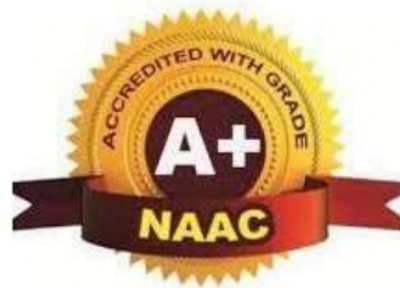




**TULSIRAMJI GAIKWAD-PATIL**  
**College of Engineering & Technology**

Mohgaon, Wardha Road, Nagpur - 441 108

(An Autonomous Institute Affiliated to RTM Nagpur University)



**DEPARTMENT OF INFORMATION TECHNOLOGY**

**M.Tech Artificial Intelligence & Machine Learning**

**As Per NEP 2020**

**Structure & Curriculum**

**From**

**Academic Year 2024-25**

### **Vision of Institute**

To contribute in the enhancement of capabilities of youth to face Information Technology challenges by empowering them with innovative ideas.

### **Mission of Institute**

- To stimulate students to learn effectively and apply the knowledge in the field of Engineering and Technology.
- To undertake industry academic collaboration to enhance competency in graduates.
- To foster innovative ideas amongst students for becoming leaders.
- To create an environment of research culture.
- To impart social and ethical values for inculcating the culture of lifelong learning.

### **Vision of the Department**

To contribute in the enhancement of capabilities of youth to face Information Technology challenges, by empowering them with innovative ideas.

### **Mission of the Department**

- To stimulate students to learn effectively and apply the knowledge in the field of Engineering and Technology.
- To undertake industry academic collaboration to enhance competency in graduates.
- To foster innovative ideas amongst students for becoming leaders.
- To create an environment of research culture.
- To impart social and ethical values for inculcating the culture of lifelong learning.

### **Program Education Objectives (PEO)**

- Acquire fundamental knowledge of mathematics, science and engineering to analyze, design and implement solutions to the Information Technology problems
- Understand emerging concepts and trends in Information Technology.
- Apply IT tools to develop innovative computational systems.
- The students are encouraged to develop the habit of lifelong learning to face the challenges.

### **Program Outcomes (PO)**

- PO1: An ability to independently carry out research /investigation and development work to solve practical problems.
- PO2: An ability to write and present a substantial technical report/document.
- PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.



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SCHEME OF INSTRUCTION & SYLLABI

Programme: B.Tech in Information Technology

Scheme of Instructions: M.Tech in AIML (As Per NEP 2020)







## Semester- I (w.e.f.:AY 2024-25)

Sr No	Sem	Type	BoS/ Dept	Sub Code	Subject	T/P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/IA	CA	ESE		
1	I	PCC	IT	MAI21101	Artificial Intelligence	T	4	-	4	4	40	-	60	3 Hrs	100
2		PCC	IT	MAI21102	Natural Language Processing	T	4	-	4	4	40	-	60	3 Hrs	100
3		PCC	IT	MAI21103	Machine Learning	T	4	-	4	4	40	-	60	3 Hrs	100
4		PCC	IT	MAI21104	Laboratory – I	P	-	4	4	2	-	25	25	2 Hrs	50
5		PEC	IT	MAI21105-07	Program Elective – I	T	4	-	4	4	40	-	60	3 Hrs	100
6		PEC	IT	MAI21108-10	Program Elective - II	T	4	-	4	4	40	-	60	3 Hrs	100
<b>Total</b>							<b>20</b>	<b>04</b>	<b>24</b>	<b>22</b>	<b>200</b>	<b>25</b>	<b>325</b>	<b>17 Hrs</b>	<b>550</b>

Course Category	PCC (Programme Core courses)	PEC (Programme Elective courses)	Proj (Project)	OEC (Open Elective Course)
Credits	14	8	-	-
Cumulative Sum	-	-	-	-

**PROGRESSIVE TOTAL CREDITS= 22**

				August,2024	1.00	Applicable for AY 2024-25 Onwards
Chairperson	Dean-Academics	Vice-Principal	Principal	Date of Release	Version	



# Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

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Programme: B.Tech in Information Technology

Scheme of Instructions: M.Tech in AIML (As Per NEP 2020)







## Semester- II (w.e.f.: AY 2024-25)

Sr No	Sem	Type	BoS/ Dept	Sub Code	Subject	T/P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/A	CA	ESE		
1	II	PCC	IT	MAI21201	Data Analysis	T	4	-	4	4	40	-	60	3 Hrs	100
2		PCC	IT	MAI21202	Information & Cyber Security	T	4	-	4	4	40	-	60	3 Hrs	100
3		PCC	IT	MAI21203	Laboratory – II	P	-	4	4	2	-	25	25	2 Hrs	50
4		PEC	IT	MAI21204-06	Program Elective - III	T	4	-	4	4	40	-	60	3 Hrs	100
5		PEC	IT	MAI21207-09	Program Elective - IV	T	4	-	4	4	40	-	60	3 Hrs	100
6		RM	ME	MME21204	Literature Review & Research Methodology	T	2	-	2	2	-	25	25	2 Hrs	50
<b>Total</b>							<b>18</b>	<b>04</b>	<b>22</b>	<b>20</b>	<b>160</b>	<b>50</b>	<b>290</b>	<b>16 Hrs</b>	<b>500</b>

