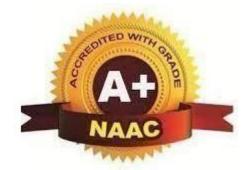


Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institute



Department of Artificial Intelligence and Machine Learning

B.Tech.
Artificial Intelligence and Machine Learning

Syllabus of
Minor in Artificial Intelligence and Machine
Learning

Considering

National Education Policy 2020

From Academic Year 2025-26

# Scheme of Minor in Artificial Intelligence and Machine Learning

Sr.	Course	Course Title	T/P	Co	ntact H	ours	Credits	Total Marks
No.	Code	Course Title	1/1	L	P	Hrs.	Credits	Total Warks
1	BAI12309	Introduction to AI	Т	3	-	3	3	100
2	BAI12409	Fundamental of Problem solving in AI	T	3	-	3	3	100
3	BAI13512	Basics of Knowledge Representation & Reasoning	T	3	-	3	3	100
4	BAI13614	Introduction to Machine Learning	T	3	-	3	3	100
5	BAI14708	Fundamentals of Deep Learning	T	3	-	3	3	100
6	BAI14810	Introduction to Natural Language Processing	T	3	_	3	3	100
		Total	-	18	-	18	18	600



Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)



# Second Year (Semester – III) B.Tech. Artificial Intelligence and Machine Learning

	<u>-</u>	1 – III) B. I cen. Al tiniciai Intemgen						
	ching Scheme	_		ation Scheme				
Theory	3 Hrs./wk.		CT-1	15 Marks				
Tutorial	-	Course Code: BAI12309	CT-2	15 Marks				
Total Credit	t 3	Course Name: Introduction to AI	CA	10 Marks				
Duroti	on of ESE: 3 Hrs.		ESE	60 Marks				
Duratio	on of ESE: 5 ms.		Total	100 Marks				
Course O	bjective:							
1 <b>Intr</b>	1 <b>Introduce</b> the fundamental concepts and history of Artificial Intelligence (AI).							
2 <b>Dev</b>	elop understandin	g of intelligent agents, knowledge represent	tation, and searc	h techniques.				
3 <b>App</b>	oly AI problem-sol	ving approaches including search algorithm	ns and constraint	satisfaction.				
4 Ana	alyze different knov	rledge representation schemes and reasoning	g under uncertai	nty.				
5 <b>Imp</b>	olement basic AI ap	plications and understand the role of learning	ng in AI systems	S.				
		<b>Course Contents</b>						
Unit I	Turing Test and	Artificial Intelligence: Introduction to A d AI applications. Intelligent Agents:	Types and cha	racteristics, agent				
		ent environments. Problem Solving by Sea A*, greedy), problem formulation.	arching: Uninfor	med search (BFS,				
Unit II	first-order prediction planning problem	resentation and Reasoning: Knowledge rate logic, inference, semantic networks m, solution strategies. Constraint Satisficking, applications.	. Automated F	Planning: Concepts,				
Unit III	networks, reason	<b>I Machine Learning:</b> Uncertainty in Aning with uncertainty. Machine Learning of the forcement, basics of learning algorithms, of the forcement of the forcement of the forcement of the force with the force of the	ng Overview: T	<u> </u>				
Unit IV	alpha-beta prunin	nd Applications: Game Playing: Minimax g. Natural Language Processing (NLP): Language: Architecture, use-cases, shell design.	_					
Unit V	planning. Ethics i	s in AI: Robotics and Perception: Introdu n AI and Societal Impacts: Bias, fairness, e ve AI, conversational agents, AI in vision ar	explain ability, j					
Text Book	is .	-		,				
T.1		er Norvig, "Artificial Intelligence: A Moder	n Approach", 4t	h Ed., Pearson,				
T.2	Hill, 2019.	Knight, Shivashankar B. Nair, "Artificial I						
T.3		Mackworth, "Artificial Intelligence: Founda e University Press, 2017.	ations of Compu	itational Agents",				
Reference	Books							
R.1	•	cial Intelligence and Intelligent Systems", C	Oxford, 2015					
R.2	Research papers from	om AAAI, IJCAI, NeurIPS, and ACM.						
Useful Lin	iks							
1	https://nptel.ac.in/c	ourses/106105079						
2	-	es.nptel.ac.in/noc22_cs56						
	incps.//omnecours	20.11pto1.uo.111/110022_0030						

