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|  |  | Ahsanullah University of Science and TechnologyBangladesh |

# The Internal Audit and Moderation Form for the Courses with Projects to address (1) Complex Engineering Problem Solving, and (2) Complex Engineering Activities

1. **Part 1: Moderation**

**1. Course Code & Section**: ***CSE 4100 + CSE 4250***

**2. Course Title**: ***Thesis & Project - I + Thesis & Project - II***

**3. Instructor(s)**: **Tamanna Tabassum**

**4. Semester**: **Fall 2022 + Spring 2023**

**5. Title of the Project: Integration of Machine Learning Algorithms for Precision**

**Crop Recommendations**

**6. Brief Description of the Project:**

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| ***The research paper develops a machine learning model that recommends crops based on soil characteristics, nutrients and weather conditions. The goal is to provide farmers with accurate and user-friendly recommendations tailored to their specific agro-ecological conditions. The research aims to enhance the economic viability of agricultural practices and promote sustainable farming practices by optimizing resource utilization and minimizing environmental impact. The machine learning model will analyze soil quality, moisture levels, and other relevant parameters to provide personalized crop recommendations, ultimately empowering farmers with data-driven insights and contributing to the long-term sustainability of agriculture in Bangladesh.***  ***The research focuses on crop recommendation system using machine learning and deep learning algorithms like Support Vector Machine (SVM), Decision Tree, Naive Bayes,***  ***K-Nearest Neighbors (KNN), Random Forest, Logistic Regression. The study also addresses the identification of essential nutrients (N, P, K) in soil, emphasizing expert validation for dataset accuracy. Dataset preprocessing, model training, performance evaluation, and class imbalance handling techniques like oversampling are key components of the research methodology. The models were evaluated using metrics like accuracy, precision, recall, and F1 score, with the Random Forest model demonstrating the highest accuracy and precision, closely followed by the Decision Tree model. This research aimed to empower farmers with data-driven insights for optimal crop selection and cultivation, contributing to sustainable agriculture practices in Bangladesh.*** |

**7. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Bloom’s Taxonomy Level, Knowledge Profiles, Ranges of Complex Engineering (CE) Problem Solving, and CE Activities**

| Sl. No. | COs | POs | Bloom’s Taxonomy | | | Knowledge Profiles | Ranges of CE Problem Solving | Ranges of CE Activities |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C | A | P |
| **1** | 1. **Apply appropriate knowledge of science, mathematics and engineering in accordance with the research scope** | **1** | **6** |  |  | ***K1-K4*** | ***P1-P7*** |  |
| **2** | 1. **Analyze complex engineering problems to identify, formulate and provide substance to valid conclusions using engineering specialist knowledge** | **2** | **6** |  |  | ***K1-K4*** | ***P1-P7*** |  |
| **3** | 1. **Design solutions for an engineering problem considering technical and non-technical requirements, constraints as well as applicable compliance, standards and codes of practice** | **3** | **6** |  |  | ***K5*** | ***P1-P7*** |  |
| **4** | 1. **Evaluate/Examine the solution(s) through designing and conducting experiments, interpretation of data and synthesized information** | **4** | **4** |  |  | ***K8*** | ***P1-P7*** |  |
| **5** | 1. **Apply modern engineering tools and techniques in the development of different stages of the solution** | **5** | **6** |  |  | ***K6*** | ***P1-P7*** |  |
| **6** | 1. **Assess the impact of the solution in terms of societal, health, safety, legal and cultural context** | **6** | **5** |  |  | ***K7*** | ***P1-P7*** |  |
| **7** | 1. **Assess the sustainability and impact of solution in terms of environmental context** | **7** | **5** |  |  | ***K7*** | ***P1-P7*** |  |
| **8** | 1. **Apply ethical considerations and professional responsibilities in designing, developing and reporting related to the project** | **8** | **6** |  |  | ***K7*** |  |  |
| **9** | 1. **Act effectively as an individual and as a team member or leader for successful completion of the project** | **9** |  |  | **5** |  |  |  |
| **10** | 1. **Demonstrate effective communication skills through writing reports, presentations and verbal communications with appropriate stakeholders** | **10** |  |  | **5** |  |  | ***A1-A5*** |
| **11** | 1. **Manage the project efficiently with the allocated resources** | **11** | **6** |  |  |  |  |  |
| **12** | 1. **Conduct independent research, literature survey and learning of new technologies and concepts as appropriate to design, develop and validate the solution** | **12** | **6** |  |  |  |  |  |

**8. The Seven Ranges of Complex Engineering Problem Solving related to the Project**

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| **"*Complex Engineering Problems have characteristic P1 and some or all of P2 to P7*"** |