Course Category	PCC (Programme Core courses)	PEC (Programme Elective courses)	Proj (Project)	OEC (Open Elective Course)
Credits	10	8	-	-
Cumulative Sum	24	16	-	-

PROGRESSIVE TOTAL CREDITS:22+20=42

 Head of Dept. Information Technology Tulsiramji Gaikwad-Patil College of Engineering and Technology, Nagpur (M.S.)	 Dean Academics (PG) Tulsiramji Gaikwad-Patil College of Engineering and Technology Nagpur (M.S.)	 Vice-Principal Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur	 Principal Tulsiramji Gaikwad-Pa College Of Engineering Technology, Nagpur	August,2024	1.00	Applicable for AY 2024-25 Onwards
Chairperson	Dean-Academics	Vice-Principal	Principal	Date of Release	Version	



# Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

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SCHEME OF INSTRUCTION & SYLLABI

Programme: B.Tech in Information Technology

Scheme of Instructions: M.Tech in AIML (As Per NEP 2020)







## Semester- III (w.e.f.: AY 2024-25)

Sr No	Sem	Type	BoS/ Dept	Sub Code	Subject	T/ P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/I A	CA	ESE		
1	III	PROJ	IT	MAI22301	Dissertation Phase -I	P	-	30	30	15	-	100	100	3 Hrs	200
2		PEC	IT	MOOCS	MOOC course (12 weeks)	T	3	-	-	3	-	25	75	3 Hrs	100
<b>Total</b>							<b>3</b>	<b>30</b>	<b>30</b>	<b>18</b>	<b>-</b>	<b>125</b>	<b>175</b>	<b>6 Hrs</b>	<b>300</b>

Course Category	PCC (Programme Core courses)	PEC (Programme Elective courses)	Proj (Project)	OEC (Open Elective Course)
Credits	-	3	15	-
Cumulative Sum	24	19	15	-

**PROGRESSIVE TOTAL CREDITS:42+18=60**

				August,2024	1.00	Applicable for AY 2024-25 Onwards
Chairperson	Dean-Academics	Vice-Principal	Principal	Date of Release	Version	



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Programme: B.Tech in Information Technology

Scheme of Instructions: M.Tech in AIML (As Per NEP 2020)







## Semester- IV (w.e.f.:AY 2024-25)

Sr.	Sem	Type	BoS/ Dept	Sub Code	Subject	T/P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/I A	CA	ESE		
1	IV	PROJ	IT	MAI22401	Dissertation Phase-II	P	-	40	40	20	-	100	200	-	300
<b>Total</b>									<b>40</b>	<b>20</b>		<b>100</b>	<b>200</b>	-	<b>300</b>

Course Category	PCC (Programme Core courses)	PEC (Programme Elective courses)	Proj (Project)	OEC (Open Elective Course)
Credits	-	-	20	-
Cumulative Sum	24	19	35	-

**PROGRESSIVE TOTAL CREDITS:60+20=80**

				August,2024	1.00	Applicable for AY 2024-25 Onwards
Chairperson	Dean-Academics	Vice-Principal	Principal	Date of Release	Version	



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SCHEME OF INSTRUCTION & SYLLABI

Programme: B.Tech in Information Technology





Scheme of Instructions: M.Tech in AIML (As Per NEP 2020)



## List of Professional Elective Courses

Program Elective- I	Program Elective-II	Program Elective-III	Program Elective- IV
<b>Semester-I</b>	<b>Semester-I</b>	<b>Semester-II</b>	<b>Semester-II</b>
MAI21105- Cloud Computing	MAI21108- Robotic Process Automation	MAI21204- Pattern Recognition	MAI21207- Computer Vision
MAI21106- Agent Based Intelligent Systems	MAI21109- Human Computer Interface	MAI21205- Reinforcement Learning	MAI21208- Data Visualization Techniques
MAI21107- Fundamentals of Data Science	MAI21110 – Advanced Algorithms and Analysis	MAI21206- Optimization Techniques	MAI21209- Block Chain Technology

