University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2022

Subject Name: Artificial Intelligence & Machine Learning **Credit:** 3 **Lecture Hours:** 40

Subject Code: **PCCCS504**

Prerequisites: Mathematics, Data structure and Algorithms

Relevant Links:

Study Material NPTEL Coursera Linkedin Learning

Course Objective:

Obj 1. The students will understand the basics concepts of Artificial Intelligence and Machine Learning.
Obj 2. They will also learn and will be able to apply different AI and ML models to various datasets.

Course Outcome:

CO 1. Understand the basic concepts and techniques of Artificial Intelligence and Machine Learning.
CO 2. Analyze various AI and ML techniques and algorithms
CO 3. Apply AI and ML algorithms for solving practical problems.
CO 4. Explain how sequential models and transformer models work

Module Number	Topic	Sub- Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Lab Assignment
1	**Introduction to AI**	Introduction Artificial Intelligence and its applications, Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents, Nature of Agents, Learning Agents. AI Techniques, advantages, and limitations of AI, Impact and Examples of AI, Application domains of AI. The AI Ladder - The Journey for Adopting AI Successfully, Advice for a career in AI, Hotbeds of AI Innovation.	*AICTE-prescribed syllabus:* https://www.aicte-india.org/sites/default/files/UG_Emerging.pdf *International Academia:* *https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/resources/lecture-1-introduction-and-scope/* *Industry Mapping:* ***Python***	4	Basic Programs using Python From https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
Artificial Intelligence by Rich and Knight Chapter 1, 2					

Module Number	Topic	Sub- Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Lab Assignment
2	**Problem solving techniques**	State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A* search, Constraint satisfaction problem, Mean-end analysis, Min-Max Search, Alpha-Beta Pruning, Additional refinements, Iterative Deepening.	*AICTE-prescribed syllabus:* https://www.aicte-india.org/sites/default/files/UG_Emerging.pdf *International Academia:* *https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/resources/lecture-1-introduction-and-scope/* *Industry Mapping:* ***Python***	10	**1. Python programming, symbolic algebra.** **2. Implementation of Depth first search, Breadth first search** **3. Implementation of A* search** **4. Implementation of bi-directional search** **5. Implementation of Decision Tree Classifier.**
Artificial Intelligence by Rich and Knight Chapter 3, 12;					

Module Number	Topic	Sub- Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Lab Assignment
3	**Introduction to ML**	What Is Machine Learning, How Do We Define Learning; what are datasets and how to handle them, Feature sets, Dataset division: test, train and validation sets, Holdout, cross validation, k Cross validation, random sampling LOOCV, Bootstrap sampling; Fitting of data; **Evaluation Measures:** SSE, MME, R2, Confusion Matrix, Precision, recall, F-Score, Kappa, ROC- Curve, Cross-Entropy Loss.	*AICTE-prescribed syllabus:* *https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf* *International Academia:* *https://ocw.mit.edu/courses/6-036-introduction-to-machine-learning-fall-2020/* *Industry Mapping:* ***Python***	6	**1. Implementation of Splitting real life data using** **a. Holdout,** **b. K Fold,** **c. Stratified K Fold,** **d. Leave-One-Out (LOO),** **e. Leave-P-Out (LPO),** **f. Shuffle Split.** **1. Compare them.** **2. Bootstrap Sampling.** **3. WAP to construct** **a. AUC-ROC curve** **b. Confusion matrix** **4. WAP Scale features in a given dataset**
Introduction to Machine Learning, Ethem Alpaydın, Chapter 1, 2, 19					

Module Number	Topic	Sub- Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Lab Assignment
4	**Supervised & Unsupervised learning techniques**	Supervised: Classification and Regression: Binary, Multi-label, Multiclass, Imbalance; K-Nearest Neighbour, Linear Regression, Logistic Regression, Naïve Bayes, Support Vector Machine (SVM), Decision Tree. Unsupervised: Introduction to clustering, Types of Clustering: Hierarchical, Agglomerative Clustering and Divisive clustering; Partitioned Clustering - K-means clustering, Association Analysis(Ginni)	*AICTE-prescribed syllabus:* *https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf* *International Academia:* *https://ocw.mit.edu/courses/6-036-introduction-to-machine-learning-fall-2020/* *Industry Mapping:* ***Python***	10	**1. Implementation on real life data** **1. Multi-class Classification** **2. Multi-label Classifications** **1. Implementation on real life data KNN** **2. Implementation on real life data Linear regression** **4. Implementation on real life data Naïve Base, Gaussian Naive Bayes** **5. Implementation on real life data SVM** **6. Implementation on real life data with** Decision **Tree** **7. Implementation on real life data Association Rule Mining** **8. Implementation on real life data with Ginni**

