# BME2121: ARTIFICIAL INTELLIGENCE IN BIOMEDICAL ENGINEERING

**Effective Term**
Semester B 2023/24

## Part I Course Overview

**Course Title**
Artificial Intelligence in Biomedical Engineering

**Subject Code**
BME - Biomedical Engineering
**Course Number**
2121

**Academic Unit**
Biomedical Engineering (BME)

**College/School**
College of Engineering (EG)

**Course Duration**
One Semester

**Credit Units**
3

**Level**
B1, B2, B3, B4 - Bachelor's Degree

**Medium of Instruction**
English

**Medium of Assessment**
English

**Prerequisites**
CS1102 Introduction to Computer Studies / CS1302 Introduction to Computer Programming or equivalent#

**Precursors**
MBE2036/BME2036 Engineering Computing

**Equivalent Courses**
Nil

**Exclusive Courses**
Nil

**Additional Information**
# Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

# Part II Course Details

**Abstract**

The aim of this course is to provide biomedical engineering students with advanced training of programming skills and fundamentals of technologies using artificial intelligence (AI) in the biomedical domain. Students are introduced of various modern computer programming languages and platforms for developing AI applications in the biomedical domain. The applications could include screening and diagnosis with biomedical imaging (MRI, CT, etc.) or physiological signals (ECG, EEG, EMG, etc.) as well as supporting clinical decision system using patient data for formulating diagnosis or healthcare workflow.

**Course Intended Learning Outcomes (CILOs)**

| | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|---|---|---|---|---|
| 1 | Describe principles of artificial intelligence and machine learning in biomedical engineering. | | x | | |
| 2 | Develop dry lab skills needed for biomedical and healthcare engineering applications. | | | x | |
| 3 | Implement AI techniques using relevant computer tools and platforms for biomedical applications. | | | x | |
| 4 | Analyze performance of the developed AI applications using known data sets. | | | x | |

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

**Teaching and Learning Activities (TLAs)**

| | TLAs | Brief Description | CILO No. | Hours/week (if applicable) |
|---|---|---|---|---|
| 1 | Lecture | Explain key principles and technical details of artificial intelligence and machine learning as well as use of computer programming techniques for biomedical engineering and healthcare applications. | 1, 2 | 1 hr/week |

| | | | | |
|---|---|---|---|---|
| 2 | Laboratory Work | Laboratory work includes training in computer programming and practical skills in AI. Additional tasks will also be given for self-practice. | 2, 3, 4 | 3 hrs/week for 12 weeks |

**Assessment Tasks / Activities (ATs)**

| | ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|---|---|---|---|---|
| 1 | Assignments | 2, 3 | 30 | 2-3 assignments will be given |
| 2 | In-class/lab assessment | 1, 2, 3, 4 | 10 | In-class assessment or short home assignment will be given during/after the lab |
| 3 | Mini project | 3, 4 | 10 | |

**Continuous Assessment (%)**

50

**Examination (%)**

50

**Examination Duration (Hours)**

2

**Additional Information for ATs**

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

**Assessment Rubrics (AR)**

**Assessment Task**

1. Assignments

**Criterion**

Ability on programming skills.

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

**Assessment Task**
2. In-class/lab assessment

**Criterion**
Ability to achieve the desired programming tasks during the lab sessions.

**Excellent (A+, A, A-)**
High

**Good (B+, B, B-)**
Significant

**Fair (C+, C, C-)**
Moderate

**Marginal (D)**
Basic

**Failure (F)**
Not even reaching marginal levels

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**Assessment Task**
3. Mini project

**Criterion**
Ability to develop a practical application.

**Excellent (A+, A, A-)**
High

**Good (B+, B, B-)**
Significant

**Fair (C+, C, C-)**
Moderate

**Marginal (D)**
Basic

**Failure (F)**
Not even reaching marginal levels

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**Assessment Task**
4. Examination

**Criterion**
Ability to explain in detail the technical aspects of using computer programming and AI for biomedical engineering.

**Excellent (A+, A, A-)**
High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**
Moderate

**Marginal (D)**
Basic

**Failure (F)**
Not even reaching marginal levels

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# Part III Other Information

**Keyword Syllabus**

- Biomedical and healthcare analytics using artificial intelligence
- Screening and diagnosis with biomedical imaging (MRI, CT, etc.)
- Screening and diagnosis with physiological signals (ECG, EEG, EMG, etc.)
- Clinical decision support system (CDSS) (use of patient data for formulating diagnosis or healthcare workflow)
- Machine learning, deep learning, and neural networks in biomedical engineering
- C programming language, Python programming language

**Reading List**

**Compulsory Readings**

| | Title |
|---|---|
| 1 | Neural Networks and Artificial Intelligence for Biomedical Engineering, 1st Edition, Donna L. Hudson, Maurice E. Cohen, Wiley-IEEE Press (1999). (Latest edition) |
| 2 | Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, Arjun Panesar, aPress (2019). |
| 3 | Machine Learning for Healthcare Analytics Projects: Build Smart AI Applications using Neural Network Methodologies across the Healthcare Vertical Market, Eduonix Learning Solutions, Packt Publishing Limited (2018). |

**Additional Readings**

| | Title |
|---|---|
| 1 | Deep Learning with Python, Francois Chollet, Manning Publications (2017). |
| 2 | C Programming Language, 2nd Edition, Brian W. Kernighan, Dennis M. Ritchie, Prentice Hall (1998). (Latest edition) |