Course Category	PCC (Program Core Course)	PEC (Program Elective Course)	Proj (Project)	OEC (Open Elective)	Semester Wise Credits
Semester-I	14	8	-	-	22
Semester-II	10	8	-	-	20
Semester-III	-	3	15	-	18
Semester-IV	-	-	20	-	20
<b>Cumulative Sum</b>	<b>24</b>	<b>19</b>	<b>35</b>	<b>00</b>	<b>80</b>

 Head of Dept. Information Technology Tulsiramji Gaikwad-Patil College of Engineering and Technology, Nagpur (M.S.)	 Dean Academics (PG) Tulsiramji Gaikwad-Patil College of Engineering and Technology Nagpur (M.S.)	 Vice-Principal Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur	 Principal Tulsiramji Gaikwad-Pa College of Engineering Technology, Nagpur	August,2024	1.00	Applicable for AY 2024-25 Onwards
Chairperson	Dean-Academics	Vice-Principal	Principal	Date of Release	Version	



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NAAC Accredited (A+ Grade)



**First Year (Semester-I) M. Tech. AIML**

**MAI21101: Artificial Intelligence**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**

1. To introduce students to the basic concepts Artificial intelligence and AI Revolution.
2. To introduce a propositional logic, reasoning , logical notations and truth tables.
3. To introduce basic first order predicate logic , inference rules and quantifiers.
4. To introduce first order predicate logic inference rules for quantifier.
5. To apply prolog rules and techniques to solve problems and also to develop programs.


**Course Contents**

<b>Unit I</b>	<b>Introduction to Artificial Intelligence:</b> Introduction, history, intelligent systems, Turing Test, Role of Knowledge, AI applications, tic-tac-tie game playing, current trends in AI, Problem solving: state-space search and control strategies: Introduction, general problem solving, characteristics of problem, AI problem solving as state space search, exhaustive searches, heuristic search techniques, Hill climbing , A* algorithms.
<b>Unit II</b>	<b>Logic and Theorem Proving concepts:</b> Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, resolution refutation in propositional logic, predicate logic.
<b>Unit III</b>	<b>Problem reduction and game playing:</b> Introduction to problem reduction, AO* algorithm, constraint satisfaction algorithm, Crypt arithmetic Problem solving, Means Ends analysis, game playing, Min-Max algorithm for game playing, alpha-beta pruning, iterative-deepening, two player perfect information games
<b>Unit IV</b>	<b>Uncertain Reasoning:</b> Probability theory: Introduction, probability theory, Bayes theorem, Bayesian belief networks, certainty factor theory, Dempster-Shafer theory, Statistical Inference
<b>Unit V</b>	<b>Planning:</b> Overview, Blocks world as example, components of planning system, Goal stack planning, Nonlinear planning, Hierarchical planning, Reactive Systems <b>Expert Systems:</b> Representing and using Domain knowledge, examples of expert systems, Expert system Architectures, Components, Building an expert system, Expert system shells

Text Books	
T.1	Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
T.2	Artificial Intelligence- 3 <sup>rd</sup> Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
Reference Books	
R.1	Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA
R.2	Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
Useful Links	
1	<a href="https://nptel.ac.in/courses/106102220">https://nptel.ac.in/courses/106102220</a>
2	<a href="https://nptel.ac.in/courses/106106140">https://nptel.ac.in/courses/106106140</a>

CO	Course Outcomes	CL	Class Sessions
CO1	<b>Explain</b> the evolution of AI, key historical milestones, and the concept of intelligent systems.	2	9
CO2	<b>Demonstrate</b> the ability to apply propositional and predicate logic to formalize reasoning in problem-solving scenarios.	3	9
CO3	<b>Apply</b> constraint satisfaction algorithms and techniques to solve problems like crypt-arithmetic puzzles.	3	9
CO4	<b>Design</b> and analyze Bayesian belief networks, modeling complex systems with probabilistic dependencies.	4	9
CO5	<b>Implement</b> an AI system that integrates planning techniques and expert system knowledge representation	6	9

  
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 Nagpur (M.S.)



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**First Year(Semester-I) M. Tech. AIML**

**MAI21102: Natural Language Processing**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**

1. To familiarize the concepts and techniques of NLP for analyzing words.
2. To relate mathematical foundations, Probability theory with Linguistic.
3. To apply the Statistical learning methods and cutting-edge research models from deep learning.
4. To understand the underlying principles behind each WSD approach and limitations of each method.
5. To provide a comprehensive understanding of Markov Models and their application in POS Tagging.


**Course Contents**


<b>Unit I</b>	<b>Introduction to NLP:</b> Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs. Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross entropy
<b>Unit II</b>	<b>Text Preprocessing and Morphology:</b> Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.
<b>Unit III</b>	<b>Language Modelling:</b> Words: Collocations- Frequency-Mean and Variance –Hypothesis testing: The t test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios. Statistical Inference: n -gram Models over Sparse Data: Bins: Forming Equivalence Classes- N gram model - Statistical Estimators- Combining Estimators
<b>Unit IV</b>	<b>Word Sense Disambiguation:</b> Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, an information theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Disambiguation based on translations in a second-language corpus.

