ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ
(ವಿ ಟಿ ಯು ಅಧಿನಿಯಮ 1994ರ ಅಡಿಯಲ್ಲಿ ಕರ್ನಾಟಕ ಸರ್ಕಾರದಿಂದ ಸ್ಥಾಪಿತವಾದ ರಾಜ್ಯ ವಿಶ್ವವಿದ್ಯಾಲಯ)
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REF: VTU/BGM/BoS/AEC-SEE/710/2024-25/6107 DATE: 27 FEB 2025

CIRCULAR

Subject: BRI405B- Machine Learning Fundamentals syllabus updated regarding...

Reference: Chairperson's BoS in Mechanical Engineering email dated; 19.02.2025

All Principals of affiliated engineering colleges under VTU are hereby informed that the non-relevant portions of **Module No. 2** in the **BRI405B - Machine Learning Fundamentals** course have been removed as part of the syllabus update. Also, few titles are added to textbook and reference section.

This update has been made to streamline the course content and enhance its relevance for students. All concerned faculty members are requested to take note of this change and implement the revised syllabus with immediate effect.

Please ensure that the updated syllabus is communicated to the respective departments and students at the earliest.

For any clarifications, please email: *sbhvtuso2022@gmail.com*.

Registrar 27.2.25

To,

The principals, of all Engineering Colleges under the ambit of the university, Belagavi

The Chairpersons /Program Coordinators of the university Departments at Kalburgi, Mysuru, Bengaluru, and Belagavi

Copy to

1. The Registrar (Evaluation) VTU Belagavi for information and needful
2. The Chairpersons and members of Board of Studies in Mechanical Engineering of VTU Belagavi for information
3. The Director, ITI SMU VTU Belagavi, for information and to make arrangements to upload the circular on the VTU web portal for stakeholders' reference.
4. The Special Officer, QPDS section for information and needful
5. Office Copy.

Machine Learning Fundamentals		Semester	IV
Course Code	**BRI405B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination nature (SEE)	Theory		

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand Machine Learning Concepts: Develop a solid foundation in machine learning principles, algorithms, and techniques.
2. Implement Machine Learning Algorithms: Learn to implement and apply a range of machine learning algorithms for tasks such as classification, regression, clustering, and recommendation systems.
3. Evaluate Model Performance: Acquire the skills to assess and optimize machine learning model performance through metrics, cross-validation, and hyperparameter tuning.
4. Solve Real-world Problems: Apply machine learning to real-world problems and datasets, gaining experience in data preprocessing, feature engineering, and model deployment.
5. Explore Advanced Topics: Delve into advanced machine learning topics, including deep learning, natural language processing, and reinforcement learning, to understand the breadth of machine learning applications and techniques.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The lecturer's approach (L) does not have to be limited to traditional methods of teaching. It is possible to incorporate alternative and effective teaching methods to achieve the desired outcomes.
2. Utilize videos and animations to illustrate the functioning of different techniques used in the manufacturing of smart materials.
3. Foster collaborative learning exercises within the classroom to encourage group participation and engagement.
4. Pose a minimum of three Higher Order Thinking (HOT) questions during class discussions to stimulate critical thinking among students.
5. Implement Problem-Based Learning (PBL) as an approach that enhances students' analytical skills and nurtures their ability to design, evaluate, generalize, and analyze information, rather than solely relying on rote memorization.

Module-1

Overview of Artificial Intelligence and Machine Learning, Historical Context and Milestones in Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Reinforcement, Machine Learning Workflow and Process Data Preparation and Preprocessing, Exploratory Data Analysis (EDA), Introduction to Python and Libraries (NumPy, Pandas, Matplotlib)

Module-2

Supervised Learning

Regression vs. Classification, Linear Regression, Logistic Regression, Decision Trees and Random Forests.

Module-3

Support Vector Machines (SVM), K-Nearest Neighbors (KNN), Naive Bayes, Ensemble Methods and Model Evaluation Metrics

Module-4

Unsupervised Learning

Clustering Algorithms (K-Means, Hierarchical Clustering), Principal Component Analysis (PCA), Dimensionality Reduction Techniques, Association Rule Mining, Anomaly Detection, Evaluation of Unsupervised Models

Module-5
Introduction to Reinforcement Learning, Markov Decision Processes (MDPs), Dynamic Programming, Q-Learning and Value Iteration, Policy Gradient Methods, Deep Reinforcement Learning, Applications of Reinforcement Learning

Course Outcomes (COs)(Course Skill Set)

At the end of the course the student will be able to:

1. **Mastery of ML Foundations:** Achieve a strong command of fundamental machine learning concepts, algorithms, and methodologies.
2. **Proficient ML Implementation:** Develop proficiency in implementing a wide range of machine learning algorithms to solve diverse problem types.
3. **Data-Driven Decision Making:** Gain the ability to make data-driven decisions by evaluating and fine-tuning machine learning models for optimal performance.
4. **Real-world Problem Solving:** Apply machine learning techniques to address real-world problems, demonstrating the capability to preprocess data, engineer features, and deploy models effectively.
5. **Exploration of Advanced ML:** Explore advanced machine learning topics and techniques, including deep learning and reinforcement learning, to expand the breadth of machine learning expertise and applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination (SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

TEXT BOOKS:

Textbook/s

1) Machine learning by Tom M Mitchell, McGraw Hill Education (India) Private Limited

2) Machine Learning by S.Sridhar & M.Vijayalakshmi

3) "Pattern Recognition and Machine Learning" by Christopher M. Bishop
4) This widely used textbook provides a comprehensive introduction to machine learning, covering various topics from pattern recognition to probabilistic graphical models.
5) "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy
6) This book takes a probabilistic approach to machine learning, offering insights into both classical and modern techniques, along with practical examples and exercises.
7) "Introduction to Machine Learning with Python" by Andreas C. Müller and Sarah Guido
8) Geared towards beginners, this book combines an introduction to machine learning with practical examples using the Python programming language and popular libraries like scikit-learn.
9) "Machine Learning: The Art and Science of Algorithms that Make Sense of Data" by Peter Flach
10) This book provides a balanced and accessible introduction to machine learning concepts, algorithms, and their applications.

Reference Books:

1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
   A comprehensive reference on deep learning, covering neural networks, optimization, and generative models.
2. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili
   This reference book explores machine learning concepts and practical implementations using Python, with a focus on scikit-learn and TensorFlow.
3. "The Hundred-Page Machine Learning Book" by Andriy Burkov
   A concise and practical reference guide to machine learning concepts, algorithms, and best practices.
4. "Pattern Classification" by Richard O. Duda, Peter E. Hart, and David G. Stork
   A classic reference in pattern recognition and machine learning, this book provides a solid foundation in classification and feature selection techniques.
5. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
   This reference book focuses on practical implementations of machine learning using popular Python libraries like scikit-learn, Keras, and TensorFlow.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc23_ee87/preview
- https://onlinecourses.nptel.ac.in/noc23_cs18/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Collaborative and Individual Project-Based Assessment