Introduction to Machine Learning, Ethem Alpaydın, Chapter 5, 8, 9, 12, 13

Module Number	Topic	Sub- Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Lab Assignment
5	**Introduction to Deep Learning**	Neural Network Architecture: Biological vs artificial neuron, Definition and Evolution of ANN, Perceptron, XOR problem, non-linearity, activation functions, stochastic gradient descent, loss functions, multi-layered perceptron, Backpropagation. Convolutional Neural Networks: Filter based image processing, convolution-1D, 2D, 3D, subsampling, rectified-linear units, fully-connected layers, CNN design principles, Applications (AlexNet, VGGNet, ResNet)	*AICTE-prescribed syllabus:* *https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf* *International Academia:* *https://www.coursera.org/learn/convolutional-neural-networks* *Industry Mapping:* TensorFlow Keras, PyTorch	10	Introduction to TensorFlow Keras, PyTorch https://www.coursera.org/learn/introduction-tensorflow **1. Implementation of different activation functions to train Neural Network.** **2. Implementation of Perceptron Networks** **3. Build Artificial Neural Network model with back propagation on a real life dataset.**
Deep Learning - Foundations and Concepts, Christopher M. Bishop, Hugh Bishop, Springer 2024 Chapter- 1,6,7,8,10, 11					

Module Number	Topic	Sub- Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Lab Assignment
6	**Generative AI and Large Language Models**	Introduction to Generative Artificial Intelligence (GANs and VAEs), Introduction to Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU): Types of RNN Layers for Sequential Data, Introduction to Generative Adversarial Networks(GANs) and Variational Autoencoders (VAEs), Large Language Models (LLMs) and Transformer Architecture.	*AICTE-prescribed syllabus:* *https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf* *International Academia:* *https://www.coursera.org/learn/convolutional-neural-networks* *Industry Mapping:* TensorFlow Keras, PyTorch	10	Introduction to TensorFlow Keras, PyTorch https://www.coursera.org/learn/introduction-tensorflow
Deep Learning - Foundations and Concepts, Christopher M. Bishop, Hugh Bishop, Springer 2024 Chapter- 12, 17, 19					

TEXT BOOK:

1. Artificial Intelligence by Rich and Knight, The McGraw Hill, 2017
2. Introduction to Machine Learning, Ethem Alpaydın, The MIT Press, Third Edition
3. Deep Learning - Foundations and Concepts, Christopher M. Bishop, Hugh Bishop, Springer 2024

Reference book:

1. Artificial Intelligence: A modern approach by Stuart Russel, Pearson Education, 2010
2. Machine Learning for Dummies, By John Paul Mueller and Luca Massaron, For Dummies, 2016
3. Machine Learning: Theory and Practice, M.N. Murty, V.S. Ananthanarayana , Universities Press, 2024
4. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016
5. Machine Learning, Tom M. Mitchell, McGraw Hill Education, 2017.
6. Artificial Intelligence & Generative AI for Beginners, The Complete Guide, David M. Patel, Independently published 2023

Online resources:

1. https://nptel.ac.in/courses/106102220
2. https://nptel.ac.in/courses/106105077
3. https://nptel.ac.in/courses/106106139
4. https://onlinecourses.nptel.ac.in/noc20_cs81/preview
5. https://onlinecourses.nptel.ac.in/noc20_cs49/preview
6. https://www.coursera.org/learn/machine-learning-duke
7. https://www.linkedin.com/learning/artificial-intelligence-foundations-machine-learning-22345868?trk=course_title&upsellOrderOrigin=default_guest_learning
8. https://www.mooc-list.com/course/transformer-models-and-bert-model-coursera
9. https://www.coursera.org/learn/nlp-sequence-models

Mandatory Prerequisite:
https://www.linkedin.com/learning/learning-python-4393370
To be completed before the starting of the class.

