through academia-industry interaction and research, while embodying professional ethics.

Information Technology
Under Graduate Program
Program Educational Objectives (PEOs)

1. Graduates will exhibit strong fundamental knowledge and skills in the field of Information Technology to pursue successful professional careers , higher studies and research.
2. Graduates will exhibit capabilities to understand and resolve the various issues through their problem solving skills.
3. Graduates will be sensitive to ethical, societal and environmental issues while serving at their professional work and society.

Program Outcomes (POs)

The program outcomes of B. Tech. Information Technology Program are summarized as following:

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities, relevant to the professional engineering practice.

7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. Students will be able to apply fundamentals of mathematics, algorithms and computational systems to Information technology.

2. Students will be able to provide a solution to the problem in the areas of Networking, Database management, System Software, Web Technology, Information Security and Thrust areas.

3. Students will be able to design and develop IT solution for societal problem/s while encouraging usage of Free and Open Source Software (FOSS)

Legends used–

L	Lecture Hours / week
T	Tutorial Hours / week
P	Practical Hours / week
FA	Formative Assessment
SA	Summative Assessment
ESE	End Semester Examination
ISE	In Semester Evaluation
ICA	Internal Continuous Assessment
POE	Practical and Oral Exam
OE	Oral Exam
F.Y.	First Year
S.Y.	Second Year
T.Y.	Third Year
B. Tech.	Bachelor of Technology

Course Code Format for Honors:

2	1	I	T	U/P	2	H	A	1	T/L
Year of Syllabus revision		Program Code		U-Under Graduate, P-Post Graduate	Semester No. / Year 1/2/3/…8	Honors Code		Course Serial No. 1-9	T-Theory, L-Lab session

Program Code	
IT	Information Technology
Honors Code	
HA	Honors in Artificial Intelligence and Machine Learning

Sample Course Code:

22ITU4HA1T	Foundations and Applications of Machine Learning

Walchand Institute of Technology, Solapur
Information Technology
Honors in Artificial Intelligence and Machine Learning

Structure of T. Y. B. Tech. Information Technology
(W.E.F. 2024-2025)

Semester- V

Course Code	Theory Course Name	Engagement Hours			Credits	FA	SA		
		L	T	P		ESE	ISE	ICA	Total
22ITU5HA1T	Reinforcement Learning	3	-	-	3	60	40	-	100
	Laboratory:								
22ITU5HA1L	Reinforcement Learning	-	-	2	1	-	-	25	25
	Grand Total	**3**		**2**	**4**	**60**	**40**	**25**	**125**

Structure of T. Y. B. Tech. Information Technology,
(W.E.F. 2024-2025)

Semester- VI

Course Code	Theory Course Name	Engagement Hours			Credits	FA	SA		
		L	T	P		ESE	ISE	ICA	Total
22ITU6HA1T	Natural Language Processing	3	-	-	3	60	40	-	100
	Laboratory:								
22ITU6HA1L	Natural Language Processing	-	-	2	1	-	-	25	25
	Grand Total	**3**		**2**	**4**	**60**	**40**	**25**	**125**

Walchand Institute of Technology, Solapur

Honors in Artificial Intelligence and Machine Learning

T.Y. B. Tech. (Information Technology), Semester-V

22ITU5HA1T: REINFORCEMENT LEARNING

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	ESE – 60 Marks
Practical – 2 Hour/week, 1 Credit	ISE – 40 Marks
	ICA – 25 Marks

Introduction:

Reinforcement learning is an area of machine learning, where an agent or a system of agents learns to archive a goal by interacting with their environment. In recent years there has been success in reinforcement learning research in both theoretical and applied fields. This course primarily focuses on training students to frame reinforcement learning problems and to tackle algorithms from dynamic programming, Monte Carlo and temporal-difference learning.

