GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering
Level: PG
Branch: Biomedical Engineering
Subject Code : ME02031041
Subject Name: Artificial Intelligence in Healthcare

w. e. f. Academic Year:	2024 - 25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Mathematics, Biostatistics, Artificial Neural Network, Python Programming
Rationale:	Artificial intelligence (AI) in healthcare enhances decision-making, improves diagnostic accuracy, and optimizes patient care through predictive analytics and personalized treatment plans. It streamlines workflows, reduces human error, and facilitates early disease detection, ultimately leading to better outcomes and cost efficiency.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Gain foundational knowledge of artificial intelligence and machine learning.	R, U
02	Understand the ability to preprocess and explore data, build and evaluate predictive models, address data quality issues, and apply feature engineering techniques to enhance model performance.	R, U, A
03	Apply supervised learning algorithms, including classification and regression techniques, to real-world datasets, analyze their performance, and understand the strengths, weaknesses, and applications of models.	U, A, N, E
04	Apply unsupervised learning algorithms such as K-means, Apriori, PCA, SVD, and ICA to analyze and interpret complex datasets, demonstrated through practical case studies.	U, A, N, E
05	Understand of deep learning concepts, including CNNs, RNNs, and their applications in computer vision and time series analysis also gain hands-on experience in building, training, and evaluating deep learning models using tools like OpenCV and YOLO for real-world applications.	U, A, N, E, C

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Artificial Intelligence** Overview of AI, Goals of AI, Advantages of AI Systems, Challenges of AI Systems, Sub-domains of AI, Types of AI, Application of AI, Overview of ML, Application of ML, Key Elements of ML, Types of Learning - Supervised Learning, Unsupervised Learning, Reinforcement Learning	8	15
2.	**Preparing to Model:** Basic data types, exploring structure of Data – Numerical Data, Categorical Data, Exploring relationship between variables, Data Quality and Remediation, Data Preprocessing **Modelling and Evaluation:** Selecting a Model, Training Model – Holdout, K fold cross validation, bootstrap sampling; model representation and interpretability – Under fitting, over fitting, bias variance tradeoff; Model Performance Evaluation – classification, regression, clustering, performance improvement **Feature Engineering –** Feature construction, Extraction and Selection	8	20
3.	**Supervised Learning Algorithms** – Classification & Regression – Steps of Classification Learning **Classification Algorithm** - k- Nearest Neighbour (kNN) – Working, Algorithm, Strength, Weakness, Application; Decision tree - Working, Algorithm, Strength, Weakness, Application; Random Forest Model - Working, Algorithm, Strength, Weakness, Application; Support Vector Machines - Working, Algorithm, Strength, Weakness, Application **Regression Algorithm** - Linear Regression, Polynomial Regression, Logistic Regression, Case Study	10	20
4.	**Unsupervised Learning Algorithms** – K - means for Clustering Algorithm, Apriori Algorithm, Principal Component Analysis (PCA), Singular Value Decomposition (SVD), Independent Component Analysis (ICA), Case Study,	10	20
5.	**Introduction to Deep Leaning** Relation between AI, ML, DL, ML Vs. DL, Working of Deep Learning, Applications of Deep Learning, Activation Functions **Convolutional Neural Networks (CNN) -** Working, CNN Layers, Building CNN Model, Compile, Train, Evaluate and Predication using the Model, Case study	9	25

	Recurrent Neural Network (RNN) – Working of LSTM, Building, Compile, Train and Evaluating Model, Saving and Loading Model, Time Series data Analysis using RNN – Case Study. **Computer Vision –** Installing of OpenCV, Reading of Image, Resizing of Image, Face detection, Object detection using YOLO Algorithm.		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**15**	**15**	**25**	**25**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Artificial Intelligence - Applications and Innovations by Rashmi Priyadarshini, R M Mehra, Amit Sehgal and Prabhu Jyot Singh, CRC Press - 2023
2. Machine Learning by Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson – 2019
3. Machine Learning in Data Science using Python by Dr. R. Nageswara Rao, dreamtech – 2023
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc. 2nd Edition
5. Tom M. Mitchell- Machine Learning - McGraw Hill Education, International Edition
6. The Elements of Statistical Learning: Data Mining, Inference, and Prediction by Trevor Hastie, Robert Tibshirani, and Jerome Friedman - Springer, 2nd edition
7. Deep Learning by Ian Goodfellow, Yoshoua Bengio, and Aaron Courville MIT Press Ltd, Illustrated edition

(b) Open-source software and website:

1. UC Irvine Machine Learning Repository - http://archive.ics.uci.edu/ml/
2. Kaggle Machine Learning and Data Science Community - https://www.kaggle.com/
3. PyTorch – An open-source deep learning Platform

Suggested Course Practical List:

Use Kaggle database for the performing below practical.

1. Implementation of Python Libraries for ML application such as Pandas, Matplotlib and perform their operation.
2. Write a python program to compute Mean, Median, Mode, Variance, Standard Deviation using Datasets.
3. Demonstrate various data pre-processing techniques for a given dataset. Write a python program to compute
   i. Reshaping the data,
   ii. Filtering the data,
   iii. Merging the data
   iv. Handling the missing values in datasets
   v. Feature Normalization: Min-max normalization
4. Implement the k-nearest neighbours classification using Python.
5. Implement the Decision tree Algorithm using Python.
6. Implement the Random Forest Model using Python.
7. Implement the Support Vector Machines using Python.
8. Implement the Linear Regression using Python.
9. Implement the Polynomial Regression using Python.
10. Implement the Logistic Regression using Python.
11. Implement the K - means for Clustering Algorithm.
12. Implement the principal component analysis algorithm
13. Implement CNN Algorithm using Python
14. Implement RNN – LSTM Algorithm using Python.
15. Implement face detection Algorithm using OpenCV.
16. Implement YOLO Algorithm and detect objects in an image using OpenCV.

List of Laboratory/Learning Resources Required:

- High end Computers
- Deep learning Workstation

Suggested Project List:

- Implement ML or DL Algorithms on Datasets (from Kaggle or PhysioNet) to predict or classify disease.

Suggested Activities for Students:

Student should participate in online AI challenges/ Hackathons to apply knowledge and gain practical experience.

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