<b>Unit V</b>	<b>Markov Model and POS Tagging:</b> Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging.
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<b>Text Books</b>	
T.1	Christopher D. Manning and Hinrich Schutze, "Foundations of Natural Language Processing", 6 <sup>th</sup> Edition, The MIT Press Cambridge, Massachusetts London, England, 2003
T.2	Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.
<b>Reference Books</b>	
R.1	Nitin Indurkha, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
R.2	James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.
<b>Useful Links</b>	
1	<a href="https://www.tutorialspoint.com/natural_language_processing/index.htm">https://www.tutorialspoint.com/natural_language_processing/index.htm</a>
2	<a href="https://nlp.stanford.edu/links/statnlp.html">https://nlp.stanford.edu/links/statnlp.html</a>

	<b>Course Outcomes</b>	<b>CL</b>	<b>Class Sessions</b>
<b>MAI21102.1</b>	<b>Apply</b> the principles and Process of Human Languages using computers.	2	9
<b>MAI21102.2</b>	<b>Implement</b> semantics and pragmatics of English language for text processing	3	9
<b>MAI21102.3</b>	<b>Create</b> CORPUS linguistics based on digestive approach (Text Corpus method)	5	9
<b>MAI21102.4</b>	<b>Evaluate</b> a current method for statistical approaches to machine translation.	5	9
<b>MAI21102.5</b>	<b>Design</b> POS tagging for a given natural language and select a suitable language.	6	9

  
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**M. Tech. Artificial Intelligence & Machine Learning**

**MAI21103: Machine Learning**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**


1. To study principles, advantages, limitations and possible applications of machine learning.
2. To study models for supervised, unsupervised, and reinforcement machine learning.
3. To study appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.
4. Make students solve probabilistic problems based on machine learning problems.
5. To make students design solution for experimental problems.


**Course Contents**

<b>Unit I</b>	<b>INTRODUCTION</b> Machine Learning: Machine Learning Foundations, Overview, Applications, Types of Machine Learning, Basic Concepts in Machine Learning, Examples of Machine Learning, Applications, Linear Models for Regression, Linear Basis Function Models, The Bias-Variance Decomposition, Bayesian Linear Regression, Bayesian Model Comparison.
<b>Unit II</b>	<b>SUPERVISED LEARNING</b> Linear Models for Classification, Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, Bayesian Logistic Regression, Decision Trees Classification Trees, Regression Trees, Pruning, Neural Networks, Feed-Forward Network Functions, Error Back-Propagation, Regularization, Bagging, Boosting.
<b>Unit III</b>	<b>UNSUPERVISED LEARNING</b> Clustering: K-means, EM – Mixtures of Gaussians, The EM Algorithm in General, Model Selection for Latent Variable Models, High-Dimensional Spaces, The Curse of Dimensionality, Dimensionality Reduction, Factor Analysis, Principal Component Analysis, Probabilistic PCA, Independent Components Analysis.
<b>Unit IV</b>	<b>PROBABILISTIC GRAPHICAL MODELS</b> Directed Graphical Models, Bayesian, Networks, Exploiting Independence Properties, From Distributions to Graphs, Examples, Markov Random Fields, Inference in Graphical Models, Learning – Naive Bayes Classifiers, Markov Models, Hidden Markov Models, Inference – Learning, Generalization, Undirected graphical models, Markov Random Fields, Conditional Independence Properties.

<b>Unit V</b>	<b>COMBINING MULTIPLE LEARNERS, MACHINE LEARNING EXPERIMENTS</b> Rationale: Generating Diverse Learners, Model Combination Schemes, Voting, Error, Correcting Output Codes, Bagging, Boosting, Mixture of Experts Revisited, Stacked Generalization, Fine-Tuning an Ensemble, Factors, Response, and Strategy of Experimentation, Response Surface Design, Randomization, Replication, and Blocking, Guidelines for Machine Learning Experiments
<b>Text Books</b>	
T.1	Pattern Recognition and Machine Learning Christopher Bishop Springer 2006
T.2	Machine Learning: A Probabilistic Perspective Kevin P. Murphy MIT Press 2012
<b>Reference Books</b>	
R.1	Machine Learning –An Algorithmic Perspective Stephen Marsland CRC Press 2009
<b>Useful Links</b>	
1	<a href="https://onlinecourses.nptel.ac.in/noc24_cs46/preview">https://onlinecourses.nptel.ac.in/noc24_cs46/preview</a>

CO	Course Outcomes	CL	Class Sessions
MAI21103.1	<b>Understand</b> the principles, advantages, limitations and possible applications of machine learning.	2	9
MAI21103.2	<b>Understand</b> a number of models for supervised, unsupervised, and reinforcement machine learning	2	9
MAI21103.3	<b>Identify</b> and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.	5	9
MAI21103.4	<b>Select</b> proper method and solve probabilistic problem for machine learning	5	9
MAI21103.5	<b>Design</b> solution for machine learning guidelines.	6	9

  
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**First Year (Semester-I)M. Tech. Information Technology**

**MAI21104: Artificial Intelligence and ML Lab**

Teaching Scheme		Examination Scheme	
Practical	2Hrs/week	CA	25Marks
Total Credits	1	ESE	25Marks
		Total	50Marks

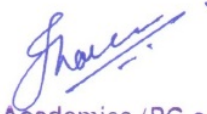
Sr. No	List of Practical	CO
1	Introduction of various python libraries used for machine learning	CO1
2	Write Program to implement Chatbot in Python	CO1
3	Write a Program to Implement Tower of Hanoi using Python.	CO2
4	Write a Program to Implement 8-Puzzle problem using Python	CO2
5	Write a Program to Implement N-Queens Problem using Python	CO3
6	Create a program for word analysis in NLP.	CO3
7	Implement NLP program for word Generation.	CO4
8	Create a program Tagging and Dependency Parsing using Feedforward Networks.	CO4
9	Write a program in NLP for word Embedding's in Feedforward Networks.	CO5
10	Implement NLP program Computational Graphs, and Backpropagation.	CO5

Text Books	
1	Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995
2	Introduction to Artificial Intelligence, Wolfgang Erte, Springer, cham
Reference Books	
1	Jensen K., Heidorn G.E., Richardson S.D., Natural Language Processing: The PLNLP Approach, Springer, 2013.
2	Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
Useful Links	
1	<a href="https://nptel.ac.in/courses/106105158">https://nptel.ac.in/courses/106105158</a>
2	<a href="https://onlinecourses.nptel.ac.in/noc22_cs56/preview">https://onlinecourses.nptel.ac.in/noc22_cs56/preview</a>

	Course Outcomes	CL	Lab Sessions
MAI21104.1	<b>Demonstrate</b> fundamental understanding of the history of artificial intelligence (AI) and various applications of AI	2	4
MAI21104.2	<b>Describe</b> basic propositional rules of AI that require problem solving for reasoning	4	4
MAI21104.3	<b>Discuss</b> solution for N-queens problem and current methods for statistical approaches to machine translation	2	4
MAI21104.4	<b>Evaluate</b> machine learning techniques used in NLP.	5	4
MAI21104.5	<b>Design</b> methods to new NLP problems and will be able to apply the methods to problems outside NLP.	6	4



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**First Year (Semester-I) M. Tech. AIML**

**MAI21105: Cloud Computing**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**

1. To understand the Service Model with reference to Cloud Computing
2. To comprehend the Cloud Computing architecture and implementation
3. To realize the role of Virtualization Technologies
4. To have knowledge on Cloud Computing management and security
5. To have knowledge on Cloud services in daily real time projects.

**Course Contents**

<b>Unit I</b>	<b>Introduction to Cloud Computing:</b> Overview, Roots of Cloud Computing, Layers and Types of Cloud, Desired Features of a Cloud, Benefits and Disadvantages of Cloud Computing, Cloud Infrastructure Management, Infrastructure as a Service Providers, Challenges and Risks.
<b>Unit II</b>	<b>Cloud Architecture, Services and Applications:</b> Exploring the Cloud Computing Stack, connecting to the Cloud, Infrastructure as a Service, Platform as a Service, SaaS Vs. PaaS, Using PaaS Application Frameworks, Software as a Service, Identity as a Service, Compliance as a Service.
<b>Unit III</b>	<b>Abstraction and Virtualization:</b> Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Machine Imaging, Porting Applications, Virtual Machines Provisioning and Manageability Virtual Machine Migration Services, Provisioning in the Cloud Context.
<b>Unit IV</b>	<b>Managing &amp; Securing the Cloud:</b> Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards, Securing the Cloud, Securing Data, Establishing Identity and Presence.
<b>Unit V</b>	<b>Service-Oriented Architecture:</b> The Pre-SOA Era, Role of SOA in Cloud Computing, Service-Oriented Architecture. <b>Case-Studies:</b> Using Google Web Services, Using Amazon Web Services, Using Microsoft cloud Services

Text Books	
T.1	Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
T.2	Sosinsky B., "Cloud Computing Bible", First Edition, Wiley Edition, 2011
Reference Books	
R.1	Miller Michael, "Cloud Computing: Web Based Applications that Change the Way You Work
R.2	Smooth S., Tan N., "Private Cloud Computing", Morgan Kauffman , First Edition,2011
Useful Links	
1	<a href="https://nptel.ac.in/courses/106105167">https://nptel.ac.in/courses/106105167</a>
2	<a href="https://nptel.ac.in/courses/106104182">https://nptel.ac.in/courses/106104182</a>