	Course Outcomes	CL	Class Room
1	<b>Understand</b> foundational concepts, history, and intelligent agent architectures in AI.	2	9
2	Apply different search algorithms and strategies for AI problem-solving.	3	9
Analyze various knowledge representation techniques, logical inference, and reasoning under uncertainty.			9
4	<b>Evaluate</b> AI models in tasks such as planning, game playing, and language understanding.	5	9
5	<b>Design</b> and implement introductory AI solutions using appropriate algorithms and programming tools.	6	9



1

### Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)



### Second Year (Semester – IV) B.Tech. Artificial Intelligence and Machine Learning

20	econ	a Year (Semesti	er – IV) B. I ech. Artificial Intelligence a	and Machii	ne Learning	
	Teacl	ning Scheme		Examir	nation Scheme	
Theor	у	3 Hrs./wk.	Course Code: BAI12409	CT-1	15 Marks	
Tutori	ial	-	Course Name: Fundamental of	CT-2	15 Marks	
Total Credits		ts 3	Problem solving in AI	CA	10 Marks	
	4.	CECE 2 II	r toblem solving in At	ESE	60 Marks	
D	uratio	on of ESE: 3 Hrs.		Total	100 Marks	
Course	e Obj	ective:				
1	Introduce various problem-solving paradigms and the fundamental concepts of search in Artificial Intelligence.					
2	Enab	le formulation of r	eal-world problems as search tasks and apply ap	propriate sear	ch algorithms.	
3	_	p students with leastions and comple	knowledge of uninformed and informed search exities.	rch strategies	s, including their	
4	Expo	se students to adva	nced topics like constraint satisfaction, and gam	ne playing as s	search problems.	
5		iliarize with efficien niques.	ncy issues and optimizations, such as heuristic de	esign and sear	ch space reduction	
		-	<b>Course Contents</b>			
Unit	t I		<b>oblem Solving in AI:</b> Problem characteristics: st tion of AI problems as search problems, Exam g, robotics	•	•	
Unit	II	·	d) Search Strategies: Breadth-First Search (BF) tive deepening, backtracking Uniform Cost Sear	, .		
Unit	III	Search A* Search	tic) Search Strategies: Heuristics and evaluati n: algorithm, admissibility and optimality Hearch: Hill-climbing, Simulated Annealing		•	
Unit	IV	backtracking algori	Topics: Constraint Satisfaction Problems thms, forward checking, arc consistency Searc algorithm and game trees Alpha-Beta prunated planning	h in game pla	aying: Adversarial	
Unit	Search Optimization and Analysis: Performance measures: completeness, optimality, time and space complexity Reducing search space: pruning, symmetry, abstraction Iterative improvement methods (Genetic Algorithms, Tabu Search - overview) Introduction to metaheuristics and their utility in AI problem solving					
Text I						
T.1			e – A Modern Approach by Stuart Russell and P	•		
T.2			e by Kevin Knight, Elaine Rich, and B. Shivasha	ankar Nair		
T.3			Artificial Intelligence by R. J. Schalkoff.			
Refer	Reference Books					
R.1		Search in Artificial Intelligence by L. Nilsson; Introduction to Artificial				
R.2	2	Intelligence by Phil	ip C. Jackson; AI: A New Synthesis by Nils J. N	Nilsson.		
Usefu	Useful Links					

https://assets.cambridge.org/97810092/84325/frontmatter/9781009284325\_frontmatter.pdf

