SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)

Department of Information Technology

Name of the course:	B. Tech in **Artificial Intelligence and Data Science**
Semester and Year of study	B. Tech 4rd Year 8thSemester
Subject Category	Engineering Science Course (OE-IV)
Subject Code: AI-2081 (A)	Subject Name: AI: Constraint Satisfaction

Maximum Marks Allotted							Contact Hours			Total Credits
Theory				Practical		**Total Marks**				
End Sem	Mid-Sem	Quiz	Assign	End Sem	Lab-Work		L	T	P	
70	20	10				100	3			3

Prerequisites:

Exposure to AI: Search Methods for Problem Solving and AI: Knowledge Representation & Reasoning helps, but is not necessary

Course Objective:

Human beings solve problems in many different ways. Problem solving in artificial intelligence (AI) is inspired from these diverse approaches. AI problem solvers may be based on search, on memory, or on knowledge representation and reasoning. An approach to problem solving is to pose problems as constraint satisfaction problems (CSP), and employ general methods to solve them. The task of a user then is only to pose a problem as a CSP, and then call an off-the-shelf solver. CSPs are amenable to combining search based methods with reasoning. In this 2 credit course we will look at general approaches to solving finite domain CSPs, and explore how search can be combined with constraint propagation to find solutions.

Course Outcomes: After completion of this course students will be able to

CO1. Understand the fundamental principles of Constraint satisfaction problems.
CO2. Learn different types of consistency.
CO3. Develops skills for solving CSPs.
CO4. Understand the role of lookahead and lookback methods.
CO5. Apply industry best practices for model based diagnosis.

UNITs	Descriptions	Hrs.	CO's
I	Constraint satisfaction problems (CSP), examples. Constraint networks, equivalent and projection networks.	8	1
II	Constraint propagation, arc consistency, path consistency, i-consistency. Directional consistency and graph ordering, backtrack free search, adaptive consistency.	8	2
III	Search methods for solving CSPs, lookahead methods, dynamic variable and value ordering.	8	3
IV	Look back methods, Gaschnig's backjumping, graph based backjumping, conflict directed back jumping. Combing lookahead with lookback, learning.	10	4
V	Model based systems, model based diagnosis, truth maintenance systems, planning as CSP. Wrapping up.	8	5
Guest Lectures (if any)		Nil	
Total Hours		42	

Suggestive list of experiments:
NO Lab
Text Book-
Reference Books-
List and Links of e-learning resources: https://nptel.ac.in/courses/106106158
Modes of Evaluation and Rubric
The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

COs	**PO1**	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_1**	**PO_{11}**	**PO_{12}**	**PSO1**	**PSO2**
CO1	**2**	**1**	**2**										**1**	**1**
CO2	**2**	**1**	**2**										**1**	**1**
CO3	**2**	**1**	**2**										**1**	**2**
CO4	**2**	**2**	**2**										**1**	**2**
CO5	**1**	**2**	**2**	**1**	**2**								**2**	**1**

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	Ramratan Ahirwal & Rashi Kumar

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Department of Information Technology

Name of the course:	B. Tech in **Artificial Intelligence and Data Science**
Semester and Year of study	B. Tech 4th Year 8thSemester
Subject Category	Engineering Science Course (OE-IV)
Subject Code: AI-2081 (B)	Subject Name: Artificial Intelligence: Knowledge representation and reasoning

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				Practical			**Total Marks**				
End Sem	Mid-Sem	Quiz	Assign	End Sem	Lab-Work	Quiz		L	T	P	
70	20	10					100	3			3

Prerequisites:

Formal languages, logic and programming

Course Objective:

An intelligent agent needs to be able to solve problems in its world. The ability to create representations of the domain of interest and reason with these representations is a key to intelligence. In this course we explore a variety of representation formalism's and the associated algorithms for reasoning. We start with a simple language of propositions, and move on to first order logic, and then to representations for reasoning about action, change, situations, and about other agents in incomplete information situations.

Course Outcomes: After completion of this course students will be able to:

CO1. Have a good understanding of the propositional logic and basics of Tableau.
CO2. Ability to differentiate the concept of backward and forward chaining.
CO3. Understand the concept of Horn Clauses and Logic Programming
CO4. Learned to use first order logic and apply default reasoning.
CO5. Use circumscription and epistemic logic.

UNITs	Descriptions	Hrs.	CO's
I	Introduction. History and Philosophy. Symbolic Reasoning. Truth, Logic, and Provability. Propositional Logic. Direct Proofs. The Tableau Method.	8	1
II	First Order Logic. Universal Instantiation. The Unification Algorithm. Forward and Backward Chaining. The Resolution Refutation Method.	7	2
III	Horn Clauses and Logic Programming. Prolog. Rule Based Systems. The OPS5 Language. The Rete Algorithm.	8	3
IV	Representation in First Order Logic. Conceptual Dependency. Frames. Description. Logics and the Web Ontology Language. Taxonomies and Inheritance. Default Reasoning.	8	4
V	Circumscription. Auto-epistemic Reasoning. Event Calculus. Epistemic Logic. Knowledge and Belief.	9	5
Guest Lectures (if any)			
Total Hours		40	
Text Book-			
Reference Books-			