CO	Course Outcomes	CL	Class Sessions
MAI21105.1	<b>Discuss</b> the concept, evolution, architecture, pros and cons of Cloud Computing	2	9
MAI21105.2	<b>Describe</b> the knowledge of how hypervisors are used in Virtual Machines	2	9
MAI21105.3	<b>Analyze</b> the virtualization and its techniques in cloud computing	4	9
MAI21105.4	<b>Evaluate</b> access and use the services in the Cloud.	5	9
MAI21105.5	<b>Appraise</b> latest advances and its applications in cloud computing.	5	9

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**First Year (Semester-I) M. Tech. AIML**

**MAI21106: Agent Based Intelligent Systems**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**

1. Understand the structure of agents and define several learning mechanisms of agents
2. Understand the principles and applications of Agent-Based Intelligent Systems (ABIS),
3. Design the agents by learning how to plan and design the actors in the real world.
4. Dealt with the communication and cooperation within agents.
5. Understand Agent architecture, perception, decision making, and interaction in multi-agent environments."

**Course Contents**

<b>Unit I</b>	<b>Introduction:</b> Definitions – Foundations – History – Intelligent Agents – Problem Solving – Searching – Heuristics – Constraint satisfaction Problems – Game Playing. Knowledge representation and reasoning: Logical agents – First order logic – First Order Inference – Unification – Chaining – Resolution Strategies – Knowledge Representation – Objects – Actions – Events.
<b>Unit II</b>	<b>Solving Problems by Searching:</b> Problem –Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed ( Heuristics ) Search Strategies, Heuristic Functions.
<b>Unit III</b>	<b>Agents and Uncertainty:</b> Acting under uncertainty – Probability Notation – Bayes Rule and use – Bayesian Networks – Other approaches – Time and Uncertainty – Temporal Models – Utility Theory – Decision Network – Complex Decisions.
<b>Unit IV</b>	<b>Robotics:</b> Introduction, Robot Hardware, Robotic Perception, planning to Move, Planning Uncertain Movements, Moving, Robotic Software Architectures, Application Domain;
<b>Unit V</b>	<b>Higher Level Agents:</b> Knowledge in Learning, Relevance information, Statistical Learning Method Reinforcement Learning Communication – Formal Grammar – Augmented Grammars Future of AI.

Text Books	
T.1	Stuart Russell and Peter Norvig "Artificial Intelligence: A Modern Approach", Third Edition , Pearson, 2015
T.2	Nils .J. Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992
Reference Books	
R.1	Patrick Henry Winston, Artificial Intelligence, 3rd Edition, Pearson, 2008.
R.2	Michael Wooldridge, "An Introduction to Multi Agent System", John Wiley, 2002
Useful Links	
1	<a href="https://cusat.ac.in/">https://cusat.ac.in/</a>
2	<a href="https://nptel.ac.in/courses/106106126">https://nptel.ac.in/courses/106106126</a>

	Course Outcomes	CL	Class Sessions
MAI21106.1	<b>Understand</b> the role of logical agents in AI and describe the importance of knowledge representation in reasoning and decision-making.	2	9
MAI21106.2	<b>Identify</b> real-world problems that can be formulated as search problems and apply appropriate strategies to model it.	3	9
MAI21106.3	<b>Analyze</b> Bayesian Networks by breaking down their structure, dependencies, and how they model uncertain data and relationships.	4	9
MAI21106.4	<b>Design</b> Planning and acting in the Real world and logic-based agents.	6	9
MAI21106.5	<b>Assemble</b> theoretical foundations of agent-based system	6	9



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**First Year (Semester-I) M. Tech.**

**MAI21107: Fundamental of Data Science**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**

1. Understand the basics of data science
2. Understand the concepts of Data collection and management
3. Identify distribution properties of data using statistical concepts.
4. Understand types of data Visualization techniques
5. Interpret multiple techniques for solving Data science applications .