2	2 https://www.cet.edu.in/noticefiles/271_AI%20Lect%20Notes.pdf					
	Course Outcomes					
1	Formulate and model problems as search tasks in Artificial Intelligence.	2	9			
2	<b>Apply</b> and compare uninformed and informed search algorithms for solutions.	3	9			
3	Analyze the effectiveness and limitations of various search strategies.	4	9			
4	Apply constraint satisfaction and adversarial search techniques to problems.	3	9			
5	<b>Evaluate</b> and optimize search-based solutions for real-world AI problems.	5	9			



Wardha Road, Nagpur- 441 108 NAAC Accredited (A+ Grade)



(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

### Third Year (Semester-V) B. Tech. Artificial Intelligence and Machine Learning

<b>Teaching Scheme</b>		ing Scheme		Examin	ation Scheme	
Tł	neory	3 Hrs./wk.	Course code: BAI13512	CT-I	15 Marks	
Tu	ıtorial	-	Course Name: - Basics of	CT-II	15 Marks	
Total	Total Credits 3		Knowledge Representation &	CA	10 Marks	
	D	CECE 211	Reasoning	ESE	60 Marks	
	Duration	of ESE: 3 Hrs.		Total	100 Marks	
Co	urse Obj	ectives:				
1	Underst	and the informed an	d uninformed problem types and apply sea	arch strategie	es to solve them.	
2		difficult real-life process like searching ar	oblems in a state space representation so	as to solve	e those using AI	
3	_		ligent expert models for perception and	d prediction	from intelligent	
	environ			1		
4	Formula	ate valid solutions f	or problems involving uncertain inputs or	r outcomes b	by using decision	
		techniques.				
5			nowledge to select and apply AI tools to	o synthesize	information and	
	develop	models within cor	astraints of application			
		T . 1	Course Contents	A.T. 1. 111		
	T •4 TF	_	roblems, foundation of AI and history of	_		
(	J <b>nit I</b>		s, the concept of rationality, the nature of environments, structure of olving agents, problem Formulation.			
			ing for solutions, uniformed search strate	egies – Brea	dth first search	
		_	a. Search with partial information (Heuristic search) Greedy best first			
U	nit II	search, A* search Game Playing: Adverbial search, Games, minimax, algorithm, optimal				
		decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of				
		search.				
U	Unit III  Knowledge Representation: Using Predicate logic, representing facts in logic, function and predicates, Conversion to clause form, Resolution in propositional logic, Resolution predicate logic, Unification. Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, forward versus Backward Reasoning			ic, Resolution in ocedural Versus easoning		
		_	Incertain Knowledge: Uncertainty, non-		=	
U	nit IV	-	ms, default reasoning and closed world	_		
		probabilistic reasoning, Bayesian probabilistic inference, introduction to fuzzy sets and fuzzy logic, reasoning using fuzzy logic.				
		•	aing using fuzzy logic.  Appresenting and using Domain Knowledge	Resconing	with knowledge	
TI	nit V		Shells, Support for explanation exam	_	_	
	1111 ¥	examples.	onens, support for explanation exam	ipios, itilowi	cage acquisition-	
		1				

Text Bo	Text Books					
T.1	Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/					
	Pearson Education.					
T.2	Artificial Intelligence, Kevin Knight, Elaine Rich, B. Shivashankar Nair, 3rd Edition,2008					
T.3	Artificial Neural Networks B. Yagna Narayana, PHI.					
T.4	Artificial Intelligence, 2nd Edition, E.Rich and K.Knight (TMH).					
Referen	Reference Books					
R.1	Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.					
R.2	PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson					
K.Z	Education.					
Useful l	Useful Links					
1	https://cyber.harvard.edu/topics/ethics-and-governance-ai					
2	https://royalsocietypublishing.org/doi/full/10.1098/rsta.2018.0085					
3	https://arxiv.org/abs/1812.02953					

