COURSE HANDOUT

Artificial Intelligence and Machine Learning (MCSE201)

M.Tech (CSE) - II Semester

BATCH: 2023-2025

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Model Institute of Engineering & Technology (Autonomous)
(Permanently Affiliated to Jammu University, Accredited by NAAC "A" Grade)

Kot Bhalwal, Jammu - 181122

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SYLLABUS COPY

Course Code	Course Name	Cd	L	T	P	Marks		
						Theory (External)	Internal	Total
MCSE-201	**Artificial Intelligence and Machine Learning**	3	3	0	0	**75**	**25**	150

SECTION-A

UNIT 1: Introduction to Artificial Intelligence and Machine Learning: Basic questions of AI, history of AI, State of the art, Symbolic AI: Decision trees, symbolic computation (medical diagnosis), Generalization Theory, Statistical learning, sample complexity, proof of learnability of finite hypothesis class. **(08 hrs)**

UNIT 2: Optimization: Sample complexity of python programs, optimization SVMs / linear classification, The perceptron, margin, proof of convergence, mathematical optimization, convexity, introduction to convex analysis, constrained optimization, Gradient Descent, proof of convergence example: learning SVM with SGD, Stochastic optimization: Stochastic estimation of the gradient, stochastic gradient descent**.** **(08 hrs)**

UNIT 3: Introduction to Deep Learning: Deep nets, Non-convex optimization, Training via backpropagation algorithm, Neural nets for image recognition, Convolutional architectures, Deep nets, Regularization strategies**.** **(06 hrs)**

SECTION-B

UNIT 4: Knowledge representation: Bayesian Networks: Definition of probabilistic Bayesian nets, Modelling via Bayes nets, Inferences, Markov Chain Monte Carlo: The sampling problem, simple sampling methods, Markov chains, stationarity, ergodicity, The MCMC algorithm, Hidden Markov Models: Temporal models, application to text tagging, Viterbi decoding algorithms. **(06 hrs)**

UNIT 5: Reinforcement learning: Game playing, Search, A* heuristic, Reinforcement learning, Markov Decision Process, Markov chains, Markov Reward processes, Ergodic theory reminder, Dynamic programming, The Bellman equation, value iteration, Policy iteration, Q-learning, function approximation, TD learning, policy gradient. **(08 hrs)**.

Text Books

S. No.	Name of the Books	Author	Publisher	Edition (Pub. Yr.)
1	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Pearson	4th (2022)
2	Deep Learning	Ian Goodfellow, Yoshua Bengio, Courville	MIT Press	1st (2016)
3	Deep Reinforcement Learning	Pieter Abbeel, et al.	Springer	1st (2020)

Reference Books

S. No.	Name of the book	Author	Publisher	Edition (Pub. Yr.)
1	Hands-On Machine Learning with Scikit-Learn and TensorFlow	Aurélien Géron	O'Reilly Media	2nd (2019)
2	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer	Ist (2006)
3	Neural Networks and Deep Learning	Michael Nielsen	BPB Publications	5th (2015)

COURSE INFORMATION SHEET

PROGRAMME: Computer Science and Engineering	**DEGREE:** M.Tech
COURSE: Artificial Intelligence and Machine Learning	**SEMESTER**: IInd Sem
COURSE CODE: MCSE201	**COURSE TYPE:** Engineering Science Course
CORRESPONDING LAB COURSE CODE (IF ANY) : NA	**CONTACT HOURS:** 3 hours/Week.
LAB COURSE NAME: NA	**INTERNAL MARKS: 25** **EXTERNAL MARKS: 75**

COURSE OBJECTIVES: (MCSE201)

This course will survey the aspects of intelligence exhibited in biological systems and algorithmic approaches to mimic it. Material will include theoretical and applicative treatment of inductive learning, reinforcement learning, artificial neural networks and knowledge representation.

COURSE OUTCOMES: (I)   THEORY COURSE (MCSE201)

CO	DESCRIPTION	PO MAPPING
CO201.1	Design and implement intelligent solutions to classification, regression and clustering problems	1,2,3,6
CO201.2	Design and implement various Deep learning algorithms in a range of Real-world applications.	1,2,3,6
CO201.3	Understand various Knowledge representation techniques.	1,2,3,6

COURSE OBJECTIVES: (MCSE201)

1) To make the student learn basic concepts, principles, and foundations of artificial intelligence and machine learning.
2) To learn problem solving techniques.
3) To teach the student fundamentals of deep learning, including neural networks, backpropagation, and various architectures such as convolutional neural networks.