**Course Contents**

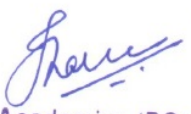
<b>Unit I</b>	<b>Introduction To Data Science:</b> Definition, Big Data and Data Science Hype, Datafication . Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Big Data Can Mean Big Assumptions, Modeling, Philosophy of Exploratory Data Analysis, The Data Science Process , A Data Scientist's Role in this Process Case Study: Real Direct
<b>Unit II</b>	<b>Mathematical Preliminaries:</b> Probability, Descriptive Statistics, Correlation Analysis. <b>Data Munging:</b> Properties of Data, Languages for Data Science, Collecting Data, Cleaning Data, Crowdsourcing
<b>Unit III</b>	<b>Scores and Rankings:</b> Developing Scoring Systems, Z-scores and Normalization, Advanced Ranking <b>Techniques Statistical Analysis:</b> Sampling from Distributions, Statistical Distributions, Statistical Significance, Permutation Tests and P-values
<b>Unit IV</b>	<b>Visualizing Data:</b> Exploratory Data Analysis, developing a Visualization Aesthetic, Chart Types, Great Visualizations. <b>Mathematical Models:</b> Philosophies of Modeling, A Taxonomy of Models, Baseline Models, Evaluating Models, Evaluation Environment.
<b>Unit V</b>	<b>Supervised Learning:</b> Linear Regression, Better Regression Models, Regression as Parameter Fitting, Simplifying Models through Regularization Classification and Logistic Regression, Issues in Logistic Classification, Naive Bayes, Decision Trees Classifiers

Text Books	
T.1	Steven S. Skiena, "The Data Science Design Manual", Springer 2017
T.2	Rachel Schutt & O'neil, "Doing Data Science", Straight Talk from The Frontline O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.

Reference Books	
R.1	Joel Grus," Data Science from Scratch" First Edition, April 2015
R.2	Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning-with Applications in R", 2013
Useful Links	
1	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs28/">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs28/</a>
2	<a href="https://www.geeksforgeeks.org/data-science-fundamentals/">https://www.geeksforgeeks.org/data-science-fundamentals/</a>

	Course Outcomes	CL	Class Sessions
MAI21107.1	<b>Describe</b> the significance of data science and understand the Data Science process.	2	9
MAI21107.2	<b>Explain</b> how data is collected, managed, and stored for data science.	2	9
MAI21107.3	<b>Apply</b> statistical significance testing methods, including permutation tests and P-values, to evaluate the results of experiments and hypotheses.	6	9
MAI21107.4	<b>Analyze</b> Data using various Visualization techniques.	4	9
MAI21107.5	<b>Choose</b> contemporary models, such as machine learning, AI, techniques to solve practical problems	5	9

  
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**First Year (Semester-I) M. Tech. AIML**

**MAI21108:Robotic Process Automation**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**

- To introduce Robotic-Process Automation.
- To assist different types of variables, Control Flow and data manipulation techniques.
- To Identify and understand Image, Text and Data Tables Automation.
- To help handle the User Events and various types of Exceptions and strategies.
- To mitigate deployment of the Robot and to maintain the connection.


**Course Contents**

<b>Unit I</b>	<b>INTRODUCTION TO ROBOTIC PROCESS AUTOMATION</b> -History of Automation, what is RPA, RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture.
<b>Unit II</b>	<b>RPA TOOL</b> - The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments.
<b>Unit III</b>	<b>ADVANCED AUTOMATION CONCEPTS &amp; TECHNIQUES:</b> Recording Introduction - Basic and Desktop Recording - Web Recording - Input/output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation
<b>Unit IV</b>	<b>HANDLING USER EVENTS &amp; ASSISTANT BOTS, EXCEPTION HANDLING:</b> Assistant bots- Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event.

<b>Unit V</b>	<b>DEPLOYING AND MAINTAINING THE BOT:</b> Publishing using publish utility - Creation of Server - Using Server to control the bots - Creating a provision Robot from the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages.
<b>Text Books</b>	
T.1	Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.
T.2	Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, 1st Edition 2015.
<b>Reference Books</b>	
R.1	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, 1st Edition 2018.
R.2	Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes", Packt Publishing, 1st Edition 2018.
<b>Useful Links</b>	
1	<a href="https://www.uipath.com/rpa/robotic-process-automation">https://www.uipath.com/rpa/robotic-process-automation</a>
2	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/</a>

	<b>Course Outcomes</b>	<b>CL</b>	<b>Class Sessions</b>
<b>MAI21108.1</b>	<b>Describe</b> RPA, RPA Development methodologies, programming, and construction of RPA.	2	9
<b>MAI21108.2</b>	<b>Illustrate</b> the different types of variables, Control Flow and data manipulation techniques.	3	9
<b>MAI21108.3</b>	<b>Apply</b> various input/output methods and data scraping techniques,.	3	9
<b>MAI21108.4</b>	<b>Analyze</b> User Events and various types of Exceptions and strategies.	4	9
<b>MAI21108.5</b>	<b>Generalize</b> the Deployment of the Robot and to maintain the connection.	5	9

  
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**First Year (Semester-I) M. Tech. AIML**

**MAI21109: Human Computer Interface**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**

1. To facilitate communication between students of psychology, design, and computer science on user interface development projects.
2. To provide the future user interface designer with concepts and strategies for making design decisions.
3. To expose the future user interface designer to tools, techniques, and ideas for interface design.
4. To introduce the student to the literature of human-computer interaction.
5. To stress the importance of good user interface design.