	Course Outcomes	CL	Class Session
CO1	<b>Identify</b> problems that are amenable to solution by specific AI methods	2	9
CO2	Represent knowledge in Prolog and write code for drawing inferences.	3	9
CO3	Identify appropriate AI technique for the problem at hand	3	9
CO4	<b>Compare</b> strengths and weaknesses of different artificial Intelligence techniques.	3	9
CO5	Sensitive towards development of responsible	4	9



Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)



# Third Year (Semester – IV) B.Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		ing Scheme		Examinatio	on Scheme		
Theory	7	3 Hrs./wk.	Course Code: BAI13614	CT-1	15 Marks		
Tutoria	al	-	Course Name: Introduction to	CT-2	15 Marks		
Total C	Credits	3	Machine Learning	CA	10 Marks		
D	uratio	n of ESE: 3 Hrs.	Wacinite Dear ining	ESE	60 Marks		
				Total	100 Marks		
Course							
1	learn	ing paradigms.	undamental concepts and methods in machine l				
2		ly and interpret core all alyze and construct N	mathematical principles such as linear algebra, ML algorithms.	probability, and o	ptimization		
3	_	ement and experime programming librarie	nt with machine learning models on real-world	datasets using mo	odern tools		
4			achine learning algorithms based on their perform	rmance, strengths	, limitations,		
4	and a	applicability to specif	ic problems.				
5			learning-based solutions to practical problems a AI and data science.	and prepare for a	lvanced		
			<b>Course Contents</b>				
Unit I		Introduction to Machine Learning: What is Machine Learning? History and Evolution of ML					
		Types of Machine Learning: Supervised Learning Unsupervised Learning Reinforcement Learning Applications of ML in various domains Challenges in Machine Learning.					
Unit II	г	Mathematical Foundations for ML: Linear Algebra: Vectors, Matrices, Eigenvalues					
Omt 11	L	Probability & Statistics for ML: Bayes' Theorem, Expectation, Variance, Optimization					
		Techniques: Gradient Descent Overfitting and Under fitting Bias-Variance Trade-off					
		Supervised Learning Algorithms and Unsupervised Learning Algorithms: Regression					
Unit II	ſΤ	Techniques: Linear Regression Logistic Regression Classification Algorithms: k-Nearest Neighbours (KNN) Decision Trees Support Vector					
		Machines (SVM) Naive Bayes Model Evaluation: Accuracy, Precision, Recall, F1-Score,					
		Confusion MatrixClustering: K-Means Hierarchical Clustering DBSCAN Dimensionality					
		Reduction: PCA (Principal Component Analysis) t-SNE Applications of Unsupervised Learning					
Unit IV	V	Advanced Topics and Model Tuning: Ensemble Methods: Random Forest Bagging & Boosting					
		(AdaBoost, XGBoost) Cross-validation Techniques Feature Selection & Engineering Hyper parameter Tuning: Grid Search, Random Search Introduction to Neural Networks					
		Tools, Libraries & Real-world Projects: Python Libraries: NumPy, Pandas, Scikit-learn, Matplotlib,					
Unit V	r	TensorFlow/Keras (basics) Building and Evaluating ML Pipelines Hands-on Case Studies: Predictive					
		Modelling (e.g., House Prices, Titanic Dataset) Classification Project (e.g., Email Spam Detection)					
/D 4 D		Ethical Considerati	ons in ML: Bias, Fairness, Transparency				
Text B							
T.1	Pattern Recognition and Machine Learning – Christopher M. Bishop						
T.2			atistical Learning – Hastie, Tibshirani, Friedman				
T.3 Machine Learning: A Probabilistic Perspective – Kevin P. Murphy							
Referen	Reference Books						
R.1	1	Hands-On Machine	Learning with Scikit-Learn, Keras & TensorFlow – Aurélien Géron				
R.2	2	Research Papers and	d Online Resources (Coursera, edX, MIT OCW	)			

