Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra
Telephone and Fax. 02140 - 275142
www.dbatu.ac.in

Structure and Detailed Syllabus

for UG Degree

Minor in Artificial Intelligence

in line with New Education Policy 2020

(Effective from Academic year 2024-25 for main campus)

Bucket for Minor in Artificial Intelligence

Case I: B. Tech degree with Minor in Artificial Intelligence (160-176 credits)

The Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with multidisciplinary minor (min.160-max.176 Credits) i.e. "**B. Tech in chosen Engg./ Tech. Discipline with Minor in Artificial Intelligence**" (160-176 credits) enables students to take up four-six or required additional courses of 14 credits in the discipline other than **chosen Engg./ Tech. Discipline** distributed over semesters III to VIII.

Case II: Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor (Multidisciplinary and Specialization Minor 180-194 credits)

The **Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor** (Multidisciplinary and Specialization Minor, 180-194 credits), i.e. "**B. Tech in chosen Engg./ Tech. Discipline with minor in *other selected discipline in* Engineering (as MDM) with Specialization Minor in Artificial Intelligence**" (180-194 credits) enables students to take up four-six additional courses of 14 credits in the discipline other than **chosen Engg./ Tech. Discipline** (for completion of multidisciplinary minor) and 18 to 20 extra credits in the **Artificial Intelligence** distributed over semesters III to VIII. Here, the ***other selected discipline* in Engineering should be different from Specialization Minor i.e. Artificial Intelligence**. This enables students to take up four-six or required additional courses of 18 to 20 credits in the discipline of **Artificial Intelligence** distributed over semesters III to VIII, which are over and above the min.160-max.176 Credits. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, prescribed for the duration of four years will be taken by respective BoS. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.

Basic Semester wise credit distribution of the syllabus is as follows as per NEP-2020.

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	06-08	08-10		--	--	--	--	--	14-18
Engineering Science Course		10-08	06-04		--	--	--	--	--	16-12
Programme Core Course (PCC)	Program Courses	--	02	08-10	08-10	10-12	08-10	04-06	04-06	44-56
Programme Elective Course (PEC)		--	--	--	--	04	08	02	06	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses		-	02	02	04	02	02	02	14
Open Elective (OE) Other than a particular program		--	--	04	02	02	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)			02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--		04	04
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	-	-	02
Project		--	--	--	--	--	--		04	04
Internship/ OJT		--	---			--	--	12	-	12
Co-curricular Courses (CC)	Liberal Learning Courses	02	02		--	--	--	--	-	04
Total Credits (Major)		**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**160-176**

List of Courses for

Minor in Artificial Intelligence

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource person	Link
1	Introduction to Artificial Intelligence	4Hrs /week	12 Weeks	3	IIT Delhi	By Prof. Mausam	https://onlinecourses.nptel.ac.in/noc24_cs08/preview
2	Introduction to Machine Learning	4Hrs /week	8 Weeks	2	IIT Kharagpur	Prof. S. Sarkar	https://nptel.ac.in/courses/106105152
3	Natural Language Processing	4Hrs /week	12 Weeks	3	IIT Kharagpur	Prof. Pawan Goyal	https://onlinecourses.nptel.ac.in/noc24_cs39/preview
4	Computer Vision	4Hrs /week	12 Weeks	3	IIT Kharagpur	Prof. Jayanta Mukhopadhyay	https://nptel.ac.in/courses/106105216
5	Reinforcement Learning	4Hrs /week	12 Weeks	3	IIT Madras	Prof. Balaraman Ravindran	https://onlinecourses.nptel.ac.in/noc24_cs52/preview
6	Artificial Intelligence: Knowledge Representation And Reasoning	4Hrs /week	12 Weeks	3	IIT Madras	Prof. Deepak Khemani	https://onlinecourses.nptel.ac.in/noc24_cs14/preview
7	Deep Learning	4Hrs /week	12 Weeks	3	IIT Kharagpur	Prof. P.K. Biswas	https://nptel.ac.in/courses/106105215
8	Applied Linear Algebra in AI and ML	4Hrs /week	12 Weeks	3	IIT Kharagpur	Prof. Swanand Khare	https://nptel.ac.in/courses/111105165
9	Fuzzy Logic and Neural Networks	4Hrs /week	8 Weeks	2	IIT Kharagpur	Prof. Dilip Kumar Pratihar	https://nptel.ac.in/courses/127105006

An Introduction to Artificial Intelligence

Module 1:Introduction: Philosophy of AI, Definitions

Module 2:Modeling a Problem as Search Problem, Uninformed Search

Module 3:Heuristic Search, Domain Relaxations

Module 4:Local Search, Genetic Algorithms

Module 5:Adversarial Search

Module 6:Constraint Satisfaction

Module 7:Propositional Logic & Satisfiability

Module 8:Uncertainty in AI, Bayesian Networks

Module 9:Bayesian Networks Learning & Inference, Decision Theory

Module 10:Markov Decision Processes

Module 11:Reinforcement Learning

Module 12:Introduction to Deep Learning & Deep RL

Introduction to Machine Learning

Module 1:Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.

Module 2:Linear regression, Decision trees, over fitting.

Module 3:Instance based learning, Feature reduction, Collaborative filtering based recommendation.

Module 4:Probability and Bayes learning

Module 5:Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

Module 6:Neural network: Perceptron, multilayer network, back propagation, introduction to deep neural network.

Module 7:Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

Module 8:Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model.