Pre-requisite:

A basic course on Artificial Intelligence & Machine learning

COURSE OUTCOMES:

At the end of the course a student will be able to

1. Demonstrate the use of Reinforcement Learning tasks.
2. Describe the core principles of applying Reinforcement Learning.
3. Implement in code common used principles in Reinforcement Learning
4. Identify current advanced techniques and applications in Reinforcement Learning

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SECTION I

Unit 1: Introduction (05)

Reinforcement Learning, Examples, Elements of Reinforcement Learning, History of Reinforcement Learning

Unit 2: Evaluative Feedback (05)

A k-armed Bandit Problem, Action-value Methods, The 10-armed Test-bed, Incremental Implementation

Unit 3: The Reinforcement Learning Problem (06)

The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, Value Functions, Optimal Value Functions, Optimality and Approximation

Unit 4: Finite Markov Decision Processes (06)

The Agent–Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions.

SECTION II

Unit 5: Dynamic Programming (05)

Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming, Introduction to Monte Carlo Methods.

Unit 6: Temporal-Difference Learning **(05)**
TD Prediction, Advantages of TD Prediction Methods, Optimality of TD (0), SARSA: On-policy TD Control, Q-learning: Off-policy TD Control.

Unit 7: Planning and Learning **(06)**
Models and Planning, Dyna: Integrating Planning, Acting, and Learning, When the Model Is Wrong, Prioritized Sweeping, Expected vs. Sample Updates.

Unit 8: Applications and Case Studies **(06)**
TD-Gammon, Samuel's Checkers Player, Watson's Daily-Double Wagering, Mastering the Game of Go and Alpha Go.

Internal Continuous Assessment (ICA):
Analysis and implementation of

1. Flappy Kernel Markov Decision Process
2. Implementation of Performance Difference Lemma.
3. Implementation of Pong with Deep Q Learning.
4. Estimation of Warfarin Dose
5. Implementing Bayesian regret bound for Thomson Sampling

Text Books:
1. Reinforcement Learning: An Introduction (Second edition + Upcoming Edition) by: Richard S. Sutton and Andrew G. Barto, MIT Press Publication
(The book is available at http://incompleteideas.net/book/the-book-2nd.html Upcoming edition's January 1 2018 draft available at http://incompleteideas.net/book/bookdraft2018jan1.pdf]

Reference Books:
1. Reinforcement Learning: With Open AI, TensorFlow and Keras Using Python By Abhishek Nandy, Manisha Biswas. Apress Publication
2. Reinforcement Learning: State-of-the-Art, Marco Wiering and Martijn van Otterlo, Eds.
3. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig.
4. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville.

Walchand Institute of Technology, Solapur

Honors in Artificial Intelligence and Machine Learning

T.Y. B. Tech. (Information Technology), Semester-VI

22ITU6HA1T: NATURAL LANGUAGE PROCESSING

Teaching Scheme	Examination Scheme
Lecture: 3 Hours /Week, 3 Credits	ESE – 60 Marks
Practical: 2 Hours/Week, 1 Credit	ISE – 40 Marks
	ICA - 25 Marks

Introduction:

Natural Language Processing (NLP) is essentially a method for teaching computers how to understand human languages and interpret text. This course covers fundamentals of NLP including language morphology and language modelling, syntax analysis, semantic analysis, and the use of NLP for information retrieval. It also covers the most popular and effective current techniques, strategies, and toolkits for NLP to develop the various real-world NLP applications.

Pre-requisite:

Basic mathematics, algorithms and programming skills, Theory of computation and parsing.

COURSE OUTCOMES:

At the end of the course students will be able to

1) Understand the fundamentals of Natural Language Processing.
2) Analyze how the words are formed morphologically and how they are related to each others.
3) Develop strategies for language modelling, syntax and semantic analysis.
4) Design and implement and analyse the Natural Language Processing algorithms for real word applications.

SECTION-I

Unit 1 Introduction to Natural Language Processing (6)

Introduction to NLP, Machine Learning and NLP, why NLP is hard? Programming languages Vs Natural Languages, Are natural languages regular? Finite automata for NLP, Stages of NLP, challenges (Open Problems) in NLP.

Basics of Text Processing: Tokenization, Stemming, Lemmatization, Part of Speech Tagging.

Unit 2: Syntax and semantic Analysis (8)

Morphological Analysis: What is Morphology? Types of Morphemes, Inflectional morphology & Derivational morphology, Phonetics, HMM, Morphological parsing with Finite State Transducers (FSD. Syntactic Analysis: Syntactic Representations of Natural Language, Parsing Algorithms, Probabilistic context-free grammars and Statistical parsing.