Useful Lin	ıks		
1	https://nptel.ac.in/courses/106/105/106105214/		
2	https://nptel.ac.in/courses/106/102/106102132		
	CL	Class Session	
1	Understand and apply core ML algorithms.	2	9
2	Implement ML solutions in Python.	3	9
3	Evaluate and improve models using statistical techniques.	5	9
4	Solve real-world problems using ML methodologies.	3	9
5	Understand and apply core ML algorithms.	2	9



Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)



### Fourth Year (Semester - VII) B.Tech. Artificial Intelligence and Machine Learning

ro	urtn	t ear (Semeste	r – VII) B. I ech. Artificial Intelligence	and Machine	Learning
Teaching Scheme		ng Scheme		Examination	on Scheme
Theory	y	3 Hrs./wk.	Course Code: BAI14708	CT-1	15 Marks
Tutori	al	-	Course Name: Fundamentals of	CT-2	15 Marks
Total Credits		3	Deep Learning	CA	10 Marks
D	unation	of ECE 2 Hwg	Deep Learning	ESE	60 Marks
D	uration	of ESE: 3 Hrs.		Total	100 Marks
	se Obj				
1			tal concepts of deep learning, Bayesian learning		
2	appro	priate tools.	various neural network architectures, including		
3	Analy netwo	_	strategies (e.g., SGD, RMSProp, Adam) and reg	gularization techni	iques in deep
4		nate different dee entation.	p learning models and techniques for classificat	ion, detection, an	d
5	Desig		vanced deep learning architectures such as LST	M, GANs, and V	AEs for real-
	1		<b>Course Contents</b>		
Unit I Foundations of Deep Learning: Introduction to Deep Learning and its Applicat Learning and Decision Surfaces, Linear Classifiers, Linear Machines with Optimization Techniques:, Gradient Descent, Batch Optimization			Machines with	•	
Unit	111	(MLP), Backprop	and Backpropagation: Introduction to Neural No agation Learning Algorithm, Unsupervised Losic and Denoising Autoencoders	•	
Unit		Architecture and C	ural Networks and Transfer Learning: Convolutioncepts, Building Blocks of CNNs: Convolutione-tuning, Revisiting Gradient Descent: Momentum	n, Pooling, Activa	ation, Transfer
Unit	<b>IV</b> ]	Early Stopping, I	egularization and Modern Architectures Effective Dropout, Batch Normalization Instance Norman Architectures:, Residual Networks (ResNorman)	lization, Group N	Normalization,
Unit V Advanced Applic Image Denoising (Long Short-Term		mage Denoising Long Short-Tern	cations and Generative Models Classical Supervised Tasks with Deep Learning: Semantic Segmentation Object Detection, Recurrent Neural Networks:, LSTM m Memory) Networks, Generative Modelling with Deep Learning:, Variational AEs), Generative Adversarial Networks (GANs)		
Text	Books				
T.1	1 ]	an Goodfellow, Y	Yoshua Bengio, and Aaron Courville, Deep Lea	rning, MIT Press,	2016.
T.2	2 ]	François Chollet,	Deep Learning with Python, 2nd Ed., Manning,	, 2021.	
T.:	3	Michael Nielsen,	Neural Networks and Deep Learning, 2015 (onl	line book).	
Refe	rence	Books			
R.		Aurelien Géron, F D'Reilly, 2023.	Hands-On Machine Learning with Scikit-Learn,	Keras & TensorF	Flow, 3rd Ed.,