**Course Contents**

<b>Unit I</b>	<b>Introduction:</b> Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design, The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system.
<b>Unit II</b>	<b>Design process</b> – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, and understanding business junctions.
<b>Unit III</b>	<b>Screen Designing:</b> Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics
<b>Unit IV</b>	<b>Windows</b> – New and Navigation schemes selection of window, selection of devices based and screen based controls, Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.
<b>Unit V</b>	<b>Software tools</b> – Specification methods, interface – Building Tools, Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.


**Text Books**


T.1	The essential guide to user interface design, Wilbert O Galitz, Wiley DreamaTech.
T.2	Designing the user interface. 3rd Edition Ben Shneidermann , Pearson Education Asia.

**Reference Books**

R.1	Human – Computer Interaction. ALAN DIX, JANET FINCAY, GRE GORYD, ABOWD, RUSSELL BEALG, PEARSON.
R.2	Interaction Design PRECE, ROGERS, SHARPS. Wiley Dreamtech, 3. User Interface Design, Soren Lauesen , Pearson Education.
<b>Useful Links</b>	
1	<a href="https://www.digimat.in/nptel/courses/video/106106177/L01.html">https://www.digimat.in/nptel/courses/video/106106177/L01.html</a>
2	<a href="https://www.digimat.in/nptel/courses/video/106106177/L015.html">https://www.digimat.in/nptel/courses/video/106106177/L015.html</a>

	<b>Course Outcomes</b>	<b>CL</b>	<b>Class Sessions</b>
<b>MAI21109.1</b>	<b>Understand</b> fundamental design and evaluation methodologies of human computer interaction	2	9
<b>MAI21109.2</b>	<b>Demonstrate</b> knowledge of human computer interaction design concepts and related methodologies.	3	9
<b>MAI21109.3</b>	<b>Examine</b> theories and concepts associated with effective work design to real-world application	4	9
<b>MAI21109.4</b>	<b>Evaluate</b> and design usable and appropriate software based on psychological, social, and technical analysis.	5	9
<b>MAI21109.5</b>	<b>Apply</b> user-centered design methods to conduct formative and summative evaluations.	3	9

  
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**M. Tech. Artificial Intelligence & Machine Learning**

**MAI21110: Advance Algorithm and Analysis**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	3	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

**Course Objectives:**

1. Introduces the recurrence relations for analyzing the algorithms.
2. To study Greedy algorithm along with graph algorithm.
3. To understand sorting network along with various matrix operation.
4. To understand String Matching.
5. To have knowledge NP-Completeness.

**Course Contents**

<b>Unit I</b>	<b>Introduction:</b> - Role of Algorithms in computing, Order Notation, Recurrences, Sorting and Order Statistics: Heap sort, Quick sort and Sorting in Linear Time.
<b>Unit II</b>	<b>Greedy Algorithms</b> - Huffman Codes, Activity Selection Problem. Amortized Analysis. Graph Algorithms: Topological Sorting, Minimum Spanning trees, Single Source Shortest Paths, Maximum Flow algorithms.
<b>Unit III</b>	<b>Sorting Networks:</b> Comparison Networks, Zero-one principle, bitonic Sorting Networks, Merging Network, Sorting Network. <b>Matrix Operations-</b> Strassen's Matrix Multiplication, inverting matrices, Solving system of linear Equations
<b>Unit IV</b>	<b>String Matching:</b> Naive String Matching, Rabin-Karp algorithm, matching with finite Automata, Knuth- Morris - Pratt algorithm.
<b>Unit V</b>	<b>NP-Completeness and Approximation Algorithms:</b> Polynomial time, polynomial time Verification, NP-Completeness and reducibility, NP-Complete problems.

**Text Books**

T.1	Introduction to Algorithms," T. H. Cormen
T.2	Data structures and Algorithm Analysis in C++, Allen Weiss, Second edition, Pearson education.

Reference Books	
R.1	Design and Analysis Algorithms - Parag Himanshu Dave, Himanshu Bhalchandra Dave Publisher: Pearson
R.2	Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajase kharam; Galgotia publications pvt. Ltd.
Useful Links	
1	<a href="https://onlinecourses.nptel.ac.in/noc24_cs46/preview">https://onlinecourses.nptel.ac.in/noc24_cs46/preview</a>
2	<a href="https://onlinecourses.nptel.ac.in/noc23_cs63/preview">https://onlinecourses.nptel.ac.in/noc23_cs63/preview</a>

CO	Course Outcomes	CL	Class Sessions
MAI21110.1	Understand rôle of Algorithms in computing.	2	9
MAI21110.2	Analysis various Graph Algorithms	4	9
MAI21110.3	Classify different types Sorting Networks	2	9
MAI21110.4	Demonstrate String Matching.	3	9
MAI21110.5	Develop NP-Completeness	5	9

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