List of Mini Projects

#	Project Title	Project Detail
1	AI-powered Legal Documentation Assistant	https://sih.gov.in/sih2023PS#:~:text=AI%2Dpowered%20Legal%20Documentation%20Assistant
2	Use of Digital Technology to calculate water footprints for different daily use items.	https://sih.gov.in/sih2023PS#:~:text=Use%20of%20Digital%20Technology%20to%20calculate%20water%20footprints%20for%20different%20daily%20use%20items
3	Digital Assistant for Legal Awareness and Designing a KYR Know-Your-Rights framework in India	https://sih.gov.in/sih2023PS#:~:text=Digital%20Assistant%20for%20Legal%20Awareness%20and%20Designing%20a%20KYR%20Know%2DYour%2DRights%20framework%20in%20India
4	AI-powered Legal Documentation Assistant	https://sih.gov.in/sih2023PS#:~:text=AI%2Dpowered%20Legal%20Documentation%20Assistant
5	Projection of the extent of inundation corresponding to the forecasts of flood levels in a river.	https://sih.gov.in/sih2023PS#:~:text=Projection%20of%20the%20extent%20of%20inundation%20corresponding%20to%20the%20forecasts%20of%20flood%20levels%20in%20a%20river

#	Project Title	Project Detail
6	Development of AI, ML and Chat boat-powered Interactive Robot Mascot (Chacha Chaudhary) and digital avatar to strengthen the river people connect component of Namami Gange.	https://sih.gov.in/sih2023PS#:~:text=Development%20of%20AI%2C%20ML%20and%20Chat%20boat%2Dpowered%20Interactive%20Robot%20Mascot%20(Chacha%20Chaudhary)%20and%20digital%20avatar%20to%20strengthen%20the%20river%20people%20connect%20component%20of%20Namami%20Gange
7	AI-enabled water well predictor	https://sih.gov.in/sih2023PS#:~:text=AI%2Denabled%20water%20well%20predictor
8	Automatic regulation of valves for release of water based upon soil moisture availability in the root zone of the crop, using artificial intelligence, in a piped and micro irrigation network of irrigation system.	https://sih.gov.in/sih2023PS#:~:text=Automatic%20regulation%20of%20valves%20for%20release%20of%20water%20based%20upon%20soil%20moisture%20availability%20in%20the%20root%20zone%20of%20the%20crop%2C%20using%20artificial%20intelligence%2C%20in%20a%20piped%20and%20micro%20irrigation%20network%20of%20irrigation%20system
9	Al-based Generative design of Hydro power plants.	https://sih.gov.in/sih2023PS#:~:text=Al%2Dbased%20Generative%20design%20of%20Hydro%20power%20plants
10	Developing an AI-powered energy management system for industrial commercial facilities to optimize energy consumption.	https://sih.gov.in/sih2023PS#:~:text=Developing%20an%20AI%2Dpowered%20energy%20management%20system%20for%20industrial%20commercial%20facilities%20to%20optimize%20energy%20consumption

#	Project Title	Project Detail
11	Chatbot to respond to text queries pertaining to various Acts, Rules, and Regulations applicable to Mining industries	https://sih.gov.in/sih2023PS#:~:text=Chatbot%20to%20respond%20to%20text%20queries%20pertaining%20to%20various%20Acts%2C%20Rules%2C%20and%20Regulations%20applicable%20to%20Mining%20industries
12	Forecasting and scheduling of railway rakes.	https://sih.gov.in/sih2023PS#:~:text=Forecasting%20and%20scheduling%20of%20railway%20rakes
13	Air and water quality index and environment monitoring	https://sih.gov.in/sih2023PS#:~:text=Air%20and%20water%20quality%20index%20and%20environment%20monitoring
14	AI Assisted Tele-medicine KIOSK for Rural India	https://sih.gov.in/sih2023PS#:~:text=AI%20Assisted%20Tele%2Dmedicine%20KIOSK%20for%20Rural%20India
15	360-degree feedback software for the Government of India related News Stories in Regional Media using Artificial Intelligence / Machine Learning	https://sih.gov.in/sih2023PS#:~:text=360%2Ddegree%20feedback%20software%20for%20the%20Government%20of%20India%20related%20News%20Stories%20in%20Regional%20Media%20using%20Artificial%20Intelligence%20/%20Machine%20Learning