R.2	R.2 Research papers from NeurIPS, ICLR, CVPR, and JMLR.					
<b>Useful I</b>	Links					
1	https://nptel.ac.in/courses/106106184					
2	https://nptel.ac.in/courses/106105215					
	Course Outcomes					
1	<b>Understand</b> key concepts of deep learning, including decision surfaces, linear classifiers, and neural networks.	2	9			
2	<b>Apply</b> various optimization algorithms and training strategies to build and improve deep learning models.	3	9			
3	<b>Analyze</b> the behaviour of deep neural architectures such as CNNs, RNNs, and Autoencoders in different tasks.	4	9			
4	<b>Evaluate</b> model performance using standard metrics and select appropriate architectures for specific problems.	5	9			
5	<b>Design</b> and implement deep learning solutions using advanced architectures like LSTM, GANs, and VAEs.	3	9			



Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)



### Fourth Year (Semester - VIII) B.Tech. Artificial Intelligence and Machine Learning

100		cai (Beillestei	- viii) b. i ech. Ai tiliciai intemgence an	u maciniic	Learning			
Teachi		ng Scheme	Course Code: BAI14810	<b>Examination Scheme</b>				
Theory		3 Hrs./wk.	Course Name:	CT-1	15 Marks			
Tutorial		-	Introduction to Natural Language	CT-2	15 Marks			
Total Credits		3	Processing	CA	10 Marks			
Duration		of ESE: 3 Hrs.	Trocessing	ESE	60 Marks			
				Total	100 Marks			
	Course Objective:							
$\frac{1}{2}$		ain key NLP concepts like text processing, language modeling, and parsing.						
3		y ML techniques to tasks such as tagging, parsing, and classification.  NLP pipelines using Python tools.						
4		nate NLP models using standard metrics						
5		and NLP solutions for real-world or research problems.						
	2 00.8	21(21 881001818	Course Contents					
		Toyt Processing		vt processing	(tokanization			
Unit I		<b>Text Processing &amp; Language Modelling:</b> Introduction & basic text processing (tokenization, normalization, spelling correction) Language Modelling using n-grams and smoothing						
		techniques						
Unit II		Sequence Labelling & Parsing: POS tagging and advanced smoothing, Sequence labelling						
		using Maximum Entropy models and CRFs, Syntax parsing—Constituency and Dependency						
		Parsing						
Unit III		<b>Distributional Semantics &amp; Topic Models</b> : Distributional semantics and lexical semantics (e.g. WordNet, WSD): Topic modelling techniques (e.g. LDA), and embeddings						
Unit IV		<b>Applications &amp; Text Mining</b> : Entity Linking and Relation Extraction, Text summarization, classification, sentiment analysis, and opinion mining						
Unit V		<b>Advanced &amp; Emerging Approaches:</b> Introduction to neural approaches (if covered): e.g., word embeddings and neural tagging, Deep NLP architectures—RNNs/LSTMs, transformers (depending on depth in course) Ethical considerations and multilingual NLP (especially Indian languages)						
Text	Books							
Т.	1	Speech and Language Processing – Dan Jurafsky & James H. Martin, 2nd Ed.						
T	T.2 Foundations of Sta		tatistical NLP – Manning & Schütze, MIT Press, 1999					
Refe	rence B	Books						
R	.1	Natural Language Processing with Python: Steven Bird, Ewan Klein, Edward Loper						
R	R.2 Neural Network Methods in Natural Language Processing, Yoav Goldberg, Morgan & Claypool							
Useful Links								
	1	https://nptel.ac.in/courses/106101007						
	2	https://nptel.ac.in/courses/106105158						

Course Outcomes			Class Session
1	<b>Explain</b> core concepts of Natural Language Processing, including tokenization, language modelling, syntax, and semantics.	2	9
2	<b>Apply</b> statistical and machine learning methods for basic NLP tasks like tagging, parsing, and text classification.	3	9
3	<b>Develop</b> NLP applications and pipelines using Python-based frameworks (e.g., NLTK, spaCy, Hugging Face).	3	9
4	<b>Analyze</b> the strengths and limitations of NLP algorithms using appropriate evaluation metrics.	4	9
5	<b>Design</b> and <b>implement</b> solutions for real-world problems in NLP domains such as sentiment.	3	9