Lexical Semantic, Relations among lexemes & their senses, Homonymy, Polysemy, Synonymy, Hyponymy, Word-Net, Word Sense Disambiguation (WSD), Dictionary based approach, Latent Semantic Analysis.

Unit 3: Language Modeling

Probabilistic language modeling, Markov models, Generative models of language, Log-Liner Models, Graph-based Models.

N-gram Models: Simple n-gram models, Estimation parameters and smoothing, evaluating language models.

Word Embeddings/Vector Semantics: Bag-of-words, TFIDF, word2vec, doc2vec, Contextualized representations (BERT).

Topic Modeling: Latent Dirichlet Allocation (LDA), Latent Semantic Analysis, Non – Negative Matrix Factorization.

SECTION-II

Unit 4: Information Retrieval using NLP (6)

Information Retrieval: Introduction, Vector Space Model.

Named Entity Recognition : NER System building process, Evaluating NER System. Entity Extraction, Relation Extraction, Reference Resolution, Co reference resolution, Cross Lingua information retrieval (CLIR).

Unit 5: NLP Tools and Techniques (7)

Prominent NLP libraries: Natural Language Toolkit (NLTK), spaCy, TextBlob, Gensim.

Linguistic Resources: Lexical Knowledge Networks, WordNets, Indian Language WordNet, (IndoWordnet), VerbNets, PropBank, Treebanks, Universal Dependency Tree banks.

Word Sense Disambiguation: Lesk Algorithm Walker's algorithm, WordNets for Word Sense Disambiguation.

Unit 6: Applications of NLP (7)

Machine Translation: Rule based techniques, Statistical Machine Translation (SMT), Cross Lingual Translation. Sentiment Analysis, Question Answering, Text Entailment, Discourse Processing, Dialog and Conversational Agents,

Natural Language Generation.

Text Books:

1. Dr. Smita M. Chaudhari, Devika A. Verma,Nitin N. Sakhare,"Natural Language Processing", Nirali Prakashan,Pune.
2. Allen, James, "Natural Language Understanding", Second Edition, Benjamin/Cumming, 1995.

Reference Books:

1. Bird, S., Klein, E., Loper, E. (2009). "Natural Language Processing with Python". Sebastopol, CA: O'Reilly Media.
2. Akshay Kulkarni, Adarsha Shivananda," Natural Language Processing Recipes Unlocking Text Data with Machine Learning and Deep Learning using Python",Apress, Bengolore
3. Radford, Andrew et. al., "Linguistics, An Introduction", Cambridge University Press, 1999.
4. Charniack, Eugene, "Statistical Language Learning", MIT Press, 1993.
5. Joseph D. Booth Foreword by Daniel Jebaraj "Natural Language Processing Succinctly", Succinctly EBook series, SyncFusion.
6. Github link for practical: https://github.com/kb1907/Natural-Language-Processing-Specialization

Internal Continuous Assessment (ICA) :

ICA shall include at least eight of the following assignments. The assignment's objective should align with course's outcomes and focus on higher order bloom's cognitive levels.

1) Perform Exploring and processing of text data.

2) Perform language modeling using one-hot encoding, N-grams, count vectorizer, TFID vectorizer and word embedding techniques.

3) Study and implementation of Noun-phrase extraction, text-similarity, part of speech tagging, chunking and named entity recognition.

4) Write a simple English to French translation algorithm using pre-computed word embeddings and locality sensitive hashing to relate words via approximate k-nearest neighbor search.

5) Study and implementation of sentimental analysis

6) Study and implementation of SPAM-HAM email classification

7) Write a better auto-complete algorithm using an N-gram language model

8) Study and implementation of text to speech and speech to text conversion

9) Study of Stanford Parser and POS Tagger. https://nlp.stanford.eclu/software/lex-parser.html

10) Study of language modeling for Indian languages

11) Study and implementation of Multi-class classification using NLP and Naïve Bayes classifier

12) Study and implementation of text summarization and document clustering.