Teaching Plan

Unit No.	Topic	Content	No. of Classes required	Evaluation Technique	Teaching AID	Resource/Link
UNIT-1	Introduction to Artificial Intelligence and Machine Learning	**Basics of AI**	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=ad79nYk2keg**
		history of AI	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=yaL5ZMvRRqE**
		State of the art	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=RzkD_rTEBYs**
		Symbolic AI: Decision trees	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=pRDEZHxaY_Q**
		symbolic computation (medical diagnosis)	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=qj8oXh6savo**
		Generalization Theory	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=lAKL7dCcBqk**
		Statistical learning	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=2f4uKpEPjIE**
		sample complexity	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=nm4dYYP-SJs**
Unit-II	Optimization	**optimizing linear classification models**	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=f8p_KWTA2iY**
		Perceptron algorithm	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=ysQun8VbUmM**
		optimization	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=1ypV5ZiIbdA**
		Gradient Descent optimization	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=1ypV5ZiIbdA**
		SVM using SGD	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=_YPScrckx28**
		principles of Stochastic Gradient Descent	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=FpDsDn-fBKA**
Unit-III	Introduction to Deep Learning	**basics of deep neural networks**	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=bfmFfD2RIcg**
		Multi-layered architecture of neural networks	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=w8KV1Hbmez4**
		basics of convolutional neural networks	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.com/watch?v=QzY57FaENXg**

		image recognition using neural networks	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=t0EzVCvQjGE
		advantages of convolutional architectures	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=B2aI7m7wldw
		Applications of CNN	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=yopUlYe-IbQ
		Real-world Applications of CNN	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=idglu_290Wo
		concept of regularization	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=2AscwXePInA
		Effects of Dropout	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=XmLYl17DbbA
Unit-IV	**Knowledge representation**	**Bayesian Networks: probabilistic Bayesian nets**	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=SkC8S3wuIfg
		Modelling via Bayes nets Inferences	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=2zSgAHi8Zyk
		Markov Chain Monte Carlo: The sampling problem	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=i3AkTO9HLXo
		simple sampling methods	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=sKtoW5cXt14
		Markov chains	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=i3AkTO9HLXo
		The MCMC algorithm, Hidden Markov Models: Temporal models	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=yApmR-c_hKU
Unit-V	**Reinforcement learning**	**Game playing**	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=FFzdXJ49KAI
		A* heuristic Search	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=5F9YzkpnaRw
		Reinforcement learning	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=FFzdXJ49KAI
		Markov Decision Process, Markov chains, Markov Reward processes	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=i3AkTO9HLXo
		Ergodic theory reminder	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	https://www.youtube.com/watch?v=qZ0dBYhcD-

					Y&list=PLNYQfyitVEf Q1I0lauILAx3J1yf0571 9a
	Dynamic programming,	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.co m/watch?v=aIsgJJYrl Xk**
	The Bellman equati on, value iteration	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.co m/watch?v=3Rx2x2tra xw**
	Policy iteration, Q-learning	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.co m/watch?v=J3qX50yvi U0**
	function approximation, TD learning, policy gradient	1	Reflective Questions and Group Discussions	PPTs., Green board (Chalk and Talk).	**https://www.youtube.co m/watch?v=0QczhVg5 HaI**

Web Source References:

1.	**NPTEL LINK:** https://onlinecourses.nptel.ac.in/noc22_cs56/preview Link for NPTEL video lectures on An Introduction to Artificial Intelligence by Prof. Mausam, Department of Computer Science and Engineering, IIT Delhi to view and understand the videos on Complete Course of C Programming.
2.	**NPTEL LINK:** https://onlinecourses.nptel.ac.in/noc21_cs85/preview This course provides a concise introduction to the fundamental concepts in machine learning by Prof. Sudeshna Sarkar, Department of Computer Science and Engineering, IIT Kharagpur. Click on link to view and understand the videos on Complete Course of C Programming.
3.	**MOOC-** https://www.coursera.org/learn/introduction-to-ai Link of Coursera course namely "Introduction to Artificial Intelligence (AI)".

Evaluation Scheme:

The term work will consist of the submission of 1 assignments and 1 sessional test of 10 marks each will be awarded for the sessional and a maximum of 10 marks will be awarded for the term attendance strictly as per following scheme**:**

Attendance Percentage	Marks out of 10
60.1-74.9	0
75-85	3
85.1-90	4
90.1-100	5

Assignment Submission Dates
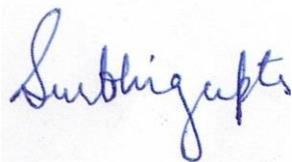
Assignment due date: 20-03-2024

Instructor Consultation Hours:

Dr. Surbhi Gupta: Thursday (12:00 pm to 12:55 pm)
Dr. Surbhi Gupta: Wednesday (12:00 pm to 12:55 pm)

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Dr. Surbhi Gupta