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| **Range** | **Attribute** | **PO** | **Relevance in the Project** | | **Related CO** |
| **P1** | Depth of Knowledge Required | **PO1** | K3 (A systematic theory-based formulation of engineering fundamentals required in the engineering discipline) | ***Our research paper involves agricultural engineering.*** | ***CO1*** |
| **PO2** | K4 (Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline) | ***Our research paper requires knowledge about Machine Learning algorithms for suitable crop recommendation system.*** | ***CO2*** |
| **PO3** | K5 (Knowledge that supports engineering design in a practice area) | ***Our research paper requires understanding of machine learning concepts for developing algorithms and models, highlighting the crucial role of engineering expertise in designing and implementing projects.*** | ***CO3*** |
| **PO5** | K6 (Knowledge of engineering practice (technology) in the practice areas in the engineering discipline) | ***Our research paper engages with data mining and machine learning.*** | ***CO5*** |
| **PO4** | K8 (Engagement with selected knowledge in the research literature of the discipline) | 1. ***Our research paper entails comprehensive investigation into agricultural expertise, the physical attributes of soil, nutrient compositions, and environmental variables across distinct seasons, alongside the application of diverse machine learning models.*** | 1. ***CO4*** |
| **P2** | Range of Conflicting Requirements | **PO1 - PO7** | ***Balancing feature richness with computational complexity comes with difficulties. Sophisticated models promise accuracy but demand significant computational resources, while accessing diverse, reliable agricultural data presents challenges. Streamlining data acquisition and optimizing resources are essential to develop scalable and accurate recommendation systems.*** | | ***CO1 - CO7*** |
| **P3** | Depth of Analysis Required | **PO1 - PO7** | ***A thorough examination is required regarding feature extraction techniques and the efficacy of various machine learning models, including ensemble methods.*** | | ***CO1 - CO7*** |
| **P4** | Familiarity of Issues | **PO1 - PO7** | ***The requisite data and information vital for crafting a robust crop recommendation system are notably disparate and predominantly analog in nature, posing challenges in aggregation and utilization. Furthermore, the dearth of comprehensive research in the context of Bangladesh constricts the breadth of available insights, constraining the system's development. While the prospect of integrating supplementary features holds promise, their validation and effective integration are hindered by a lack of authentication and methodical implementation.*** | | ***CO1 - CO7*** |
| **P5** | Extent of Applicable Codes | **PO1 - PO7** | ***Our research paper has devised a crop recommendation system utilizing machine learning algorithms, implemented in Python programming language, and leveraging libraries such as pandas and scikit-learn.*** | | ***CO1 - CO7*** |
| **P6** | Extent of Stakeholder involvement and Conflicting requirements | **PO1 - PO7** | ***A custom dataset was meticulously crafted and utilized to train machine learning models for recommending appropriate crops to farmers. Technical experts were engaged to ensure accurate feature extraction from the dataset.*** | | ***CO1 - CO7*** |
| **P7** | Interdependence | **PO1 - PO7** | ***The study is centered around the development of a custom dataset through creation and augmentations, followed by the integration of various machine learning models tailored to this dataset. The aim is to identify the most well-suited crops for farmers to cultivate using ML models, ultimately enhancing the overall performance and reliability of the classifier.*** | | ***CO1 - CO7*** |

**9. The Five Ranges of Complex Engineering Activities related to the Project (CO10)**

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| **"*Complex activities means (engineering) activities or projects that have some or all of the following characteristics*"** |

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| **Range** | **Attribute** | **Relevance in the Project** |
| **A1**: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies) | Range of Resources | ***Our research paper encompasses the creation of a custom dataset from scratch, utilizing feature extraction tools and libraries. It involves the implementation of various machine learning models and the allocation of computational resources. Additionally, transportation costs are considered for data gathering and information retrieval.*** |
| **A2** : Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues | Level of Interaction | ***Given the absence of prior work in this area, there is a need to start from scratch and address every aspect of the project. This includes gathering data, developing methods for analysis, and implementing machine learning models. Moreover, the scarcity of reliable data emphasizes the importance of thorough exploration and creative problem-solving.*** |
| **A3**: Involve creative use of engineering principles and research-based knowledge in novel ways | Innovation | ***A custom dataset has been curated, encompassing a range of soil physical characteristics including land type, land level, water levels, drainage, and pH levels, along with nutrient levels such as N, P, and K. Additionally, weather information such as temperature and rainfall has been incorporated. This dataset serves as the foundation for predicting optimal crops for specific soil types and seasons, aiming to enhance agricultural practices and environmental sustainability.*** |
| **A4**: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation | Consequences for Society and the Environment | ***The objective is to assist farmers in making informed crop recommendations, ultimately enhancing their livelihoods and bolstering the agricultural landscape in Bangladesh. By digitalizing this information, it can be readily accessed and utilized for future agricultural endeavors, contributing to sustainable growth and prosperity within the sector.*** |
| **A5**: Can extend beyond previous experiences by applying principles-based approaches | Familiarity | ***Adopting principles-based approaches offers a structured and ethical foundation for the development and deployment of machine learning and deep learning models. By adhering to these principles, fairness, transparency, and accountability are prioritized throughout the recommendation process, promoting trust and integrity in the system.*** |

Signature of the Instructor/Course Coordinator: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date:

Name:

**10. Verifications** *(To Be Completed by the Moderator)*

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|  | Moderator 1 |
| Recommended without any modification | □ |
| Recommended with some modifications (describe under the remark section below) | □ |
| Not recommended and the form should be rewritten and resubmitted (describe the reasons under the remark section below) | □ |

Remarks (if any):

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|  | Signature of the Moderator:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date:  Name: |

1. **Part 2: Modifications (if any)**

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| □ | All the required modifications have been done. |
| □ | Some/all of the modifications have not been done due to the following reasons: |

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Signature of the Instructor/Course Coordinator: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date:

Name:

1. **Part 3: Approval by the Head of the Department**

Signature of the Head of the Department: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date:

Name: