Subject Description Form

Subject Code	BME42167
Subject Title	**Artificial Intelligence and Data Analysis for Sports**
Credit Value	3
Level	4
Pre-requisite	ENG2002 Computer Programming BME32165 Applied Technology in Sports and Performance Analysis
Objectives	1. To introduce the principles of artificial intelligence (AI) and digital technologies within the realm of sports; 2. To provide students with knowledge of AI techniques and big data analytics relevant to sports performance and management; 3. To develop students' ability to apply AI, computer vision, and data analytics in solving sports-related problems; 4. To familiarize students with the latest advancements and trends in sports technology, including AI applications in performance tracking, motion tracking, and game strategy.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the fundamental concepts and theories of AI and digital technologies in sports. b. Analyze and apply AI techniques and big data analytics in sports contexts. Apply computer vision techniques (e.g., 3D reconstruction, markerless motion tracking, posture recognition) on regular video records. c. Evaluate the impact of AI and digital technology on sports performance, injury prevention, and decision-making. d. Design and execute projects that integrate AI and digital technologies to address specific challenges in sports.
Contribution to Programme Outcomes (Refer to Part I Section 10)	▪ Programme Outcome 1: Demonstrate an ability to apply knowledge of mathematics, science, and engineering appropriate to the Biomedical Engineering (BME) discipline. (Teach, Practice and Measure) ▪ Programme Outcome 2: Demonstrate an ability to design and conduct BME experiments, as well as to analyze and interpret data. (Practice and Measure) ▪ Programme Outcome 8: Demonstrate an ability to use the computer / IT tools relevant to the BME discipline along with an understanding of their processes and limitations. (Practice and Measure) ▪ Programme Outcome 13: Demonstrate an understanding of contemporary issues. (Teach)
Subject Synopsis/ Indicative Syllabus	▪ **Introduction to AI and Digital Technology in Sports:** o Overview of AI and digital technology concepts.

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Historical development and significance in sports.
Key applications in sports performance and management.

Fundamental AI Techniques in Sports:

Machine learning algorithms: Regression, classification, clustering, and their applications in sports analytics.
Deep learning and neural networks: Neural network architectures and their role in advanced sports data analysis.
Computer vision techniques: 3D reconstruction, motion tracking, posture and object recognition, kinematic data extraction from regular video cameras.

Data Collection and Management in Sports:

Data sources and types in sports: Wearable devices, cameras, and sensors.
Data preprocessing, cleaning techniques, and data management systems.

AI and Big Data Analytics in Sports:

Descriptive, predictive, and prescriptive analytics.
Statistical analysis and visualization tools.
Case studies of AI and data analytics in various sports.

AI Applications in Sports Performance:

Performance tracking and enhancement.
Injury prediction and prevention.
Game strategy and decision-making support.

Trends in AI and Digital Technology:

Recent advancements in AI and data analytics.
Integration of AI with IoT, AR/VR, and other emerging technologies.

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<tr><td>Teaching/Learning Methodology</td><td>
Students will learn the fundamental knowledge and principles in lectures; Sufficient laboratory and practice hours will be provided in labs and tutorials hours; Practice projects/assignments will be adopted to assess the students' learning outcome.
<table>
<tr><td rowspan="2">Teaching/ learning methodology</td><td colspan="6">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td></td><td></td></tr>
<tr><td>1. Lectures</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>2. Laboratories</td><td>✓</td><td>✓</td><td></td><td>✓</td><td></td><td></td></tr>
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<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td></td><td></td><td></td></tr>
<tr><td>1. In-class quiz</td><td>10%</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2. Assignments</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>3. Lab reports</td><td>30%</td><td></td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>4. Final project</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
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- **In-class quiz:** Assesses students' understanding of key concepts and theories related to AI and digital technology in sports.
- **Assignments:** Provide hands-on experience with data analysis and AI techniques, including model training/testing and interpretation.
- **Lab reports:** Evaluate students' coding and algorithm implementation skills.
- **Final project:** Requires students to design and execute a research project that applies AI techniques to a sports-related challenge.

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<tr><td rowspan="7">Student Study Effort Expected</td><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lectures</td><td>30 Hrs.</td></tr>
<tr><td>▪ Laboratories</td><td>9 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Self-study</td><td>30 Hrs.</td></tr>
<tr><td>▪ Assignments, lab reports, and project</td><td>48 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>117 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">

- Alamar, B. C. (2013). Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers. Columbia University Press.
- He, H., & Ma, Y. (2013). Imbalanced Learning: Foundations, Algorithms, and Applications. Wiley.
- Moeslund, T., Thomas, G., Hilton, A. (2014). Computer Vision in Sports. Springer.
- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An Introduction to Statistical Learning: With Applications in R. Springer.
- Jordan, M. I., & Mitchell, T. M. (2015). Machine learning: Trends, perspectives, and prospects. Science, 349(6245), 255-260.
- Miller, T. (2015). Sports Analytics and Data Science: Winning the Game with Methods and Models. Pearson Education.

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<tr><td>Date of Last Major Revision</td><td colspan="2">29 August 2024</td></tr>
<tr><td>Date of Last Minor Revision</td><td colspan="2">29 August 2024</td></tr>
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