Natural Language Processing

Module 1: Introduction and Basic Text Processing

Module 2: Spelling Correction, Language Modeling

Module 3:Advanced smoothing for language modeling, POS tagging

Module 4:Models for Sequential tagging – MaxEnt, CRF

Module 5: Syntax – Constituency Parsing

Module 6: Dependency Parsing

Module 7: Distributional Semantics

Module 8: Lexical Semantics

Module 9: Topic Models

Module 10: Entity Linking, Information Extraction

Module 11: Text Summarization, Text Classification

Module 12: Sentiment Analysis and Opinion Mining

Computer Vision

Module 1: Fundamentals of Image Processing

Module 2: 2-D Projective Geometry and Homography and Properties of homography

Module 3: Camera geometry

Module 4: Stereo geometry

Module 5: Stereo Geometry

Module 6: Feature detection and description

Module 7: Feature matching and model fitting

Module 8: Color Processing

Module 9: Range image processing

Module 10: Clustering and classification

Module 11: Dimensionality Reduction and Sparse Representation

Module 12: Deep Neural Architecture and applications

Reinforcement Learning

Module 1: Introduction

Module 2: Bandit algorithms – UCB, PAC

Module 3: Bandit algorithms –Median Elimination, Policy Gradient

Module 4: Full RL & MDPs

Module 5: Bellman Optimality

Module 6: Dynamic Programming & TD Methods

Module 7: Eligibility Traces

Module 8: Function Approximation

Module 9: Least Squares Methods

Module 10: Fitted Q, DQN & Policy Gradient for Full RL

Module 11: Hierarchical RL

Module 12: POMDPs

Artificial Intelligence: Knowledge Representation and Reasoning

Module 1: Introduction. History and Philosophy.

Module 2: Symbolic Reasoning. Truth, Logic, and Provability.

Module 3: Propositional Logic. Direct Proofs. The Tableau Method.

Module 4: First Order Logic. Universal Instantiation. The Unification Algorithm.

Module 5: Forward and Backward Chaining. The Resolution Refutation Method.

Module 6: Horn Clauses and Logic Programming. Prolog.

Module 7: Rule Based Systems. The OPS5 Language. The Rete Algorithm.

Module 8: Representation in First Order Logic. Conceptual Dependency.

Module 9: Frames. Description Logics and the Web Ontology Language

Module 10: Taxonomies and Inheritance. Default Reasoning.

Module 11: Circumscription. Auto-epistemic Reasoning. Event Calculus

Module 12: Epistemic Logic, Knowledge and Belief.

Deep Learning

Module 1: Introduction to Deep Learning, Bayesian Learning, Decision Surfaces

Module 2: Linear Classifiers, Linear Machines with Hinge Loss

Module 3: Optimization Techniques, Gradient Descent, Batch Optimization

Module 4: Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning

Module 5: Unsupervised Learning with Deep Network, Auto encoders

Module 6: Convolutional Neural Network, Building blocks of CNN, Transfer Learning

Module 7: Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

Module 8: Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization

Module 9: Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc.

Module 10: Classical Supervised Tasks with Deep Learning, Image Denoising, Semanticd Segmentation, Object Detection etc.

Module 11: LSTM Networks

Module 12: Generative Modeling with DL, Variational Auto encoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

Applied Linear Algebra in AI and ML

Module 1: Vectors, operations on vectors, vector spaces and subspaces, inner product and vector norm, linear dependence and independence, Matrices, linear transformations, orthogonal matrices

Module 2: System of linear equations, existence and uniqueness, left and right inverses, pseudo inverse, triangular systems

Module 3: LU decomposition and computational complexity, rotators and reflectors, QR decomposition, Gram Schmidt Orthogonalization

Module 4:Condition number of a square matrix, geometric interpretation, norm of matrix, sensitivity analysis results for the system of linear equations

Module 5: Linear least squares, existence and uniqueness, geometrical interpretation, data fitting with least squares, feature engineering, application to Vector auto-regressive models, fitting with continuous and discontinuous piecewise linear functions

Module 6: Application of least squares to classification, two-class and multi-class least squares classifiers, Polynomial classifiers, application to MNIST data set

Module 7: Multi-objective least squares, applications to estimation and regularized inversion, regularized data fitting and application to image de-blurring, constrained least squares, application to portfolio optimization

Module 8: Eigenvalue eigenvector decomposition of square matrices, spectral theorem for symmetric matrices

Module 9:SVD, relation to condition number, sensitivity analysis of least squares problems, variation in parameter estimates in regression

Module 10: Multicollinearity problem and applications to principal component analysis (PCA) and dimensionality reduction, power method, application to Google page ranking algorithm

Module 11: Underdetermined systems of linear equations, least norm solutions, sparse solutions, applications in dictionary learning and sparse code recovery, inverse eigenvalue problem, application in construction of Markov chains from the given stationary distribution

Module 12: Low rank approximation (LRA) and structured low rank approximation problem (SLRA), application to model order selection in time series, alternating projections for computing LRA and SLRA

Fuzzy Logic and Neural Networks

Module 1: Introduction to Fuzzy Sets

Module 2: Introduction to Fuzzy Sets (contd.); Fuzzy reasoning

Module 3: Fuzzy reasoning (contd.); Fuzzy clustering

Module 4: Fuzzy clustering (contd.); Fundamentals of Neural Networks

Module 5: Multi-layer Feed-Forward Neural Network; Radial Basis Function Network

Module 6: Self-Organizing Map; Counter-Propagation Neural Network; Recurrent Neural Networks; Deep Learning Neural Network

Module 7: Genetic-Fuzzy system; Genetic-Neural System

Module 8: Neuro-Fuzzy System; Concepts of Soft Computing and Computational Intelligence; Summary of the Course