List and Links of e-learning resources:https://nptel.ac.in/courses/106106140

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

COs	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_1	PO_{11}	PO_{12}	PSO1	PSO2
CO-1	**1**	**1**	**2**		**2**							**2**	**1**	**2**
CO-2	**3**	**2**	**2**										**1**	**2**
CO-3	**2**	**1**	**2**		**2**								**1**	**2**
CO-4	**2**	**1**	**2**											**2**
CO-5	**2**	**2**	**2**								**1**			**1**

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	Ramratan Ahirwal & Rashi Kumar

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Department of Information Technology

Name of the course:	B. Tech in **Artificial Intelligence and Data Science**
Semester and Year of study	B. Tech 4th Year 8thSemester
Subject Category	Engineering Science Course (OE-V)
Subject Code: AI-2082 (A)	Subject Name: Optimisation for Machine Learning: Theory and Implementation

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				Practical			**Total Marks**				
End Sem	Mid-Sem	Quiz	Assign	End Sem	Lab-Work	Quiz		L	T	P	
70	20	10					100	3			3

Prerequisites:

Linear Algebra, Calculus, Basic Programming

Course Objective:

Optimisation is the workhorse of machine learning. Knowing optimisation is a key prerequisite in understanding theory and practise of machine learning. In this course, we will discuss the foundations required for solving optimization problems in the context of machine learning through various case-studies/running-examples. We will start with covering the basics of linear algebra and calculus required for learning optimization theory. We will learn both the theory and implement optimization algorithms like stochastic gradient descent and its various variants to solve machine learning problems of classification, clustering etc using standard problem formulations which are convex (SVM etc) and non-convex (Neural Networks and Deep Neural Networks) etc.

Course Outcomes: After completion of this course students will be able to:

CO1. Describe a basics of linear algebra and calculus.
CO2. Classify convex and non convex optimization problems.
CO3. Develop gradient descent.
CO4. Correlate variants of gradient descent and train a neural network.
CO5. Assess the newton's method.

UNITs	Descriptions	Hrs.	CO's
I	Basics of Linear Algebra and Calculus: Subspaces, EigenValue Decomposition, Singular Value Decomposition - Algorithms and Methods, PSD Matrices and Kernel Functions, Vector Calculus	8	1
II	Convex Functions, First and Second Order Conditions for Optimisations, Convex and Non Convex Optimisation problems in Machine Learning.	**7**	2
III	Gradient Descent: math, programming basic optimisation problems and their solutions	8	3
IV	Variants of Gradient Descent: Projected, Stochastic, Proximal, Accelerated, Coordinate Descent, Training a Neural Network: Theory	8	4
V	Newton's Method, Optimization for ML in practice: Pytorch/Tensor Flow. Training a Neural Network, Implementation	9	5
Guest Lectures (if any)			
Total Hours		40	

Text Book-

Reference Books-

List and Links of e-learning resources:https://nptel.ac.in/courses/106106245

Modes of Evaluation and Rubric
The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

COs	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_1	PO_{11}	PO_{12}	PSO1	PSO2
CO-1	**1**	**1**	**2**										**1**	**2**
CO-2	**3**	**2**	**2**										**1**	**2**
CO-3	**2**	**1**	**2**		**2**								**1**	**2**
CO-4	**2**	**1**	**2**											**2**
CO-5	**2**	**2**	**2**											**1**

Recommendation by Board of studies on	
Approval by Academic council on	
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Name of the course:	B. Tech in **Artificial Intelligence and Data Science**
Semester and Year of study	B. Tech 4th Year 8thSemester
Subject Category	Engineering Science Course (OE-V)
Subject Code: AI-2082 (B)	Subject Name: Fuzzy Sets, Logic and Systems & Applications

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				Practical			**Total Marks**				
End Sem	Mid-Sem	Quiz	Assign	End Sem	Lab-Work	Quiz		L	T	P	
70	20	10					100	3			3

Prerequisites:

Linear Algebra, Calculus, Basic Programming

Course Objective:

The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

Course Outcomes: After completion of this course students will be able to:

CO1. Understand the concept of fuzzy sets theory.
CO2. Learn to create fuzzy relations.
CO3. Develops fuzzy interface systems.
CO4. Understand the Wang and Mendel Model.
CO5. Apply fuzzifiers and defuzzifiers in machine learning.

UNITs	Descriptions	Hrs.	CO's
I	Introduction and Fuzzy Sets Theory. Membership Functions	8	1
II	Set Theoretic Operations. Fuzzy Arithmetic. Fuzzy Relations	**7**	2
III	Fuzzy Inference Systems I. Fuzzy Inference Systems II	8	3
IV	Wang and Mendel Model. TSK Model	8	4
V	Fuzzifiers and Defuzzifiers. ANFIS Architecture Fuzzy Systems and Machine Learning	9	5
Guest Lectures (if any)			
Total Hours		40	

Text Book-

Reference Books-

List and Links of e-learning resources:https://nptel.ac.in/courses/108104157

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

COs	**PO_1**	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_1**	**PO_{11}**	**PO_{12}**	**PSO1**	**PSO2**
CO-1	**1**	**1**									**3**	**3**	**3**	**2**
CO-2	**1**		**1**	**2**							**2**	**1**	**3**	**2**
CO-3	**2**	**1**									**2**	**2**	**1**	**2**
CO-4	**3**	**2**	**3**	**2**	**1**			**1**	**2**		**3**		**3**	**1**
CO-5	**3**	**3**	**2**	**1**				**2**		**2**	**2**	**3**	**1**	**1**

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	Ramratan Ahirwal & Rashi Kumar